UDC 159.9
DOI: 10.23951/2782-2575-2023-1-47-60

NEUROGYMNASTICS AS A WAY OF DEVELOPING INTERHEMISPHERIC INTERACTION IN PRESCHOOL CHILDREN WITH AUTISM SPECTRUM DISORDERS

Irina A. Kuvshinova, Darya A. Novozhilova, Vladimir A. Chernobrovkin

[1, 2, 3] *Magnitogorsk State Technical University named after G.I. Nosov, Magnitogorsk, Russian Federation*
[1] *erenkuv@gmail.com*
[2] *vybornova_99@mail.ru*
[3] *chernobrov.vl@mail.ru*

Abstract. The article deals with the pathology of the development of interhemispheric interaction in children with autism spectrum disorders (ASD). Based on the research results of Russian and foreign authors on the morphological differences in the corpus callosum in people with ASD, in which a specific neural marker was identified, a new directional vector for corrective work was established. Since the corpus callosum is the main commissure of the brain and is responsible for interhemispheric interaction, the authors suggested that its development in children with ASD in corrective work would reduce such manifestations as uncoordinated handwork, difficulty in the spatial organization of movements and actions and simplification of the program in dynamic practice, as well as improve concentration and increase stress resistance. Therefore, Neuro-gymnastics was chosen as a means of developing interhemispheric interaction. In order to prove the effectiveness of the use of neuro-gymnastics, an experiment was conducted using fragments of the neuropsychological diagnostics of preschool children according to Zh.M. Glozman, in particular, a set of adapted samples, the quantitative assessment of which is compared with the predetermined values. The results of all phases of the study are described. Additional methods served as an experimental factor, in particular neuro-gymnastics, which was included in the lessons with the children of the experimental group, first as a substitute for the traditional warm-up and then in the structure of the lessons themselves. An analysis of the results obtained at the beginning and the end of the experiment suggests that short daily neuro-gymnastics sessions can accelerate the development of interhemispheric interaction in children with ASD and bring it to the level of normally developed children.

Keywords: *autism spectrum disorders, autism, interhemispheric interaction, corpus callosum, neuro-gymnastics*

For citation: Kuvshinova I.A., Novozhilova D.A., Chernobrovkin V.A. Neurogymnastics as a Way of Developing Interhemispheric Interaction in Preschool Children With Autism Spectrum Disorders. *Education & Pedagogy Journal*. 2023;1(5):47–60. doi: 10.23951/2782-2575-2023-1-47-60

In recent years, the prevalence of autism spectrum disorders (ASD) has increased significantly – from five cases in the early 2000s to more than 50 cases per 10,000 children currently [1, p. four]. According to the Centers for Disease Control and Prevention, one in 54 children is autistic [2]. Boys are four times more likely to be diagnosed with this condition [3]. Most of these children require systematic corrective help and suffer from various mental disorders. The variability of the expression of the disease significantly complicates the diagnosis, treatment, and correction. Therefore, it is important to study the existing practical experience and develop new methods of corrective work with children with ASD [4].

Numerous medical studies have not yet revealed a unified concept of the causes of ASD in children. However, it is known that genetic and biological factors that cause abnormalities in a child’s development at an early stage play an important role. Children with ASD have been shown to have impaired brain function. American scientists have successfully identified a neural marker for ASD specific to infancy before the major behavioral symptoms of the disorder appear [5]. Differences in the size of the corpus callosum of normally developed infants and those later diagnosed with ASD were found to be most pronounced at six months of age. This is of particular significance and suggests that excessive growth of the corpus callosum may be one of the earliest neural signs of autism [5].

It is noteworthy that the results obtained by other scientists contradict the results of the above study. In a medical study by C.M. Freitag, the sample of subjects was composed of elderly people. It was found that the corpus callosum is disproportionately smaller in people with ASD compared to healthy people [6]. Italian researchers Alessia Giuliano, Paolo Brambilla, and

Filippo Muratori showed that the smaller size of the corpus callosum was also observed in older preschool children [7]. Consequently, the change in the size of the corpus callosum in ASD suggests the interplay of neurodynamic developmental processes characteristic only of infancy. In the first year of life, the rapid growth of the corpus callosum and cerebral cortex occurs, and after 2–3 years of age, development gradually weakens, and by 6–7 years of age, the corpus callosum in children with ASD is smaller than in healthy peers [5].

According to the theory of L.S. Vygotsky and A.R. Luria about the systemic dynamic localization of higher mental functions, the interhemispheric interaction is a special mechanism that connects the left and right hemispheres of the brain into a single holistically functioning system [8]. Abnormalities in interhemispheric interaction in ASD are due to weak neural connections between distant parts of the brain and structural disturbances in the corpus callosum [9]. Since the corpus callosum is the main brain connection through which the hemispheres perform joint activities and exchange information via specialized pathways that have an integrating function and transmit inhibitory and excitatory currents between the hemispheres, it is the corpus callosum that provides interhemispheric interaction [10].

With unformed interhemispheric interaction, the following are observed: uncoordinated work of the hands, simplification of the program in dynamic praxis, low level of phonemic hearing (inaccurate perception of words and sounds, misunderstanding of the meaning of speech), low-stress resistance (anxiety, tearfulness, bad mood), difficulties in the spatial organization of movements and actions (spatial search, mirroring, spatial distortions, tension, slowness in reciprocal coordination), as well as intellectual deficiency [11].

The same symptoms are observed in most cases of autism. This fact, as well as the fact about the pathology of the corpus callosum in children with ASD, gives us the right to suspect that a number of ASD symptoms are due to a low developmental level of interhemispheric interaction. On this basis, we hypothesize that the development of interhemispheric interaction in children with ASD helps to reduce the number of manifestations and improve concentration.

Exercises aimed at developing interhemispheric interaction are, in our opinion, best started from the age of 3 years since, at this age, the development of the corpus callosum is weaker in children with ASD. Therefore, start with the simplest exercises and gradually increase the difficulty level.

Of all the variety of methods for the development of interhemispheric interaction, leading neuropsychologists Zh.M. Glozman and Yu.V. Mikaze distinguish neuro-gymnastics [12]. This is due to the fact that neuro-gymnastics exercises are primarily aimed specifically at the development of the corpus callosum. In addition, neuro-gymnastics is more “flexible” and may include exercises from other methods in accordance with the purpose of our study. So, by including kinesiology exercises, logorhythmics, graphomotor exercises, mirror drawing with both hands, and rhythmics in neuro-gymnastics, we have adapted these techniques for children with ASD.

Modernity, versatility, and the ability to combine different methods determine our choice of neuro-gymnastics to develop interhemispheric interaction in children with ASD.

To prove the effectiveness of neuro-gymnastics as a means of developing interhemispheric interaction in preschool children with ASD, we conducted a six-month experiment in the city preschool institution “Kindergarten No. 105 of compensatory type” in the city of Magnitogorsk. The phases, schedule, and content of the experimental work are presented in Table 1.

Table 1

Phases, schedule, and content of the experimental work

The phase of the experiment	Deadlines	Content
Concluding	September–November 2021	Performance of a diagnostic study to determine the developmental stage of interhemispheric interaction. Analysis of data obtained at the beginning of the experiment
Formative	November–May 2021–2022	Selection of methods for the development of interhemispheric interaction in older preschool children with ASD. Implementation of neuro-gymnastic exercises with the children
Control Diagnostic	May 2022	Conducting a diagnostic control examination. Analysis of the results obtained at the beginning and at the end of the experiment. Description of the results. Preparation of guidelines for the implementation of neuro-gymnastics with children with ASD

In the following, we describe the diagnostic instruments, analyze the data from the ascertaining and control experiment, and draw the appropriate conclusions.

Twelve children aged 5–6 years with ASD participated in the experiment. We divided them into the experimental group (E.G.) and the control group (C.G.), each with six subjects.

The selection of an effective diagnostic technique is of particular importance to assess the extent of interhemispheric interaction in children. Considering that the brain is a paired organ but functions as a whole, methods for assessing interhemispheric interaction belong to a special category because they differ from methods for assessing interhemispheric asymmetry, which are based on simultaneous (bilateral or dual) stimulation or response [13].

In performing a diagnostic examination, we considered the following important principles:

1) the principle of scientificity – diagnostic work to determine the level of development of interhemispheric interaction in older preschool children with ASD should be based on scientific research that justifies the choice of studied indicators, methods, timing, and organization of the examination;

2) the principle of ethics suggests that a diagnostic investigation should be conducted in compliance with ethical norms and rules;

3) the principle of optimality – the necessary amount of diagnostic information about the developmental status of interhemispheric interaction in children with ASD should be obtained as much as possible with minimal effort;

4) the ontogenetic principle – involves the study of the level of interhemispheric interaction in children with ASD taking into account the age norm of development;

5) the principle of accessibility – involves the construction of tasks at the level of the actual abilities of a child with ASD.

In order to assess the developmental status of interhemispheric interaction, we used an extract from the neuropsychological diagnostics of preschool children according to Zh.M. Glozman [14] and, in particular, adapted the following tests for children with ASD:

– Reciprocal coordination test (from the age of four)

– Test of finger posture praxis

– Test of oral praxis (from the age of four)

– Tests of dynamic praxis

– Test of conditioned choice responses (for children five years and older)

– Test of reproduction of rhythmic structures (for children 5 years and older, involving reproduction of two or three palm strikes on the table).

In his methodology, Zh.M. Glozman uses a penalty point system for each sample. We adapted this system to the aims of the study and compared the quantitative scores with the developmental stages of interhemispheric interaction (Table 2).

Thus, in Table 2, we see that depending on the number of points obtained for all methods in total, it is possible to determine the level of development of interhemispheric interaction and present it as low, moderately low, normative, and high.

It should be noted that all children showed perseveration of movements, simplification of the program in dynamic praxis, and difficulties in the spatial organization of movements and actions during the diagnostic examination. In addition to motor problems, there was a low concentration of attention on one thing, frequent distractibility by strange objects, tantrums, and inadequate reactions to what was happening. This is typical of children with ASD, and we considered this characteristic.

Table 2

Quantification in points of developmental stages of interhemispheric interaction

Test	Development level			
	Low	Moderate-Low	Normative	High
Reciprocal coordination test	3	1.5–2	0.5–1	0
Test of finger posture praxis	3	1.5–2	1	0–0.5
Test of oral praxis	3	1.5–2	0.5–1	0
Tests of dynamic praxis	3	1.5–2	1	0–0.5
Test of conditioned choice responses	3	2	1	0
Test of reproduction of rhythmic structures	3	2	1	0
Total:	20–22 points	19–9.5 points	9–3 points	2–0 points

In the ascertaining phase of the experiment, we obtained the results, which are given in percentages in Table 3.

Table 3

Results of the ascertaining experiment

Development Level	Groups	
	Control Group	Experimental Group
Low level of development of interhemispheric connections	17%	33%
Moderately low level of development of interhemispheric connections	83%	66%
Normative level of development of interhemispheric connections	0%	0%
High level of development of interhemispheric connections	0%	0%

From Table 3, we see that all children have problems with the development of interhemispheric interaction. Thus, we ensured that interhemispheric interaction is low or moderately low in children with ASD. This allowed us to assume that it was necessary to introduce additional methods in the children's classes in the experiment's formative stage. Namely, neuro-gymnastics was included in the teaching program for the children of EG, while CG continued their education according to the traditional program.

A traditional training program is a training program that includes a certain structure of teaching that is valid for an extended period of time. It includes the following structure of teaching: warm-up, repetition of the material covered, the study of the material covered, dynamic break, and consolidation of the material. For the children of EG we have changed the lesson's structure: We replaced the warm-up with kinesiology exercises and combined the dynamic break with graphomotor exercises.

In the first month of the experiment, the children mastered the exercises "ring," then "bunny ring," and at the end of the month, "bunny ring chain." The difficulty was the persistence of the movements, the distraction of attention, and the difficulty in the spatial organization of the movements. Therefore, we also incorporated graphomotor exercises into the structure of the lessons.

In the second month, the exercises "goat," "fingers say hello," and "lezginka" were added to the list of kinesiological exercises performed with the children. These exercises are slightly more difficult and require more focused attention than the exercises added in the first month, but as practice showed, the children were already able to master them. During this phase, improvements were noted in the concentration of attention and spatial organization of movements. However, the movements' perseveration continued, making the assimilation of the Lezginka exercise more challenging. The graphomotor exercises continued to be performed with the children.

In the third month, the list of kinesiology exercises remained the same, but some exercises were slightly changed: Spoken instructions were added to change the order of movements. For example, in the Fingers say hello exercise, the teacher dictates which finger should say hello to which finger. Or Lezginka with alternating straightening of certain fingers. In addition to graphomotor exercises, exercises with neuro-rehabilitation games were also included in the structure of the lessons.

At 4–5 months, the children continued the kinesiological exercises, to which the ear-nose exercise was added. At this point, the children could control their (initially frantic) movements and focus on the learning material. A brief perseveration of movements and errors occurred only in new tasks and at the end of the session, when fatigue was observed, control decreased. After a few repetitions, the perseveration disappeared. The lessons additionally included mirror drawing.

By month 6, the children had mastered the "goat," "fingers say hello," "lezginka," "ear-nose," and "fist-palm-rib" exercise complexes. The last exercise in the "fist-palm-rib" sequence remained difficult for them. However, the children successfully completed the simple mirror drawing tasks at this phase.

The control experiment was conducted in April 2021. For this, we also used an excerpt from Zh.M. Glozman's neuropsychological diagnosis for preschool children and our adjusted quantification. The results of the control experiment are given in Table 4 in percentages.

From Table 4, it can be seen that at the control phase, the level of development of interhemispheric connections in children of both the control and experimental groups increased. In contrast, a low level was not noted in anyone, and in the experimental group there, a high level of development of interhemispheric connections was seen.

Table 5 presents a comparative analysis at the beginning and end of the experiment to evaluate the dynamics of the evolution of the interhemispheric interaction at CG and EG.

Table 4

Results of the control phase experiment

Development Level	Groups	
	Control Group	Experimental Group
Low level of development of interhemispheric connections	0%	0%
Moderately low level of development of interhemispheric connections	66%	17%
Normative level of development of interhemispheric connections	33%	66%
High level of development of interhemispheric connections	0%	17%

Table 5

Comparative analysis of the dynamics of the development of interhemispheric interaction at the beginning and at the end of the experiment

	Results of the ascertaining experiment		Results of the control experiment	
	CG	EG	CG	EG
Low level of development of interhemispheric connections	17%	33%	0%	0%
Moderately low level of development of interhemispheric connections	83%	66%	66%	17%
Normative level of development of interhemispheric connections	0%	0%	33%	66%
High level of development of interhemispheric connections	0%	0%	0%	17%

To illustrate the dynamics of the development of interhemispheric interaction in both groups, we present the results in the form of a diagram in Figure 1

We see changes in both groups by analyzing the data presented above (Table 5 and Fig. 1). Almost all children of EG moved toward the normative level of development of interhemispheric interaction. Out of 100%, only 17% remained at a moderately low level. Here we can see that 17% of the children showed high dynamics and moved to a high level. In addition, the children of

EG became calmer, the concentration of attention improved, distractibility and inappropriate reactions to unexpected situations practically disappeared.

The children of CG remained predominantly at a moderately low level of interhemispheric interaction development. Only 33% of the children moved at the normative level. The changes in the children of CG can be explained by the fact that at the age of seven, the hippocampal commissure responsible for polysensory intermodal integration and memory matures. In addition, the interhippocampal structures play the role of initiator and stabilizer of the relationships between the right and left hemispheres. Therefore, there is a positive trend even without specific exercises [15].

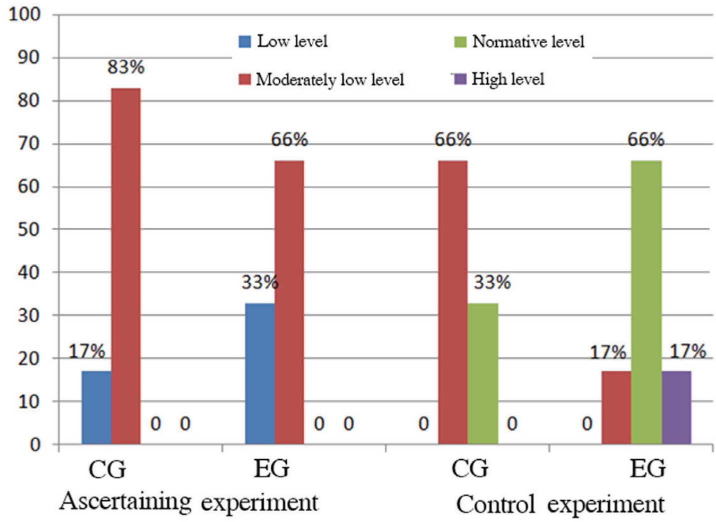

Fig. 1. Comparative analysis of the dynamics of the development of interhemispheric interaction between CG and EG

In conclusion, interhemispheric interaction in children with ASD is at a low or moderately low developmental level without specific additional courses and exercises. The experiment has shown that some symptoms of ASD are associated with low developmental levels of interhemispheric interaction. Therefore, in this category of children, it is necessary to work on their development. Short daily neuro-gymnastics over a longer period of time compensates for such manifestations of ASD as uncoordinated hand movements, difficulties in the spatial organization of movements and actions, program simplification in dynamic praxis, and improved concentration and increased resistance to stress.

References

1. Borozinets N.M., Shekhovtsova T.S., Bugaeva E.A. Usloviya formirovaniya navykov kommunikatsii u detey s rasstroystvami autisticheskogo spektra [Conditions for the formation of communication skills in children with autism spectrum disorders]. *Sptsial'noye obrazovaniye – Special Education*. 2022;(1 (65)):35-53 (in Russian).
2. Tkachuk E.A., Martynovich N.N., Rychkova L.V., Polyakov V.M. Problemy diagnostiki rasstroystv autisticheskogo spektra u detey [Problems of diagnosing autism spectrum disorders in children]. *ТМЖ*. 2020;(4 (82)):35-43(in Russian).
3. *Autism Speaks. Autism and health: a special report by Autism Speaks*. 2017. URL: https://www.autismspeaks.org/autism-statistics-asd (accessed 02/20/2022).
4. Kuvshinova I.A., Vybornova D.A., Mitsan E.L. Sotsializatsiya detey s rasstroystvom autisticheskogo spektra posredstvom gornolyzhnogo sporta [Socialization of children with autism spectrum disorder through skiing]. *Problemy sovremennogo pedagogicheskogo obrazovaniya – Problems of modern pedagogical education*. 2020;(69-4):145-149 (in Russian).
5. Jason J. Wolff, Guido Gerig, John D. Lewis, Takahiro Soda, Martin A. Styner, Clement Vachet, Kelly N. Botteron, Jed T. Elison, Stephen R. Dager, Annette M. Estes, Heather C. Hazlett , Robert T. Schultz, Lonnie Zwaigenbaum, Joseph Piven. Altered corpus callosum morphology associated with autism over the first 2 years of life. *Brain*. 2015;138(7):2046-2058.
6. Freitag CM, Luders E, Hulst HE, Narr KL, Thompson PM, Toga AW, et al. Total brain volume and corpus callosum size in medication-naïve adolescents and young adults with autism spectrum disorder. Biol Psychiatry. 2009;66:316-319.
7. Vidal C.N., Nicolson R., DeVito T.J., Hayashi K.M., Geaga J.A., Drost D.J., Williamson P.C., Rayakumar N., Sui Y., Dutton R.A., Toga A.W., Thompson P.M. Mapping corpus callosum deficits in autism: an index of aberrant cortical connectivity. *Biol Psychiatry*. 2006;(1, 60 (3)):218-225.
8. Traugott N.N. Interhemispheric interaction in local brain lesions. In: Chomsky E.D. (ed.) *Neuropsychological analysis of interhemispheric asymmetry of the brain*. Moscow, Nauka. 1986:14-22.
9. Zavadenko N.N., Pechatnikova N.L., Simashkova N.V., Zavadenko A.N., Orlova K.A. Nevrologicheskiye narusheniya u detey s autizmom [Neurological disorders in children with autism]. *Rossiyskiy vestnik perinatologii i pediatrii – Russian Bulletin of Perinatology and Pediatrics*. 2015;(2):14-21 (in Russian).
10. Semenovich A.V. Vvedeniye v neyropsikhologiyu detskogo vozrasta. Uchebnoye posobiye [Introduction to the neuropsychology of childhood. Textbook]

[Electronic resource]. Electron. text data. (1 pdf file: 321 pages). Moscow, Genesis, 2017 (in Russian).

11. Traugott N.N. Mezhpolusharnoye vzaimodeystviye pri lokal'nykh porazheniyakh golovnogo mozga [Megalocornea interaction with local brain lesions]. In: Khomskaya E.D. (ed.) *Neyropsikhologicheskiy analiz mezhpolusharnoy asimmetrii mozga* [Neyropsikhologicheskiy analiz mezhpolusharnoy asimmetrii mozga]. Moscow, Nauka Publ., 1986:14-22 (in Russian).
12. Sichko N.O. Aktivizatsiya mezhpolusharnogo vzaimodeystviya kory golovnogo mozga kak osnova uspeshnogo obucheniya i vospitaniya podrastayushchego pokoleniya [Activation of interhemispheric interaction of the cerebr al cortex as the basis for successful education and upbringing of the younger generation]. *Vestnik Adygeyskogo gosudarstvennogo universiteta. Seriya 3: Pedagogika i psikhologiya – The Bulletin of the Adyghe State University. Series "Pedagogy and Psychology"*. 2009;(4):309-314 (in Russian).
13. Kovyazina M.S. *Neyropsikhologicheskiy sindrom u bol'nykh s patologiey mozolistogo tela* [Neuropsychological syndrome in patients with pathology of the corpus callosum]. Moscow, 2014:358 p. (in Russian).
14. Glozman Zh.M., Potanina A.Yu., Soboleva A.E. *Neyropsikhologicheskaya diagnostika v doshkol'nom vozraste* [Neuropsychological diagnostics in preschool age]. Saint Petersburg, Piter Publ., 2006:80 p. (in Russian).
15. Kovyazina M.S. *Neyropsikhologicheskiy analiz patologii mozolistogo tela* [Neuropsychological analysis of the pathology of the corpus callosum]. Moscow, 2012:210 p. (in Russian).

Information about the authors

Irina A. Kuvshinova, Candidate Pedagogical Sciences, Associate Professor, Magnitogorsk State Technical University named after G. I. Nosov (pr. Lenina, 38, Magnitogorsk, Russian Federation, 455000).
E-mail: erenkuv@gmail.com

Darya A. Novozhilova, Student, Magnitogorsk State Technical University named after G. I. Nosov (pr. Lenina, 38, Magnitogorsk, Russian Federation, 455000).
E-mail: vybornova_99@mail.ru

Vladimir A. Chernobrovkin, Candidate of Philosophical Sciences, Associate Professor, Magnitogorsk State Technical University named after G. I. Nosov (pr. Lenina, 38, Magnitogorsk, Russian Federation, 455000).
E-mail: chernobrov.vl@mail.ru

Submitted May 22, 2022

НЕЙРОГИМНАСТИКА КАК СПОСОБ РАЗВИТИЯ МЕЖПОЛУШАРНОГО ВЗАИМОДЕЙСТВИЯ У ДЕТЕЙ ДОШКОЛЬНОГО ВОЗРАСТА С РАССТРОЙСТВАМИ АУТИСТИЧЕСКОГО СПЕКТРА

Ирина Александровна Кувшинова[1], Дарья Алексеевна Новожилова[2], Владимир Александрович Чернобровкин[3]

[1, 2, 3] *Магнитогорский государственный технический университет имени Г.И. Носова, Магнитогорск, Россия*

[1] *erenkuv@gmail.com*

[2] *vybornova_99@mail.ru*

[3] *chernobrov.vl@mail.ru*

Аннотация. В статье рассмотрена патология развития межполушарного взаимодействия у детей с расстройствами аутистического спектра (РАС). На основе изученных результатов исследований российских и зарубежных авторов относительно морфологических различий мозолистого тела у людей с РАС, в которых выявлен специфический нейронный маркер, был определен новый вектор направления коррекционной работы. Поскольку мозолистое тело является главной комиссурой головного мозга и отвечает за межполушарное взаимодействие, авторы предположили, что его развитие у детей с РАС в процессе коррекционной работы позволит снизить такие проявления, как нескоординированная работа рук, трудности пространственной организации движений и действий, упрощение программы в динамическом праксисе, а также улучшить концентрацию внимания, повысить стрессоустойчивость. В качестве способа развития межполушарного взаимодействия была выбрана нейрогимнастика. С целью доказательства эффективности применения нейрогимнастики был проведен эксперимент, где для оценки уровня развития межполушарного взаимодействия использованы фрагменты нейропсихологической диагностики детей дошкольного возраста по Ж.М. Глозман, в частности ряд адаптированных проб, количественная оценка которых сопоставлена с обозначенными уровнями. Описаны результаты всех этапов исследования. В качестве экспериментального фактора выступали дополнительные методики, в частности нейрогимнастика, включенная в занятия с детьми экспериментальной группы сначала как замена традиционной разминки, а затем в структуру самих занятий. Анализ результатов, полученных на начало и конец эксперимента, позволили заключить, что короткие ежедневные занятия нейрогимнастикой могут ускорить развитие межполушарного взаимодействия у детей с РАС и приблизить его к уровню нормально развивающихся детей.

Ключевые слова: *расстройства аутистического спектра, аутизм, межполушарное взаимодействие, мозолистое тело, нейрогимнастика*

Для цитирования: Kuvshinova I.A., Novozhilova D.A., Chernobrovkin V.A. Neurogymnastics as a Way of Developing Interhemispheric Interaction in Preschool Children With Autism Spectrum Disorders // Education & Pedagogy Journal. 2023. Вып. 1 (5). P. 47–60. doi: 10.23951/2782-2575-2023-1-47-60

Информация об авторах

Кувшинова И.А., кандидат педагогических наук, доцент, Магнитогорский государственный технический университет имени Г. И. Носова (пр. Ленина, 38, Магнитогорск, Россия, 455000).

Новожилова Д.А., студент, Магнитогорский государственный технический университет имени Г.И. Носова (пр. Ленина, 38, Магнитогорск, Россия, 455000).

Чернобровкин В.А., кандидат философских наук, доцент Магнитогорский государственный технический университет имени Г.И. Носова (пр. Ленина, 38, Магнитогорск, Россия, 455000).