Influence of swimming on sensory functioning, quality of life and behavior of children with autism

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Abstrakt
Aim: to establish the influence of swimming as a means of adaptive physical education on behavior, emotional state, sensory, motor coordination and quality of life of children with autism spectrum disorders (ASD).
Material and methods. Three children with autism who were swimming were examined. Research methods: pedagogical observations, pedagogical experiment, method of expert evaluations, questionnaires.
Results. There is a significant improvement in the behavior of children with ASD: reducing aggression and autoaggression, reducing the frequency of stereotyped movements, reducing opposition, improving emotional state, improving willpower, improving coordination and dexterity. According to the results of expert assessment, against the background of increasing the results of dexterity, the formation of swimming skills, a significant increase in positive emotions, the acquisition of communication skills there is a significant reduction in problem behavior. Swimming is a powerful sensory stimulus for children with ASD, they improve their sensory profile by promoting proper sensory responses. Swimming contributes to a significant increase in the quality of life of both children and their parents.
Conclusions: Swimming is a powerful sensory stimulus for children with ASD. As a result of swimming lessons in children with ASD there is an improvement in behavior, development of communication skills, development of smooth movements, growth of positive emotions, development of swimming skills. Swimming also helps to improve the quality of life of children with ASD and their parents. In children with ASD, swimming helps to improve certain indicators of the sensory profile. Individual swimming lessons can be recommended for children with ASD as an effective means of adaptive physical education.
Key words: autism, swimming, coordination of movements, quality of life, short sensory profile.

Анотація
Мусієнко О. В., Чопик Р.В., Кізло Н.Б. Вплив занять з плавання на сенсорне функціонування, якість життя та поведінку дітей з аутизмом
Мета: встановити вплив плавання як засобу адаптивного фізичного виховання на поведінку, емоційний стан, сенсорику, координацію рухів та якість життя дітей з розладами спектру аутизму (РАС).
Матеріал і методи. Обстежено троє дітей з аутизмом, які займались плаванням. Дослідження проведно з використанням наступних методів: педагогічні спостереження, педагогічний експеримент, метод експертних оцінок, анкетування.
Результати. Було виявлено достовірне покращення поведінки дітей з РАС: зменшення агресії та аутоагресії, зниження частоти виникнення стереотипних рухів, зниження опозиційних проявів, поліпшення емоційного стану, покращення вольових якостей, підвищення координації і вправності рухів. За результатами експертної оцінки, на фоні зростання результатів вправності рухів, формування навичок плавання, значного зростання позитивних емоцій, набуття навичок комунікації відбувається суттєве зниження проблемної поведінки. Заняття плаванням є потужним сенсорним стимулом для дітей з РАС, вони поліпшують їхній сенсорний профіль, сприяючи правильним сенсорним реакціям. Заняття плаванням сприяють суттєвому зростанню якості життя як дітей, так їхніх батьків.
Висновки: Заняття плаванням є потужним сенсорним стимулом для дітей з РАС. В результаті занять плаванням у дітей з РАС спостерігається покращання поведінки, розвиток комунікативних навичок, розвиток плавності рухів, зростання позитивних емоцій, розвиток навичок плавання. Також заняття плаванням сприяють зростанню якості життя дітей з РАС та їхніх батьків. У дітей з РАС плавання сприяє вдосконаленню окремих показників сенсорного профілю. Можна рекомендувати індивідуальні заняття плаванням для дітей з РАС як ефективний засіб адаптивного фізичного виховання.
Ключові слова: аутизм, плавання, координація рухів, якість життя, короткий сенсорний профіль.

Аннотация
Мусиенко Е.В., Чопик Р.В., Кизло Н.Б. Влияние занятий плаванием на сенсорное функционирование, качество жизни и поведение детей с аутизмом
Цель: установить влияние плавания как средства адаптивного физического воспитания на поведение, эмоциональное состояние, сенсорику, координацию движений и качество жизни детей с расстройствами спектра аутизма (РАС).
Материал и методы. Обследовано трое детей с аутизмом, которые занимались плаванием. Исследование проведено с использованием следующих методов: педагогические наблюдения, педагогический эксперимент, метод экспертных оценок, анкетирование.
Результаты. Было выявлено достоверное улучшение поведения детей с РАС: уменьшение агрессии и аутоагрессии, снижение частоты возникновения стереотипных движений, снижение оппозиционных проявлений, улучшение эмоционального состояния, улучшение волевых качеств, повышение координации и ловкости движений. По результатам экспертной оценки, на фоне роста результатов сноровки движений, формирования навыков плавания, значительного роста положительных эмоций, приобретение навыков коммуникации происходит существенное снижение проблемного поведения. Занятия плаванием является мощным сенсорным стимулом для детей с РАС, они улучшают их сенсорный профиль, способствуя правильным сенсорным реакциям. Занятия плаванием способствуют существенному росту качества жизни как детей, так их родителей.
Выводы: Занятия плаванием является мощным сенсорным стимулом для детей с РАС. В результате занятий плаванием у детей с РАС наблюдается улучшение поведения, развитие коммуникативных навыков, развитие плавности движений, рост положительных эмоций, развитие навыков плавания. Также занятия плаванием способствуют росту качества жизни детей с РАС и их родителей. У детей с РАС плавание способствует совершенствованию отдельных показателей сенсорного профиля. Можно рекомендовать индивидуальные занятия плаванием для детей с РАС как эффективное средство адаптивного физического воспитания.
Ключевые слова: аутизм, плавание, координация движений, качество жизни, короткий сенсорный профиль.

Introduction

Many children with autism spectrum disorders (ASD) have impaired regulation of muscular activity, as a result of which control over motor acts is not formed in time, there are difficulties in forming arbitrary movements, in forming their purposefulness and coordination, and spatial orientation suffers. Many children develop synkinesis, as well as difficulties in visual-motor coordination [1–3]. At the same time, the motor components of speech, closely related to the general development of both large and small motility, are severely impaired [4–6]. Disorders of the motor sphere are exacerbated by the characteristic behavioral characteristics of autistic children with a lack of social interaction, mutual communication, underdevelopment of imagination [7-11].

A wide range of disorders occurs even against the background of shallow intellectual functions. A child with autism and high tested intelligence may have severe impairment of motivation [12–15]. Children with autism spectrum disorders need specially organized classes aimed at the correction and development of the motor sphere [16-18].

The motor development of a child with autism is not so much the development of motor skills of adaptation to the world around, as the accumulation of stereotypical means of obtaining pleasant vestibular, proprioceptive, tactile sensations [19-22]. Deep delay in the development of household skills, awkwardness in performing any action with objects are combined with exceptional dexterity in the stereotype of self-stimulation. For years, a child may not be able to master the simplest self-care skills, but to lay out complex patterns of small objects, climb on furniture without falling and clogging, selectively tense and relax individual muscles, focusing on their feelings [3; 7].

Children on the autism spectrum, as a rule, have difficulty imitating, with imitation of movements. Not only in children but also in adults with autism there is a violation of the ability to reproduce movements according to the pattern [1; 9; 20]. This is more due to impaired perception and communication, not due to motor insufficiency. Corrective work should take into account such an important fact that children with autism spectrum often violated the so-called "body scheme" - that is, the idea of ??body structure, the feeling of your body and its movements. The main features inherent in the motor sphere of children with autism, complicate the development of their motor skills, increase with age and increase depending on the severity of autism.

It is now recognized that education for children with autism is needed no less, and in many cases even more, than medical. On the other hand, it is not enough to teach an autistic child: even the successful accumulation of knowledge and skills development do not in themselves solve its problems. It is known that the development of a child with autism is not just delayed, it is distorted: a broken system that supports the child's activity, directs and organizes its relations with the world. That is why it is difficult for a child with autism to apply in real life the knowledge and skills he has. All children with X-ray diffraction, with a significant heterogeneity of this group in composition, need medical education, the task of which is, above all, the development of meaningful interaction with the outside world [11; 12; 22].

The motor sphere of children with autism is characterized by the presence of stereotyped movements, difficulties in the formation of objective actions and household skills, disorders of fine and gross motor skills. Children are characterized, in particular, disorders in basic movements: heavy, jerky gait, impulsive running with a distorted rhythm, excessive hand movements or meaninglessly outstretched arms that do not participate in the process of motor activity, one-push repulsion when jumping from two legs. Children's movements can be sluggish or, conversely, tightly constrained and mechanistic, with a lack of plasticity. Exercises and actions with the ball are difficult for children, which is associated with impaired sensorimotor coordination and fine motor skills of the hands [4; 7; 14].

Many children in the adaptive physical education class show stereotypical movements: rocking the whole body, patting or scratching, monotonous turns of the head, swinging movements of the hands and fingers, hand movements similar to flapping wings, walking on tiptoe, circling around its axis and other movements associated with self-stimulation and lack of self-control. In students with autism, there are violations of the regulation of muscular activity, control over motor actions is not formed in a timely manner, there are difficulties in the formation of purposeful movements, spatial orientation suffers [2; 17; 20].

Practice shows that reduced randomness of movement in autistic children leads primarily to impaired coordination. Stability of vertical posture, balance and confident gait, the ability to coordinate and regulate their actions in space, performing them freely, without undue stress and awkwardness - all this is necessary for normal life, personal, household and social needs. Most often, the lack of these characteristics limits motor activity [2; 8; 11; 19].

Physical culture, adapted to the characteristics of children with autism, is not only a necessary means of correcting motor disorders, stimulating physical and motor development, but also a powerful "agent of socialization" of the individual. The conscious nature of motor learning is important for the development of the motor sphere of autistic children. It is difficult for an autistic child to regulate arbitrary motor reactions according to language instructions. She cannot control the movement according to the instructions of another person and is not able to completely subordinate the movement to her own language commands. Therefore, the main goals of teaching autistic children in classes of adaptive physical education are [3; 12; 14; 22]:

• improvement of sensory integration;
• development of imitation abilities (ability to imitate);
• incentives to follow instructions;
• formation of skills of arbitrary organization of movements (in the space of one's own body and in outer space);
• education of communication functions and the ability to interact in a team.

Sensory processing - processing, integration and modulation of sensory information from the environment and from one's own body. Sensory integration is a person's ability to organize sensations for movement, learning and normal behavior. Sensory disturbances are a complex cerebral disorder in which a child misinterprets everyday sensory information, which can lead to problems with coordination, language, behavior, learning, and others. In clinical practice, the term dysfunction of sensory integration is accepted, within which there are sensory modulation disorders and sensory-related motor disorders [18–21].

In this case, it is difficult for a person to determine which sensory information is important and which is not, it is difficult to respond adaptively to the situation. Disorders of sensory information processing can manifest itself in the form of hypersensitivity or hypersensitivity to certain stimuli [8; 15; 17].

In addition to all the above, an important issue is the functional state of organs and systems of the body in conditions of insufficient motor activity of children with PCA. They often have the phenomena of hypodynamics and hypokinesia and accompanying changes in health [7; 13].

Aim: to establish the impact of swimming as a means of adaptive physical education on behavior, sensory profile, emotional state, coordination of movements and quality of life of children with autism spectrum disorders.

Material and methods

Participants

The experiment involved three children 8-9 years of age. All children who were involved in swimming had the so-called. low-functioning autism (disability of subgroup A). They did not speak, could not read or write, had problematic behavior, stereotyped movements, a large number of inappropriate movements, impaired coordination of movements, aggression and self-aggression.

Procedure

The children attended swimming lessons twice a week for 40 minutes. in the pool from September 1, 2019 to March 10, 2020. Classes were individual. Each of them started with a warm-up (5 minutes), most of the children were taught to stay afloat, swimming skills (25 minutes) and were taught communication skills (playing with a partner) (10 minutes).

Pedagogical observations during swimming lessons were carried out constantly, recording the behavior of children (desirable and undesirable), determining their capabilities and tasks available to them.

Prior to the start of classes (August 2019), a survey of parents was conducted regarding the psychophysical condition of children who were included in the experiment. Parents filled out such a questionnaire every three months during the experiment, where they reported changes in the psychophysical condition of their children.

Additionally, we used the EQ-5D-5L questionnaire [16; 19] to assess the quality of life of children with ASD, the answers were given by parents at the beginning of the experiment and at the end. The questionnaire allowed to assess the ability of children with ASD to move, self-care (self-care), normal daily activities, the presence of pain / discomfort, anxiety / depression.

In addition to surveying parents, we used the method of expert evaluations in the research. The expert was a specialist in correctional pedagogy and physical culture.

Table 1

Psychophysical condition of children with autism (Parent questionnaire)

Dear parents, evaluate, please, the psychophysical condition of your child and describe it.
Baby's name
Age of the child
The presence of stereotypical movements (describe)
Spinning on the spot or grabbing rotating objects
Protest behavior regarding changes in lifestyle or environment (describe)
The presence of aggression
Presence of autoaggression (beating yourself, biting, etc.)
Specific use of objects (toys) or excessive interest in their parts (describe)
Excessive fascination with some action, subject (describe)
Plays not with toys, but with unusual things (describe)
It is difficult to stop, to distract from monotonous, repetitive actions.
Problem behavior (mark or cite something else): • deceleration • tantrums • cry • excessive passivity • oppositional behavior • self-stimulation
Emotions prevail (positive, negative)
Volitional qualities (does the child overcome difficulties and what behavior accompanies it?)
Cognitive qualities (opportunities, desires, successes) - to describe features.
Orientation in space (describe)
Coordination of movements (walking, running, jumping and other movements) - describe the features.
Writing skills (opportunities, desires, successes)
Other school skills (describe)
Some (additional) issues regarding the quality of life of the family (in March 2020): How does a child behave in public? The child's preferences (describe). Your emotions while communicating with the child. Are your child's movements (walking, running, squats, jumping, etc.) correct? Does your child want to exercise and play games that require movement?

He evaluated the following parameters on a 10-point scale: children's emotional state, the presence of problematic behavior, dexterity, swimming skills, communication skills.

Also, the expert together with the parents conducted an assessment of the sensory profile of each child in August 2019 and in March 2020 according to the method of Short Sensory Profile, developed and recognized by The Psychological Corporation (USA) [22; 23].

Results

Before the experiment, parents' questionnaires regarding the psychophysical condition of their children showed that all children we examined had significant inhibition of movements, significant manifestations of stereotypical behavior and self-stimulation (shaking, clicking of the tongue and fingers, specific hand movements, etc.). Two children had manifestations of aggression (beating parents, strangers, beating hands and feet on surrounding objects). All three examined children had manifestations of autoaggression (beating themselves on the head, legs, arms, biting their hands), used toys for other purposes (knocked on them, examined their individual parts, broke). The emotional state of all examined children was very labile. Two of them had hysterical behavior and oppositional behavior. As for the volitional

qualities, they were violated in all children, it was very difficult to insist on any actions, the children themselves also did not want to overcome the slightest difficulties. All the boys had impaired coordination of movements, although each in his own way (E. and B. walked on tiptoe, K. bumped into people and objects while moving, had impaired gait, walked on, shuffled his feet, had an imperfectly cross-coordinated act of walking). all examined children had clumsy movements of large muscle groups, had a tendency to stoop, made many unnecessary movements while performing motor tasks. Regarding cognitive qualities: they were significantly reduced in all examined children, school skills (knowledge of letters and numbers, reading and writing) are insufficiently formed, extremely difficult to learn to write and draw (inability to hold a pencil correctly, insufficiently enduring muscles of the hand and fingers to hold a pencil for some time, lacking motivation to learn to write).

In addition to our questionnaire on the psychophysical condition of children, we used the questionnaire EQ-5D-5L to assess the quality of life of children with ASD, the answers were given by parents at the beginning of the experiment and at the end. The EQ-5D-5L questionnaire is designed to provide answers to patients themselves. Because children with ASD could not answer the questions on their own, their parents did it for them. In August 2019, before the experiment, all parents pointed out minor difficulties with movement, significant difficulties with self-care and washing, moderate difficulties with normal daily activities, sometimes pain, almost constant discomfort in the body, anxiety or sometimes depression. On the scale of quality of life of their children, they set 42 ± 8 points out of 100 possible, which indicates a rather low quality of life of their children as patients (people with special needs).

Based on the expert assessment of the functioning of children with ASD (Fig. 1, Table 2), it can be argued that at the beginning of swimming lessons (September 2019) they had significant problem behavior, estimated at 9.8 ± 0.2 points, poor emotional condition (1.2 ± 0.3 points), low dexterity (1.3 ± 0.2 points), unformed communication skills (1.0 ± 0.2 points), swimming skills at the initial level in all children are absent.

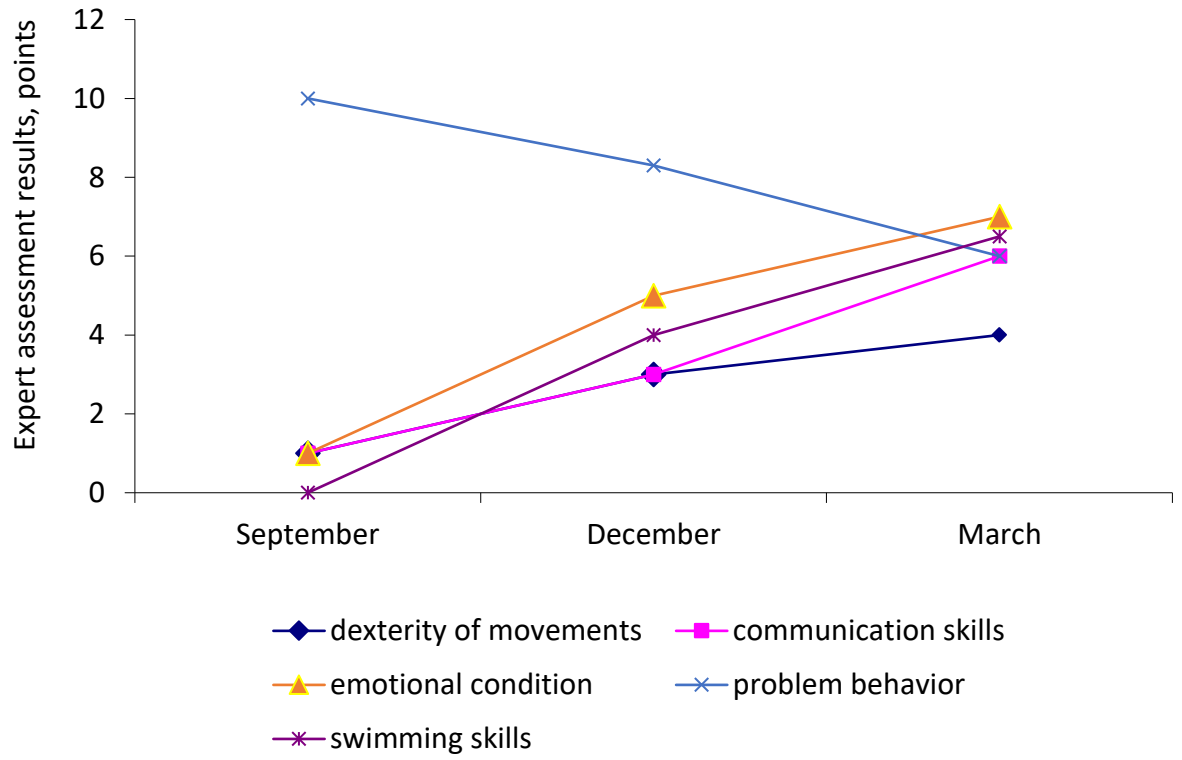

Fig. 1. The results of expert assessment of the functioning of children with ASD during the experiment

Table 2

The results of the expert assessment of the functioning of children with ASD at the beginning (September 2019) and at the end (March 2020) of the experiment

Indicators	Statistical indicators		t	p
	$\bar{x} \pm S$ September 2019	$\bar{x} \pm S$ March 2020		
Dexterity of movements, points	1,3±0,2	4,3±0,3	4,46	<0,05
Communication skills, scores	1,0±0,2	5,9±0,6	9,92	<0,01
Emotional state, points	1,2±0,3	7,1±0,4	9,92	<0,01
Problem behavior, points	9,8±0,2	6,1±0,2	9,92	<0,01
Swimming skills, points	0	6,5±0,8	9,92	<0,01

After 3 months of swimming, parents did not notice significant changes in children's behavior, observed significant problem behaviors, motor deceleration, stereotypes and self-stimulation, although according to the results of expert assessment in December 2019 there was a tendency to improve. Thus, the expert assessed in 3 points the skill of movements and communication skills, swimming skills also significantly ($p < 0.05$) improved (4.0 ± 0.4 points). Significantly improved the emotional state of children (5.2 ± 0.4 points), the significance of the difference $p < 0.01$, ie exercise in the classroom did not cause such a violent negative reaction, children gradually began to get used to them, as evidenced by a slight decrease problem behavior in swimming from 10.0 ± 0.2 to 8.0 ± 0.4 points ($p < 0.05$).

During this period, according to the results of the survey of parents, there was a positive trend in the manifestations of aggression and self-aggression. These manifestations in children became less frequent, less prolonged, fewer stimuli caused them. There was also a positive trend in emotional and volitional qualities: the boys' parents emphasized that their children became less stubborn, showed much less oppositional behavior when parents insisted on something, were more willing to perform tasks at home and at school, which they previously refused to perform. Regarding the coordination of movements, no significant changes took place during this period, motor incapacity remained. The skills of holding a pencil, drawing geometric shapes and lines and other simple drawings have not changed yet.

In March 2020, there were significant ($p < 0.01$) changes in the functioning of the examined children, compared with the data of the beginning of the experiment, which is shown in table. 2. Parents of all boys in the questionnaires noted that their children became calmer, their motor deceleration decreased significantly, stereotyped movements occurred less often, children needed less self-stimulation, aggressive and autoaggressive behavior still occurred, but much less often (in two boys E. and K. such manifestations were already in a day, in B. every day). The emotions of the boys became less labile, more appropriate to the situation, the number of positive emotions increased. Children's movements have become more coordinated, skillful. E. and B.'s children continued to walk on tiptoe, but sometimes (especially after exercise) they began to fall on their heels while standing, K. began to pay more attention to an object or person who could be in his way and go around. K.'s gait improved - he shuffled his legs less and swayed less while walking. In all three children, the number of extra movements decreased and there was a tendency to decrease stooping. There has been little progress in school skills: hand movements during drawing and writing have become more skilful, and children have been calmer about these tasks.

In the questionnaire for parents, which we provided in March 2020, we included several additional questions that characterize the functioning of children with ASD, although we did not work directly on these qualities. Yes, to the question: "How does a child behave in public?" the parents of all the boys replied that they were now quite calm, their children began to understand that being on public transport, in the supermarket, at the train station, etc. was safe, and that their anxiety was reduced. When asked about the child's preferences, all parents answered that now it has become easier to involve children in joint activities, that children have become interested in life (cooking). When asked

about the emotional color of communication with the child, all five parents said that children have learned to respond better to the manifestations of parents' emotions. For example, K. began to hug his parents often, E. began to look into his eyes and smile more often, and B. was more willing to listen to requests than before. When asked about children's movements, parents answered that their dexterity has significantly improved, children have become more active to move for a certain purpose, some inappropriate movements and stereotypes have decreased (swaying, spinning on the spot, shaking hands, jumping). To the question: "Does the child want to exercise?" all five parents answered that from now on it became much easier to involve children in various physical activities (not only swimming), children began to perceive these activities with joy and enjoy exercise.

At the end of our experiment, we again asked parents to answer the EQ-5D-5L survey questions about the quality of life of their children and the family as a whole. Parents noted that from now on their children began to have fewer problems with movement, their movements became more coordinated and it became easier to move. In terms of self-care and self-care, the difficulties became less significant (average level), the usual daily activities also became easier, the phenomena of discomfort and anxiety decreased.

On the scale of quality of life of their children, they set 74 ± 6 points out of 100 possible, which indicates a significant ($p < 0.01$) increase in the quality of life of their children as patients (people with special needs). Children with ASD have not stopped being disabled, but their quality of life has increased significantly, which has added positive emotions to the difficult lives of these children and their parents.

The results of the expert assessment reflected the results of the parents' survey. In March 2020, the expert noted a significant decrease in problem behavior (by 4 points) against the background of increasing results of movement skills (by 3 points), communication skills (by 5 points), swimming skills (by 6 points), a significant increase in positive emotions (by 6 points). Significance of the difference of all indicators with the results of previous periods $p < 0,01$.

To assess the sensory functioning of the examined children, we used the method of determining the short sensory profile Short Sensory Profile, developed by Winnie Dunn (USA) of The Psychological corporation [22; 23]. Sensory profile was determined before the beginning of the experiment (September 2019) and at the end of the experiment (March 2020). In August 2019 and in March 2020, the sensory profile of children who participated in the study was assessed, and the following data were obtained (Table 3).

Table 3

Assessment of sensory functioning of children with autism by the method of Short Sensory Profile at the beginning (August 2019) and at the end (March 2020) of the experiment

Indicators	Indicators		t	p
	$\bar{x} \pm S$	$\bar{x} \pm S$		
	September 2019	March 2020		
Tactile sensitivity, points	13±3	24±4	9,92	<0,01
Sensitivity to taste and smell, points	7±2	8±2	1,23	0,8
Motor sensitivity, points	5±2	9±2	9,92	<0,01
The desire to feel, points	12±3	18±4	4,40	<0,05
Auditory filtration, points	9±3	9±2	1,01	0,8
Energy, points	10±2	17±3	9,93	<0,01
Visual / auditory sensitivity, points	10±2	13±3	4,30	<0,05

Discussion

In the study, we found significant sensory impairments in children with autism who participated in the experiment. All considered types of sensitivity were violated. Some of them were restored or formed during swimming lessons, but were not restored and were not fully formed,

remaining at a level deficient for normal functioning. Yes, from table. 1 shows that the levels of tactile and motor sensitivity during the experiment are close to normal values, other sensations are significantly improved, only the sensitivity to taste and smell does not change, which is not affected by swimming.

We found improvements in the following types of sensitivity, which are taken into account in the Short Sensory Profile [22; 23]:

• Tactile sensitivity - avoid walking barefoot, especially on sand or grass; emotional or aggressive reaction to touch; fear of splashing water;

• Motor sensitivity - anxiety or suffering when the feet do not touch the ground; avoidance of activities when the head is at the bottom (overturns, racks);

• Insufficient reaction / desire to feel - the desire for all kinds of movement that interferes with daily procedures, restlessness; excessive excitability during motor activity; touching (pushing) people and things; switching from one activity to another when it interferes with the game;

• Low energy / weakness - weakness (insufficient tone) of muscles; slight fatigue, especially when standing or maintaining a certain body position; weak grip; the need for support (even during activities); poor endurance;

• Visual / auditory sensitivity - concern with bright light after others have adapted to light; eye coverage or mowing to protect the eyes from light.

Quantitative reflection in the scores of improvement of these types of sensitivity is given in table. 2.

Swimming did not affect sensitivity to taste and smell and auditory filtration.

During swimming, muscles are noticeably strengthened, and the cardiovascular system is trained. In addition, regular swimming classes develop flexibility and plasticity of movements, improve coordination of movements, increase hand strength, promote the development of emotional and volitional qualities and increase self-esteem [8; 16]. Since the most characteristic disorders in autism are disorders of the human sensory sphere, we need to look for ways to influence the body's sensory systems, especially the processes of sensory processing, sensory modulation and sensory integration of information from the environment and the body.

In our opinion, swimming serves, first of all, as a powerful stimulus to influence the sensory system of the body (tactile sensitivity, proprioceptive system, visual analyzer). During swimming, all the muscles of the body are activated, afferent nerve stimuli to the CNS come from the proprioceptors of the muscle fibers, and after processing, the CNS directs impulses through the efferent fibers to the muscles. During such processes, the CNS "learns" to correctly recognize nerve impulses from the working organs and create in the brain an adequate picture of the body [24]. Because a child with autism very often tries to avoid exercise and any physical activity, in particular because of pleasurable sensations, swimming is a factor that cannot be avoided (the child is in a pool or pond, which can not be left at the same time) . As a result, the CNS must work, process stimuli first "forced" (stress), and later in a calmer mode (adaptation).

Tactile sensations are activated during children's swimming lessons. In the process of swimming, the child feels with his fingers, palms, feet and whole body the temperature of the water, its flow, waves, changes in their sensations from motor activity in the water. In the process of training children develop hand strength. In addition, warm water also has a calming effect on the CNS.

In addition to the development of sensory perception and information processing, swimming develops physical qualities such as strength, flexibility and endurance, the development of which is indirectly related to sensory (the better these qualities are developed, the more adapted sensory systems and coordinated movements). Thus, swimming through sensory integration can significantly improve the quality of life of both children with ASD and their families.

Conclusion

1. Swimming has been identified as a powerful sensory stimulus for children with ASD. As a result of swimming lessons in children with ASD there is an improvement in behavior: reduced aggression and autoaggression, reduced incidence of stereotyped movements, reduced opposition, improved emotional state, improved willpower, increased coordination and dexterity, improved communication between play partners.

2. It is established that against the background of increasing the results of movement skills, improving swimming skills, a significant increase in positive emotions, there is a significant reduction in problem behavior and the development and formation of communication skills. Individual swimming lessons for children with ASD can be recommended as an effective means of adaptive physical education.

Conflict of interest

The authors report that there is no conflict of interest.

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