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Sensory integration of the proprioceptive sensory system of children with intellectual disabilities

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ABSTRACT

Introduction: Sensory integration is the way in which the nervous system processes information from the senses. Irregularities or disturbances in brain function that make it difficult to integrate sensory input from stimuli lead to sensory disintegration. The proprioceptive sensory system provides information about joint and body movements, extent, strength, duration and direction of movement, position of the body or body parts in space, and muscle tone. The aim of this study is to investigate the prevalence of sensory integration disorders of the proprioceptive sensory system in children with intellectual disabilities and children without developmental disabilities and to determine whether the existing difference is statistically significant.

Methods: The study was conducted on a sample of 60 respondents. The first subsample of respondents (n = 30) consisted of children with intellectual disabilities. The second subsample of respondents (n = 30) consisted of children without developmental disabilities of the same chronological age. The measuring instrument "Questionnaire for examining proprioceptive sensory sensitivity" was used. Data were collected by observing the respondents and interviewing the rehabilitator and the child's parents. The frequencies and percentages of the respondents' answers for all variables were calculated. To determine the statistical significance of differences, the Mann-Whitney U test and Wilcoxon W test were used at a statistical significance level of $p < 0.05$.

Results: The results show that 81.4% of children with intellectual disabilities have difficulties with sensory integration of the sensations of the proprioceptive sensory system, manifested as hypersensitivity (37.6%), hyposensitivity (19.5%), and mixed sensory response (24.3%). Sensory integration difficulties are also experienced by 75.7% of children without developmental disabilities, manifested by hypersensitivity (17.62%), hyposensitivity (27.6%), and mixed sensory reactions (30.5%). There is a statistically significant difference in the variables: high-risk games, fine motor tasks, and activities requiring physical strength. For the other variables, the difference in sensory integration is not statistically significant.

Conclusion: 81.4% of children with intellectual disabilities and 75.7% of children without developmental disabilities have difficulties in sensory integration of the proprioceptive sensory system. Children with intellectual disabilities show better integration of proprioceptive sensory input in activities requiring physical strength and in activities with eyes closed or covered. In all other activities, they show poorer sensory integration of proprioceptive sensations than children without developmental disabilities.

Keywords: Sensory integration; proprioception; developmental disabilities; intellectual disabilities

INTRODUCTION

Sensory integration is the organization of sensory impressions for their use (1). It is a neurobiological activity that makes it possible to receive and process sensory information, which reaches the brain in large quantities from the senses, at any time (2). The brain integrates the sensory stimuli it receives into a harmonious whole. Appropriate integration of sensory stimuli enables the functioning of every living being and determines its behavior, learning, perception, and reaction (3).

Sensory disintegration is an irregularity or disturbance in brain function that makes it difficult to integrate sensory input from stimuli (1). Sensory integration difficulties occur when the brain and nervous system have difficulty receiving and processing sensory information or when they are not exposed to appropriate sensory stimuli (4). Sensory disintegration is the inability of the brain to adequately integrate sensory information coming from different senses (5). Difficulties in sensory integration are manifested by excessive sensitivity (avoidance of sensory stimuli) leading to an overreaction - hypersensitivity, then by decreased sensitivity (seeking sensory stimuli) leading to a decreased reaction - hyposensitivity, and by combined

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sensitivity (the child avoids the same sensory stimulus at one moment and seeks it at another) leading to a mixed type of sensory reaction (1).

Sensory integration disorder can occur alone, but also often occurs in conjunction with other disorders such as attention-deficit/hyperactivity disorder (ADHD), autism, obsessive-compulsive disorder, intellectual disabilities, cerebral palsy, etc. (6). The problems of a person with sensory integration disorder include: Learning difficulties, feelings of inferiority, low self-esteem, susceptibility to stress, difficulty controlling behavior, loss of attention, delayed speech development, inadequate motor coordination, tendency to self-harm, excessive anxiety, etc. (7).

Proprioception is the internal sense that tells us where parts of our body are without having to look at them. This internal perception of the body is transmitted by receptors in the joints, muscles, ligaments, and connective tissue. The receptors receive information about how the muscles contract and stretch and whether the body is at rest (2). Proprioception is the ability to control muscles (8). Proprioception is the sensory information provided by the contraction and stretching of muscles and the bending, stretching, pulling, and pushing of joints between bones (9).

Problems with proprioception interfere with everyday activities in learning and teaching and are particularly evident in subjects that require practical tasks, such as technical culture. When completing practical tasks, students perform various grasps and movements that have a positive impact on the development of their motor skills. Grips can be: Finger grips, fist grips, hand grips. The movements are performed in individual parts of the body to utilize the body's energy during the work. The most important are the hand movements, which include the following: Finger movements, hand movements, forearm movements, upper arm movements and shoulder movements (10). Impaired proprioception leads to difficulties in performing the aforementioned processes and movements.

According to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition, intellectual disability is a disorder that includes intellectual deficits and deficits in adaptive functioning in social, practical and conceptual domains and occurs in childhood or adolescence (11).

The aim of the study is to investigate the prevalence of sensory integration disorders of the proprioceptive sensory system in children with intellectual disabilities and children without developmental disabilities and to determine whether the existing difference is statistically significant.

METHODS

The study was conducted with a total sample of 60 children. The total sample of respondents (n = 60) was divided into two subsamples. The first subsample of respondents (n = 30) consisted of children with intellectual disabilities who were students of the Public Institution Center for Upbringing, Education and Rehabilitation "Vladimir Nazor" and the Public Institution "Children of Sarajevo". The second subsample of respondents (n = 30) consisted of children without developmental disabilities, students at Elementary School "Aneks" Sarajevo, of the same chronological age as the respondents of the first subsample, children with intellectual disabilities. This study was approved by the Ministry of Education of Sarajevo Canton and consent for children's participation in the research was requested from parents/guardians. Children who did not receive consent to participate from their parents/guardians were not included in the study.

For the study, the "Proprioceptive Sensory Sensitivity Test Questionnaire" was used, which is available in the book "Sensory Integration from Day to Day". The measuring instrument consists of 7 questions (variables) with answers on the possible sensory reaction to proprioceptive sensory stimuli. The answers offered are: it reacts modularly, it reacts hypersensitively, it reacts hyposensitively, and it reacts in combination.

Statistical data analysis was carried out in Statistical Package for the Social Sciences version 24.0. The descriptive statistics method was used. The ranks of the matrices and the sum of the ranks were created to show the differences between children with and children without developmental disorders. The Kolmogorov–Smirnov and Shapiro–Wilk tests were used to check for deviations from the normal distribution of the results. The Mann–Whitney U test and Wilcoxon W test were used to test the statistical significance of the differences between the subsamples of respondents at the statistical significance level of $p < 0.05$.

RESULTS

Based on Table 1 and the results of the Kolmogorov–Smirnov and Shapiro–Wilk tests for all individual variables of the measurement instrument, it can be seen that the results obtained for all variables of the measurement instrument deviate from the normal distribution.

From the analysis of Table 2 and the evaluation of the frequencies and percentages of respondents' answers for

TABLE 1. Distribution of the results in the total sample of respondents

S. No.	Variable	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Test value	df	*p*	Test value	df	*p*
1.	Age	0.192	60	0.000	0.917	60	0.001
2.	Activities such as playful wrestling, jumping, hitting, pushing, climbing, and other active play	0.215	60	0.000	0.836	60	0.000
3.	High-risk games (jumping from great heights, climbing tall trees, riding a bike on gravel)	0.270	60	0.000	0.798	60	0.000
4.	Fine motor tasks such as writing, drawing, fastening buttons and buckles, stringing beads, and construction toys	0.186	60	0.000	0.863	60	0.000
5.	Activities that require physical strength	0.212	60	0.000	0.866	60	0.000
6.	Crunchy foods (snacks, dry cereals) or foods that need to be chewed (meat, caramels)	0.222	60	0.000	0.859	60	0.000
7.	Smooth, creamy foods (yoghurt, cheese spread, pudding)	0.234	60	0.000	0.874	60	0.000
8.	Covering or closing the eyes	0.250	60	0.000	0.760	60	0.000

the variable "Activities such as playful wrestling, jumping, hitting, pushing, climbing and other active games," it appears that 90% of children with intellectual disabilities have difficulties with this type of sensory input from the proprioceptive sensory system. The percentage of children without disabilities who have difficulty processing sensory input through activities such as playful wrestling, jumping, hitting, pushing, climbing and other active play is not insignificant.

From a baseline perspective, 40% of children with intellectual disabilities and 30% of children without disabilities have hypersensitive responses, while 23.30% of both children are hyposensitive. The mixed type of proprioceptive sensory response has 26.70% of children with intellectual disabilities and 16.7% of children without disabilities.

From the analysis of Table 3 and based on the analysis of frequencies and percentages of respondents' answers for the variable "high risk games (jumping from great heights, climbing tall trees, riding a bicycle on gravel)," it can be noted that 93.3% of children with intellectual disabilities have some form of sensory integration problem. There is a large percentage of children without disabilities who show elements of sensory integration difficulties of the proprioceptive system in activities such as jumping from great heights, climbing tall trees or riding bicycles on gravel. There is an equal percentage of children with intellectual disabilities and children without disabilities (23.3%) who show a hyposensitive reaction to the activities mentioned. 60.0% of children with intellectual disabilities and 30.0% of children without disabilities are hypersensitive to these types of sensory input. A mixed type of sensory response is present in 10% of children with intellectual disabilities and in 23.3% of children without developmental disabilities.

The analysis of frequencies and percentages in Table 4 shows that only 10% of children with intellectual disabilities have normal sensory integration of the proprioceptive sensory system in fine motor tasks such as writing, drawing, fastening buttons and buckles, stringing beads, and construction toys. Therefore, 90% of children with intellectual disabilities have difficulties with sensory integration of the proprioceptive sensory system in activities that require fine motor skills. Of these, 16.7% of children are hyposensitive, 50% of children are hypersensitive and 23.30% have a mixed type of sensory reactivity. In children without developmental disorders, 43.30% of children are hyposensitive, 10.0% are hypersensitive, and 33.30% have mixed sensory reactivity to the introduced variable.

Neutral reaction, that is, normal sensory processing of proprioceptive input associated with activities requiring physical strength, is found in 10% of children with intellectual disabilities. The highest percentage of children respond hypersensitively (46.70%), followed by a mixed type (23.30%), and a hyposensitive type (20%) to sensory inputs requiring physical force.

In children without difficulties, the largest percentage of children (43.30%) has a mixed type of sensory response, followed by a hyposensitive 30.00% and 6.70% hypersensitive.

A normal sensory response, that is, a neutral response to this type of proprioceptive sensory input, is found in 30% of children in both groups, children with intellectual disabilities and children without disabilities (Table 5).

TABLE 2. Analysis of frequencies and percentages of the total sample of respondents for the variable "Activities such as playful wrestling, jumping, hitting, pushing, climbing and other active play"

S. No.	Respondents	Avoids		Seeks		Mixed		Neutral		Total	
		n	%	n	%	n	%	n	%	n	%
1.	Children without developmental disabilities	9	30.0	7	23.3	5	16.7	9	30.0	30	100.0
2.	Children with intellectual disabilities	12	40.0	7	23.3	8	26.7	3	10.0	30	100.0

TABLE 3. Analysis of frequencies and percentages of the total sample of respondents for the variable "High-risk games (jumping from a great height, climbing tall trees, riding a bicycle on gravel)"

S. No.	Respondents	Avoids		Seeks		Mixed		Neutral		Total	
		n	%	n	%	n	%	n	%	n	%
1.	Children without developmental disabilities	9	30.0	7	23.3	7	23.3	7	23.3	30	100.0
2.	Children with intellectual disabilities	18	60.0	7	23.3	3	10.0	2	6.7	30	100.0

TABLE 4. Analysis of frequencies and percentages of the total sample of respondents for the variable "Fine motor tasks such as writing, drawing, fastening buttons and buckles, stringing beads and construction toys"

S. No.	Respondents	Avoids		Seeks		Mixed		Neutral		Total	
		n	%	n	%	n	%	n	%	n	%
1.	Children without developmental disabilities	3	10.0	13	43.3	10	33.3	4	13.3	30	100.0
2.	Children with intellectual disabilities	15	50.0	5	16.7	7	23.3	3	10.0	30	100.0

TABLE 5. Analysis of frequencies and percentages of the total sample of respondents for the variable "Activities requiring physical strength"

S. No.	Respondents	Avoids		Seeks		Mixed		Neutral		Total	
		n	%	n	%	n	%	n	%	n	%
1.	Children without developmental disabilities	2	6.7	9	30.0	13	43.3	6	20.0	30	100.0
2.	Children with intellectual disabilities	14	46.7	6	20.0	7	23.3	3	10.0	30	100.0

There is also the same percentage of children with intellectual disabilities and children without disabilities who are hyposensitive to this type of sensory input, namely, 23.3% each. The data in the table show that 16.7% of children with intellectual disabilities and 3.3% of children without disabilities are hyposensitive. The mixed type of sensory response is responded to by 43.3% of children without disabilities and 30% of children with intellectual disabilities (Table 6.).

A look at Table 7 shows that 23.3% of children without developmental disabilities and 16.7% of children with intellectual disabilities have a neutral reaction or normal sensory integration of the proprioceptive sensory system to this type of sensory input. A mixed sensory response is found in 23.3% of children without developmental disabilities and 30% of children with intellectual disabilities. It can also be noted that 30% of children with intellectual disabilities and 46.7% of children without disabilities are hyposensitive. Children with intellectual disabilities show a hypersensitive sensory response to this type of proprioceptive sensory input in 23.3% of cases, compared to children without disabilities where the hypersensitivity is 6.7%.

From baseline, 46.6% of children with intellectual disabilities and 30% of children without developmental disabilities have a neutral sensory reaction or a normal sensory reaction. 30% of children without developmental disabilities and 26.7% of children with intellectual disabilities have a mixed reaction to this type of sensory input. A hypersensitive sensory response is present in 26.7% of children with intellectual disabilities and in 36.7% of children without developmental disabilities. Children with intellectual disabilities are not hyposensitive to this type of sensory input, and 3.3% of children without developmental disabilities are hyposensitive (Table 8).

Looking at Table 9, and based on the analysis of the frequencies and percentages of respondents' responses for all variables of the measuring instrument, it can be noted that 37.6% of children with intellectual disabilities have difficulties with sensory integration of the proprioceptive sensory system, which they manifest through hypersensitive sensory response, and 17.6% of children without developmental disabilities.

Hyposensitive sensory response of the proprioceptive sensory system is present in 19.5% of children with intellectual disabilities, and 27.6% of children without developmental disabilities.

Mixed sensory response of the proprioceptive sensory system has 24.3% of children with intellectual disabilities and 30.5% of children without developmental disabilities.

18.6% of children with intellectual disabilities and 24.3% of children without developmental disabilities show a neutral or normal sensory reaction to sensory stimuli of the proprioceptive system.

Based on the results in Table 10, it is clear that there is a difference in sensory integration between children with intellectual disabilities and children without developmental disabilities. In the further analysis, it was examined whether this difference is statistically significant. A look at Table 11 shows that there is a statistically significant difference in sensory integration of the proprioceptive sensory system between children with intellectual disabilities and children without developmental disabilities for the variables: "High risk games (jumping from great heights, climbing tall trees, riding bicycles on gravel)," "Fine motor tasks such as writing, drawing, fastening buttons and buckles, stringing beads and construction toys" and "Activities requiring physical strength," at the level of statistical significance of $p < 0.05$.

TABLE 6. Analysis of frequencies and percentages of the total sample of respondents for the variable "Crunchy food (snacks, dry cereals) or food that needs to be chewed (meat, caramels)"

S. No.	Respondents	Avoids		Seeks		Mixed		Neutral		Total	
		n	%	n	%	n	%	n	%	n	%
1.	Children without developmental disabilities	1	3.3	7	23.3	13	43.3	9	30.0	30	100.0
2.	Children with intellectual disabilities	5	16.7	7	23.3	9	30.0	9	30.0	30	100.0

TABLE 7. Frequency and percentage analysis of the total sample of respondents for the variable "Smooth, creamy food (yoghurt, cheese spread, pudding)"

S. No.	Respondents	Avoids		Seeks		Mixed		Neutral		Total	
		n	%	n	%	n	%	n	%	n	%
1.	Children without developmental disabilities	2	6.7	14	46.7	7	23.3	7	23.3	30	100.0
2.	Children with intellectual disabilities	7	23.3	9	30.0	9	30.0	5	16.7	30	100.0

TABLE 8. Analysis of frequencies and percentages of the total sample of respondents for the variable "Covering or closing the eyes"

S. No.	Respondents	Avoids		Seeks		Mixed		Neutral		Total	
		n	%	n	%	n	%	n	%	n	%
1.	Children without developmental disabilities	11	36.7	1	3.3	9	30.0	9	30.0	30	100.0
2.	Children with intellectual disabilities	8	26.7	0	0.0	8	26.7	14	46.6	30	100.0

TABLE 9. Analysis of frequencies and percentages of the total sample of respondents for all variables of the measuring instruments

Respondents	Avoids		Seeks		Mixed		Neutral		Total	
	n	%	n	%	n	%	n	%	n	%
Children without developmental disabilities	5	17.6	8	27.6	9	30.5	8	24.3	30	100.0
Children with intellectual disabilities	11	37.6	6	19.5	7	24.3	6	18.6	30	100.0

TABLE 10. Differences in the prevalence of sensory integration difficulties in the post-proprioceptive sensory system between children with intellectual disabilities and children without developmental disabilities

S. No.	Variable	Group	n	Rank M	Sum of ranks
1.	Activities such as playful wrestling, jumping, hitting, pushing, climbing, and other active play	Children without developmental disabilities	30	33.30	999.00
		Children with intellectual disabilities	30	27.70	831.00
		Total	60		
2.	High-risk games (jumping from great heights, climbing tall trees, riding a bike on gravel)	Children without developmental disabilities	30	36.17	1085.00
		Children with intellectual disabilities	30	24.83	745.00
		Total	60		
3	Fine motor tasks such as writing, drawing, fastening buttons and buckles, stringing beads, construction toys	Children without developmental disabilities	30	35.47	1064.00
		Children with intellectual disabilities	30	25.53	766.00
		Total	60		
4.	Activities that require physical strengths	Children without developmental disabilities	30	36.95	1108.50
		Children with intellectual disabilities	30	24.05	721.50
		Total	60		
5.	Crunchy foods (snacks, dry cereals) or foods that need to be chewed (meat, caramels)	Children without developmental disabilities	30	32.37	971.00
		Children with intellectual disabilities	30	28.63	859.00
		Total	60		
6.	Smooth, creamy foods (yoghurt, cheese spread, pudding)	Children without developmental disabilities	30	32.30	969.00
		Children with intellectual disabilities	30	28.70	861.00
		Total	60		
7.	Covering or closing the eyes	Children without developmental disabilities	30	27.73	832.00
		Children with intellectual disabilities	30	33.27	998.00
		Total	60		

TABLE 11. Testing the statistical significance of differences between children with intellectual disabilities and children without disabilities

S. No.	Variable	Mann-Whitney U	Wilcoxon W	Z	*p*
1.	Activities such as playful wrestling, jumping, hitting, pushing, climbing, and other active play	366	831	−1.29	0.197
2.	High-risk games (jumping from great heights, climbing tall trees, riding a bike on gravel)	280	745	−2.667	0.008
3.	Fine motor tasks such as writing, drawing, fastening buttons and buckles, stringing beads, construction toys	301	766	−2.294	0.022
4.	Activities that require physical strengths	256,5	721,5	−2.974	0.003
5.	Crunchy foods (snacks, dry cereals) or foods that need to be chewed (meat, caramels)	394	859	−0.868	0.386
6.	Smooth, creamy foods (yoghurt, cheese spread, pudding)	396	861	−0.835	0.404
7.	Covering or closing the eyes	367	832	−1.301	0.193

For the other variables "Activities such as playful wrestling, jumping, hitting, pushing, climbing and other active play," "Crunchy foods (snacks, dry cereals) or foods that require chewing (meat, caramel candies)," "Smooth, creamy foods (yoghurt, Spreadable cheese, pudding)" and "Covering or closing the eyes," the difference in sensory integration of the proprioceptive sensory system between children with intellectual disabilities and children without developmental disabilities is not statistically significant.

DISCUSSION

A large percentage of children with and without developmental disabilities have difficulties with sensory integration of the proprioceptive sensory system. Difficulties in the sensory integration of the proprioceptive sensory system are experienced by 81.4% of children with intellectual disabilities, which are manifested by hypersensitive, hyposensitive, and mixed sensory responses, and the same difficulties and the same sensory responses are experienced by 75.7% of children without developmental disabilities.

Children with intellectual disabilities show poorer results on the variables or poorer sensory integration of the proprioceptive sensory system compared to children without disabilities: "Activities such as playful wrestling, jumping, hitting, pushing, climbing and other active games," "High risk games (jumping from a great heights, climbing tall trees, riding a bicycle on a slippery slope)," "Fine motor tasks such as writing, Drawing, fastening buttons and buckles, stringing beads and construction toys," "Crunchy foods (snacks, dry cereals) or foods that need to be chewed (meat, caramel candies)," "Smooth, creamy foods (yoghurt, cheese spread, pudding)."

Children with intellectual disabilities show better results, that is, they have a better sensory integration of the proprioceptive sensory system compared to children without disabilities in the variables "covering or closing eyes" and "activities requiring physical strength."

The function of proprioception is to increase body awareness and contribute to motor control of movements and motor planning, increase movement strength, and improve postural stability. Adequate proprioception helps with daily movement (12). The results of our study show that only 10 of children with intellectual disabilities have normal sensory integration of the proprioceptive sensory system in fine motor tasks such as writing, drawing, fastening buttons and buckles, stringing beads, and building toys. Therefore, 90% of children with intellectual disabilities have difficulties

with sensory integration of the proprioceptive sensory system in activities that require fine motor skills, motor planning, and execution of movements that require fine motor skills of the fingers. Of these, 50% of children avoid said activities, 16.7% seek them out and 23.3% have mixed sensory responses.

Indicators of proprioception problems in children are: Clumsiness, poor motor development, using too little or too much force, colliding with a wall or with other children, avoiding or seeking out jumping and pushing, and looking at what they are doing (2). The results of our research show that 10% of children with intellectual disabilities have a neutral reaction, that is, normal sensory processing of proprioceptive input related to activities that require physical force. The largest proportion of children are hypersensitive and avoid activities that require physical strength (46.70%), while 23.30% of children seek activities that require physical strength. 20% of children with intellectual disabilities have a mixed type of sensory response.

Proprioception causes difficulties in perceiving the position of the body in relation to objects and people, resulting in frequent collisions with objects, knocking over a glass, dropping cutlery, or falling from a chair (13). These findings are consistent with the results of our study on the variable "activities such as playful wrestling, jumping, hitting, pushing, climbing and other active games," which showed that 90% of children with intellectual disabilities have difficulties with this type of sensory input from the proprioceptive sensory system. 40% of children with intellectual disabilities are hypersensitive, 23.30% are hyposensitive and 26.70% of children with intellectual disabilities have a mixed type of reaction.

Sensitivity of the proprioceptive system manifests itself in the form of a difficult ability to interpret sensory information about body position and head and limb movements, reduced or absent body awareness, and the absence of a mental image of body parts and the relationship between body parts (13). The authors' conclusions can be linked to the results of our study on the variable "High-risk games (jumping from great heights, climbing high trees, riding bicycles on gravel)," which showed that 93.3% of children with intellectual disabilities have one of the difficulties listed. 60% of children with intellectual disabilities are hypersensitive to these types of sensory input because they avoid the listed activities. The problems listed could be a consequence of children's decreasing involvement in these forms of play, which are necessary for the development of the world of the body and the position of the body in space, as well as children's increasing attachment to social networks and various virtual games, which has a negative impact on the development of sensory integration of the proprioceptive sensory system.

Difficulties in interpreting proprioceptive information may have an impact on food refusal at mealtimes and on the development of feeding skills (13). The conclusion of these authors can be related to the results of our study, which show that 70% of children with intellectual disabilities have problems with eating crunchy foods or foods that require chewing. Of these, 23.3% of children are hyposensitive, 16.7% are hypersensitive and 30% of children show a mixed type of sensory reaction. The above difficulties are the result of insufficient proprioceptive input in the temporomandibular joints making it difficult to chew food. This is also supported by the variable showing a preference for or rejection of smooth and creamy foods (yoghurt, cheese spread, pudding). 16.7% of children with intellectual disabilities have a normal sensory response of the proprioceptive sensory system to this type of food. 23.3% avoid smooth and creamy foods, while 30% of children with intellectual disabilities prefer them. 30% of children with intellectual disabilities have a mixed type of sensory response.

The Importance of Sensory Integration in the Development of Children with Autism Spectrum Disorders study comes to the following conclusions. For activities requiring wrestling, jumping, climbing, and hitting, 60% of children were reported to enjoy and seek such stimuli, while 19% of children avoided such stimuli. For the variable of high-risk play, less than half of children seek such stimuli and slightly fewer children avoid them. Up to 60% of children avoid fine motor tasks, such as drawing, writing, and buttoning, about 21% of children have a mixed response, and very few seek out such stimuli. To the variable of covering the eyes, 35% of children have a mixed reaction, 26% avoid it, 23% seek it and 16% are neutral to this type of sensory input (14).

The results of the study show that 83.6% of children show a definite difference in sensory processing compared to the results of children without developmental difficulties, while 11.4% show a possible difference in sensory processing. The study was conducted on a sample of 256 children with autism spectrum disorder. The Short Sensory Profile was used to test sensory processing (15).

A study on a sample of 27 children of primary school age showed that 96% of the children belonged to the group with severe sensory integration dysfunction (16).

CONCLUSIONS

Overall, 81.4% of children with intellectual disabilities have difficulties with sensory integration of the proprioceptive sensory system and 75.7% of children without developmental disabilities.

A hypersensitive sensory response is present in 37.6% of children with intellectual disabilities and in 17.62% of children without developmental disabilities.

A hyposensitive sensory reaction is present in 19.5% of children with intellectual disabilities and in 27.6% of children without developmental disabilities.

A mixed type of sensory reaction was present in 24.3% of children with intellectual disabilities and in 30.5% of children without developmental disabilities.

Neutral or normal sensory responses to sensory stimuli of the proprioceptive system are present in 18.6% of children with intellectual disabilities and 24.3% of children without developmental disabilities. The above data show that a large percentage of children with and without developmental disabilities have difficulties with sensory integration of the proprioceptive sensory system. Difficulties in the sensory integration of the proprioceptive sensory system are

experienced by 81.4% of children with intellectual disabilities, which are manifested by hypersensitive, hyposensitive and mixed sensory responses, and the same difficulties and the same sensory responses are experienced by 75.7% of children without developmental disabilities.

Children with intellectual disabilities have poorer sensory integration of the proprioceptive sensory system in comparison to children without developmental disabilities: activities (playful wrestling, jumping, hitting, pushing, climbing and other active games), high-risk games (jumping from great heights, climbing tall trees, riding bicycles on gravel), fine motor tasks (writing, drawing, attaching buttons and buckles, Threading beads and using construction toys), eating crunchy foods (snacks, dry cereals), foods that require chewing (meat, caramel candies), and soft or creamy foods (yoghurt, cheese spread, pudding).

Children with intellectual disabilities show better integration of proprioceptive sensations in activities that require physical strength and in activities where the eyes are covered or closed. In all other activities, they show poorer sensory integration of proprioceptive sensations compared to children without developmental disabilities.

There is a statistically significant difference in the sensory integration of the proprioceptive sensory system between children with intellectual disabilities and children without developmental disabilities in fine motor tasks (writing, drawing, buttoning and fastening buttons and buckles, stringing beads, and construction toys), in activities that require physical strength and in high-risk play (jumping from great heights, climbing tall trees, riding a bicycle on a slippery slope). For other variables, the difference in responses is not statistically significant, with a statistical significance level of $p < 0.05$.

DECLARATION OF INTERESTS

Authors declare no conflict of interest.

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