Original Research Article

DIFFICULTIES OF TACTILE SENSORY SYSTEM SENSORY INTEGRATION OF CHILDREN WITH DOWN SYNDROME

Abstract

Sensory integration is the organization of the sense for their use. It is a neuro-biological activity that allows the reception and processing of sensory information, which in large quantity arrive to the brain, at all times. The brain's ability to successfully process tactile information allows the child to feel safe and develop a connection with those around they. Children with Down syndrome may have difficulties of sensory integration. Decreased awareness and attention to tactile stimulation is possible, which leads to a reduction in tactile discrimination and difficult manipulation of objects, or to an increased response to sensory stimuli in the form of tactile defense. The aim of the study is to examine the prevalence of sensory integration of the tactile sensory system of children with Down syndrome, and to determine the statistical significance of differences in relation to children without developmental disabilities. The total sample of respondents (N=30) consisted of two subsamples. The first subsample of respondents (N=15) consisted of children with Down syndrome, and the second subsample of respondents (N=15) consisted of children without developmental disabilities. The measurement instrument „Questionnaire for testing tactile sensory sensitivity“ with 11 variables and offered answers of possible sensory response was applied. The Mann-Whitney U test and the Wilcoxon W test at the level of statistical significance of $p<0.05$ were used to test the statistical significance of the differences between the subsamples of the respondents. The results of the study showed that 66.67% of children with Down syndrome have difficulties with sensory integration of the tactile sensory system. 26.67% of children are hypersensitive and 6.67% are hyposensitive. 33.33% of children with Down syndrome have a mixed type of tactile sensory response. Children with Down syndrome compared to children without developmental disabilities show better results of sensory integration of the tactile sensory system on two variables; „Walking barefoot“ and „Certain types of fabric, seams, labels, belts, cuffs, etc.“. There is a statistically significant difference at the level of $p<0.05$ between children with Down syndrome and children without developmental disabilities on 5 variables.

Key words: sensory integration, tactile sensory system, Down syndrome, children with disabilities, children without disabilities.

INTRODUCTION

Sensory integration represents the organization of the sense for the adequate use (1). It is a neuro-biological activity that enables the reception and processing of sensory information, which in large quantity arrive from the senses to the brain, at any time (2). Sensory disintegration is an abnormality or disturbance in brain function that makes it difficult to integrate sensory stimulus input (1). Difficulties in

sensory integration occur when the brain and nervous system have difficulties in receiving and processing sensory information or if they are not exposed to appropriate stimuli (3).

The tactile system is the largest sensory system and develops first, during intrauterine development. Tactile information is obtained through receptors (4), located on the skin, but also in the throat, ear canals, digestive tract... (2). Majority of tactile receptors are located in the mouth and on hands (5). The first role of touch in a child's life is to establish a connection between the mother and the infant, and this connection is important for the further development of the child's brain (6). The ability of the brain to successfully process tactile information allows the child to feel safe and to develop a connection with those around it (7).

Down syndrome is the most common form of moderate developmental disability. According to estimates, the incidence of newborns with Down syndrome is 1:600-800 newborns (8). Children with Down syndrome may have difficulty with sensory integration. Decreased awareness and attention to tactile stimulation is possible, which leads to a reduction in tactile discrimination and more difficult manipulation of objects. Also, children can react more strongly to sensory stimuli in the form of tactile defense. As a consequence of proprioceptive hyperactivity, they avoid carrying load on their arms, hands, feet and knees (9). There are also difficulties in processing sensations in the mouth or hypersensitivity to touch around the face. Due to the reduced muscle tone, for them is difficult to be breast-feed and swallow. Children with Down syndrome very often avoid and resist during bathing, haircutting and combing. With the help of tactile skills such as touching hands, lips, mouth and tongue, children establish contact with people and objects in their environment (10). Therapy involves differentiating the texture of materials and shapes, playing in the sand and water, exploring objects with the mouth and body massage... (9).

The aim of the study is to examine the prevalence of sensory integration of the tactile sensory system of children with Down syndrome, and to determine the statistical significance of differences in relation to children without developmental disabilities.

2. METHODS

2.1. Sample

The study was conducted on a sample of 30 respondents. The total sample of respondents was divided into two subsamples. The first subsample of respondents (N=15) consisted of children with Down syndrome (students of the „Vladimir Nazor“ Center and the „Mjedenica“ Institute). The second subsample of respondents (N=15) consisted of children without disabilities, students of the Elementary School „Isak Samokovlija“ Sarajevo.

2.2. Type of research and measurement instrument

The study is prospective, analytical-descriptive and control. Data were collected using the „Tactile Sensory Sensitivity Test Questionnaire“ (2). The measurement instrument consists of 11 questions, variables with offered answers of possible sensory response; neutral, avoids, seeks and mixed. Data were collected by observing students and interviewing rehabilitators, teachers and parents of students.

2.3. Statistical data analysis

Statistical analysis of the data was performed in the statistical software SPSS version 24.0. The method of descriptive statistics was used. The ranks of the matrices and the sum of the ranks of the representation of the differences in the difficulties of sensory integration of the tactile sensory system between children with Down syndrome and children without developmental disabilities were made. The Mann-Whitney U test and the Wilcoxon W test at the level of statistical significance of $p < 0.05$ were used to test the statistical significance of the differences between the subsamples of the respondents.

3. RESULTS AND DIACUSSION

3.1. Analysis of frequencies and percentages in subsamples of respondents

Table 1. Response frequencies and percentages of children with Down syndrome and children without developmental disabilities

Variables	Down syndrome				Children without developmental disabilities			
	Avoids N / %	**Seeks N / %**	**Mixed N / %**	**Neutral N / %**	**Avoids N / %**	**Seeks N / %**	**Mixed N / %**	**Neutral N / %**
1. Touching some parts of the body, hugs and caresses	1 6.67	5 33.33	6 40.00	3 20.00	0 0.00	2 13.33	6 40.00	7 46.67
2. Certain types of fabric, seams, labels, belts, cuffs, etc.	3 20.00	0 0.00	5 33.33	7 46.67	0 0.00	6 40.00	2 13.33	7 46.67
3. Clothing, footwear or embellishments that are very narrow or very loose	4 26.67	0 0.00	5 33.33	6 40.00	0 0.00	4 26.67	4 26.67	7 46.67
4. Contamination of hands, face or other parts of the body with paint, glue, sand, food, lotion	5 33.33	0 0.00	4 26.67	6 40.00	5 33.33	0 0.00	0 0.00	10 66.67
5. Hygienic activities such as washing face and washing hair, combing, cutting nails, brushing teeth	4 26.67	0 0.00	7 46.67	4 26.67	0 0.00	0 0.00	1 6.67	14 93.33
6. Bathing, showering or swimming	4 26.67	1 6.67	4 26.67	6 40.00	0 0.00	0 0.00	1 6.67	14 93.33
7. Towel drying	4 26.67	0 0.00	4 26.67	7 46.67	0 0.00	0 0.00	1 6.67	14 93.33
8. Trying new foods	8 53.33	1 6.67	3 20.00	3 20.00	0 0.00	0 0.00	14 93.33	1 6.67
9. Sensation of certain foods in the mouth (e.g., dry, crumbly, smooth ....)	8 53.33	1 6.67	3 20.00	3 20.00	2 13.33	0 0.00	11 73.33	2 13.33
10. Standing close to other people	2 13.33	1 6.67	6 40.00	6 40.00	1 6.67	0 0.00	9 60.00	5 33.33
11. Walking barefoot	2 13.33	0 0.00	3 20.00	10 66.67	2 13.33	0 0.00	6 40.00	7 46.67
TOTAL	**4 26.67**	**1 6.67**	**5 33.33**	**5 33.33**	**1 6.67**	**1 6.67**	**5 33.33**	**8 53.33**

By reviewing Table 1, and based on the analysis of frequencies and percentages of responses for the variable *„Touching certain parts of the body, hugs and caresses“*, it can be stated that 20% of children with Down syndrome have normal sensory integration of the tactile sensory system. A large percentage of children with Down syndrome, 40% of them have a mixed type of tactile sensory response, and a slightly smaller percentage, 33.33% of them are hyposensitive. 6.67% of children have hypersensitive tactile sensory response. Children without developmental disabilities show in 13.33% of cases a hyposensitive sensory response, and in 40% of cases a mixed type of sensory response. 46.67% of children without developmental difficulties have a normal sensory response.

For the variable *„Certain types of fabric, seams, labels, belts, cuffs, etc.“* the majority of respondents with Down syndrome, 46.67% of them have a neutral tactile sensory response. From total, 33.33% of children with Down syndrome have a mixed type of tactile sensory response, and 20% of respondents are hypersensitive. There are no respondents with a hyposensitive reaction to this type of tactile sensory input. Children without developmental difficulties show in 40% of cases a hyposensitive sensory response, and in 13.33% of cases a mixed type of sensory response. 46.67% of children without developmental difficulties have a normal sensory response.

Normal sensory integration is present in 40% of children with Down syndrome for the variable *„Clothing, footwear or jewelry that is very narrow or very loose“*. The mixed type of tactile sensory response has 33.33%, and 26.67% is hypersensitive. There are no respondents who react hyposensitively to this type of tactile sensory input. In 26.26% of cases, children without developmental difficulties show a hyposensitive sensory response, and the same type shows a mixed type of sensory response. From total, 46.67% of children without difficulties have a normal sensory response.

For the variable *„Contamination of hands, face or other parts of the body with paint, glue, sand, food, lotion“* only 40% of children with Down syndrome have a normal sensory reaction, and a slightly smaller percentage, 33.33% of them are hypersensitive. 26.67% of children with Down syndrome have a mixed type of tactile sensory response. Children without developmental disabilities show hypersensitive sensory response in 33.33% of cases. There are no children with a hyposensitive and mixed type of response. From total, 66.67% of children without developmental difficulties have a normal sensory response.

For the variable *„Hygienic activities such as washing and washing hair, combing, cutting nails, brushing teeth“*, 26.67% of children with Down syndrome have a normal sensory reaction to this type of sensory stimuli. From baseline, 46.67% of children have a mixed type of tactile sensory response, and 26.67% are hypersensitive. Children without developmental disabilities show in 6.67% of cases a mixed type of tactile sensory response, while 93.33% of children without developmental difficulties have a normal sensory response.

For the variable *„Bathing, showering or swimming“*, 40% of children with Down syndrome have a normal sensory response. The mixed type of tactile sensory response is shown by 26.67%

of children, and the same number is hypersensitive. Form total, 6.67% of children are hyposensitive. Children without developmental disabilities show in 6.67% of cases a mixed type of tactile sensory response. Children without developmental difficulties have a normal sensory response in 93.33% of cases.

Normal sensory response is recorded in 46.67% of children with Down syndrome for the variable *„Towel drying"*. From total, 26.67% of children with Down syndrome have a mixed type of tactile sensory response, and the same number are hypersensitive. There are no respondents who react hyposensitively to this type of tactile sensory input. Children without developmental disabilities show in 6.67% of cases a mixed type of tactile sensory response. Children without developmental difficulties have a normal sensory response in 93.33% of cases.

For the variable *„Trying new foods"*, 20% of children with Down syndrome have a normal sensory response. The largest percentage of children, 53.33%, react hypersensitively. From baseline, 20% of children have a mixed type of tactile sensory response, and 6.67% of children are hyposensitive. Children without developmental disabilities show in 93.33% of cases a mixed type of tactile sensory response. Children without difficulties have a normal sensory response in 6.67% of cases.

For the variable *„Sensation of certain foods in the mouth (e.g., dry, crumbly, smooth ...)"* 20% of children with Down syndrome have a normal sensory response. Most children, 53.33% of them have a hypersensitivity reaction, 20% of children have a mixed type of tactile sensory response, and 6.67% of children are hyposensitive. Children without developmental difficulties show in 73.33% of cases a mixed type of tactile sensory response, and 13.33% are hypersensitive. Children without developmental difficulties have a normal sensory response in 13.33% of cases.

Normal tactile sensory response has 40% of children with Down syndrome for the variable *„Standing close to other people"*. From baseline, 40% of children have a mixed type of tactile sensory response, and 13.33% of children are hypersensitive, while 6.67% are hyposensitive. Children without developmental disabilities show a mixed type of tactile sensory response in 60% of cases, and 6.67% are hypersensitive. Children without developmental difficulties have a normal sensory response in 33.33% of cases.

Most children with Down syndrome, 66.67% of them have a normal sensory response to the variable *„Walking barefoot"*. From total, 20% of children have a mixed type of tactile sensory response, and 13.33% of children are hypersensitive. There are no respondents who react hyposensitively to this type of tactile sensory input. Children without developmental disabilities show in 40% of cases a mixed type of tactile sensory response, and 13.33% are hypersensitive. Children without developmental difficulties have a normal sensory response in 46.67% of cases.

Based on the total frequencies and percentages of responses to all variables of the measurement instrument, it can be concluded that children with Down syndrome and children without developmental difficulties have difficulties with sensory integration of the tactile sensory system. It can also be stated

that children with Down syndrome have greater difficulties in sensory integration of the tactile sensory system compared to their peers, children without developmental difficulties. From total, 33.33% of children with Down syndrome and 53.33% of children without developmental disabilities have normal sensory integration of the tactile sensory system. Also, 26.67% of children with Down syndrome and 6.67% of children without difficulties are hypersensitive. There is no difference in the prevalence of difficulties in the hyposensitive type of tactile sensory response between children with Down syndrome and children without developmental disabilities, the prevalence is 6.67%. It can also be stated that there is no difference in the prevalence of mixed-type sensory response difficulties between children with Down syndrome and children without developmental disabilities, the prevalence is 33.33%.

3.2. Differences in the prevalence of sensory integration difficulties of the tactile sensory system between children with Down syndrome and children without difficulties

Table 2. Differences in the prevalence of sensory integration difficulties of the tactile sensory system between children with Down syndrome and children without developmental disabilities

Variables	Subsample	N	Rank M	Sum of ranks
1. Touching some parts of the body, hugs and caresses	Down syndrome	15	12.63	189.50
	Children without difficulties	15	18.37	275.50
	Total	30		
2. Certain types of fabric, seams, labels, belts, cuffs, etc.	Down syndrome	15	15.70	235.50
	Children without difficulties	15	15.30	229.50
	Total	30		
3. Clothing, footwear or embellishments that are very narrow or very loose	Down syndrome	15	14.60	219.00
	Children without difficulties	15	16.40	246.00
	Total	30		
4. Contamination of hands, face or other parts of the body with paint, glue, sand, food, lotion	Down syndrome	15	14.17	212.50
	Children without difficulties	15	16.83	252.50
	Total	30		
5. Hygienic activities such as washing face and washing hair, combing, cutting nails, brushing teeth	Down syndrome	15	10.37	155.50
	Children without difficulties	15	20.63	309.50
	Total	30		
6. Bathing, showering or swimming	Down syndrome	15	11.33	170.00
	Children without difficulties	15	19.67	295.00
	Total	30		
7. Towel drying	Down syndrome	15	11.87	178.00

	Children without difficulties	15	19.13	287.00
	Total	30		
8. Trying new foods	Down syndrome	15	11.90	178.50
	Children without difficulties	15	19.10	286.50
	Total	30		
9. Sensation of certain foods in the mouth (e.g., dry, crumbly, smooth ....)	Down syndrome	15	12.67	190.00
	Children without difficulties	15	17.50	245.00
	Total	30		
10. Standing close to other people	Down syndrome	15	15.33	230.00
	Children without difficulties	15	15.67	235.00
	Total	30		
11. Walking barefoot	Down syndrome	15	16.80	252.00
	Children without difficulties	15	14.20	213.00
	Total	30		

With an insight into the ranks of representation matrices of differences in tactile sensory integration difficulties between children with Down syndrome and children without developmental disabilities, it can be concluded ***that children with Down syndrome show better results of sensory integration of tactile sensory system on two variables; „Walking barefoot" and „Certain types of fabric, seams, labels, belts, cuffs, etc.". On all other variables of the measurement instrument, children with Down syndrome show poorer results of sensory integration of the tactile sensory system.***

Based on the analysis of frequencies and percentages of tactile sensory integration difficulties (Table 1) and differences in tactile sensory integration difficulties (Table 2) between children with Down syndrome and children without developmental disabilities, it can be concluded ***that there is a difference in the sensory integration of the tactile sensory system between children with Down syndrome and children without difficulties.***

In the further analysis, it was checked whether this difference was statistically significant at the level of statistical significance of $p < 0.05$.

Table 3. Statistical significance of differences in the prevalence of sensory integration difficulties between children with Down syndrome and children without developmental disabilities

Variables	Mann-Whitney U	Wilcoxon W	Z	P
1. Touching some parts of the body, hugs and caresses	69.500	189.500	-1.894	0.058
2. Certain types of fabric, seams, labels, belts, cuffs, etc.	109.500	229.500	-.133	0.894
3. Clothing, footwear or embellishments that	99.000	219.000	-.594	0.552

	are very narrow or very loose				
4.	Contamination of hands, face or other parts of the body with paint, glue, sand, food, lotion	92.500	212.500	-.922	0.357
5.	Hygienic activities such as washing face and washing hair, combing, cutting nails, brushing teeth	35.500	155.500	-3.655	0.000
6.	Bathing, showering or swimming	50.000	170.000	-3.104	0.002
7.	Towel drying	58.000	178.000	-2.802	0.005
8.	Trying new foods	58.500	178.500	-2.431	0.015
9.	Sensation of certain foods in the mouth (e.g., dry, crumbly, smooth ....)	70.000	190.000	-1.643	0.00
10.	Standing close to other people	110.000	230.000	-.114	0.909
11.	Walking barefoot	93.000	213.000	-.910	0.363

The results of the Mann-Whitney U test and the Wilcoxon W test indicate ***that there is a statistically significant difference at the level of statistical significance of p<0.05 between children with Down syndrome and children without developmental disabilities on 5 variables; „Hygienic activities such as washing and washing hair, combing, cutting nails, brushing teeth“, „Bathing, showering or swimming“, „Towel drying“, „Sensation of certain foods in the mouth (e.g. dry, crumbly, smooth .....)“ and „Trying new foods“. No statistically significant difference was found in other variables of the measurement instrument between children with Down syndrome and children without developmental difficulties in the sensory integration of the tactile sensory system.***

Similar studies

Children with Down syndrome may be hypersensitive and hyposensitive to touch as a result of difficulties in sensory integration or the ability to receive and absorb accurate sensory information from the environment, their coordination and integration. Children with Down syndrome very often avoid and resist when bathing, cutting and combing, often have sensory difficulties in processing sensations in the mouth, hypersensitivity to touch and stimulation around the face that make feeding difficult (10).

The results of study conducted by Chen and Fang showed that children with Down syndrome have a sensory deficit in terms of tactile perception (11).

Bruni et al. conducted a study on the sensory processing of children with Down syndrome aged 3 to 10 years. The results of the study showed that children with Down syndrome react, either typically enjoying sensory play, or hyposensitively by seeking tactile input by touching people or objects (12).

Jaarsveld, Rooyen, Biljo et al. conducted a study on a sample of 15 children with Down syndrome in South Africa. The aim of the research was to examine sensory processing, practice and related social participation. The age of the respondents ranged from 5 to 12 years. The results of the research showed that 93.3% of respondents have difficulties with sensory integration. Children with Down syndrome showed vulnerability to touch, and one child had no tactile sensory system difficulties. Children with Down syndrome prefer to

touch someone rather than be touched (13).

4. CONCLUSION

Difficulties with sensory integration of the tactile sensory system have 66.67% of children with Down syndrome and 46.67% of children without developmental difficulties have. Hypersensitive are 26.67% of children with Down syndrome and 6.67% of children without difficulties. There is no difference in the prevalence of difficulties in the hyposensitive type of tactile sensory response between children with Down syndrome and children without developmental disabilities, the prevalence is 6.67%. There is no difference in the representation of difficulties even with the mixed type of tactile sensory response, the representation is 33.33%.

Children with Down syndrome compared to children without developmental difficulties show better results of sensory integration of the tactile sensory system on two variables; „Walking barefoot“ and „Certain types of fabric, seams, labels, belts, cuffs, etc.“. On all other variables of the measurement instrument, children with Down syndrome show poorer results of sensory integration of the tactile sensory system.

Children with Down syndrome have poorer sensory integration of the tactile sensory system compared to children without difficulties. There is a statistically significant difference at the level of statistical significance of $p<0.05$ between children with Down syndrome and children without developmental disabilities on 5 variables; „Hygienic activities such as washing and washing hair, combing, cutting nails, brushing teeth“, „Bathing, showering or swimming“, „Towel drying“, „Sensation of certain foods in the mouth (e.g., dry, crumbly, smooth ....)“ and „Trying new foods“. No statistically significant difference was found in other variables of the measurement instrument between children with Down syndrome and children without developmental difficulties in the sensory integration of the tactile sensory system.

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