

TACTILE AND HEARING SENSITIVITY OF CHILDREN WITH AND WITHOUT AUTISM USING THE SENSORY PROFILE AND DSM-5

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Background: Children with autism in their characteristics show a series of unusual reactions to stimuli in all areas of the sensory system.

Aim: The aim of this paper was to compare the tactile and auditory processes, i.e. to determine the deficits of these processes by children with autism spectrum disorder (Diagnostic and Statistical Manual of Mental Disorders, 5th ed.) in relation to children with intellectual disabilities and children of the typical population.

Methods: The sample consisted of a total of 105 children. During the survey, the method of proportional stratified sample was used and the data collection was carried out in 2017 on the entire territory of Bosnia and Herzegovina. Short Sensory Profile was applied (Dunn, 1999) and through 13 items, Tactile Perception and Hearing Perception were examined.

Results: It was found that 71.4% of children with autism had significant difficulties in the area of tactile perception and 65.7% in the area of hearing perception. Tactile and hearing sensitivity is also common by children with intellectual disabilities, which undermines the inclusion of the difficulty of sensory processing as a key diagnostic criterion for autism.

Keywords: autism, tactile sensitivity, hearing sensitivity, DSM-V.

INTRODUCTION

Everything we do requires sensory integration and when it comes to sensory data, it refers to the information that comes in tactile, vestibular, proprioceptive, auditory, visual and oral-gustatory systems (1). In one word, we can say that the world is experiencing the senses and the way in which sensory input and processing is carried out is reflected directly on our behaviour and learning.

Children with autism in their characteristics show a whole series of unusual reactions to stimuli in the area of tactile, auditory, visual and olfactory, vestibular and perceptive systems. Reports show that more than 96% of children with autism are hyper or hyposensitive in multiple domains, communication, social deficits, and sensory behavioural differences ranging from mild to severe. Although sensory hypersensitivity is not unique only to children with autism, it is more common in this population than in other populations. Studies of the comparison of the pattern of the sensory processes of children with autism or other pervasive developmental disorders with the control group of the typical population revealed the essential differences in the profile of

the sensory processes of children with autism. These result clearly showed that dysfunction of sensory processes is one of the key characteristics of autism (2).

Some children with autism are described as sensitively insensitive or have a high threshold in response to stimuli (3), while they may be hypersensitive to sounds, others may look like deaf, as a consequence of the problem of sensory processing (4). Recent research has reported that a high percentage of children with autism show unusual responses to sensory experiences, compared to the responses offered by typically developing children with the same chronological age (5). These difficulties affect the entire spectrum, so that the greater the sensory dysfunction, the greater the severity of the autism symptomatology (6) and they are present from toddlers to adults (7).

The latest version of the DSM has included a typical sensory responsiveness or unusual interests in sensory aspects of the environment as one of four possible elements of which two must be met in Criterion B, which combined with persistent deficits in social communication and interaction across multiple contexts, define autism spectrum disorder (8). However,

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the enhanced or reduced response to external stimuli, as a new criterion in DSM-V for the diagnosis of autism, also occurs in intellectual and other developmental difficulties (9). This is a relatively new issue both in research and in clinical practice involving the sensory deficit of children with autism as one of the key or primary criteria for diagnosing and distinguishing from other pervasive developmental disorders.

In Bosnia and Herzegovina, there is no significant research on the tactile and hearing sensitivity of children with autism, and in this study we set out the following goal to examine the proportion of individuals with hyper- or hypo-reactivity to the sensory input of tactile and auditory inputs, in accordance with the DSM-V criterion and to determine the deficiencies of these processes by children with autism in relation to children with intellectual disabilities and children of the typical population.

METHODS

The sample of respondents consisted of children with autism, children with intellectual disabilities and children of typical development aged 3-8 year. The sample consisted of a total of 105 children divided into three groups: 35 autistic children, 35 children with intellectual disabilities, and 35 children of typical development who were included as a control sample. During the research, a proportional stratified sample method was used.

The empirical part of the study required the collection of primary data, which was done by the method of

testing using the Short Sensory Profile questionnaire (10) and two sensible areas were examined through 13 items: Tactile perception (7 items) and Hearing perception (6 items). For each item, a choice of five answers on the Likert scale was used: 1-always, 2-often, 3-occasionally, 4-rarely, 5-never. The assessment was carried out individually with each student in 2017 by observation method.

In order to respect the ethical principles of the research, during the examination, each respondent was informed in detail about the purposes of the collected data; individuals were examined only with the personal approval of the parent / guardian, and an adequate level of anonymity was ensured in order to protect their privacy. The data were collected by the method of observation of subjects during everyday activities in kindergarten or at home or during the treatment. The data collected were processed in the SPSS 20 statistical program and a single-factor analysis of ANOVA variance and the Tukey HSD test was applied.

RESULTS AND DISCUSSION

The first aim of the study was to examine the structure of tactile and hearing sensitivity of children with autism, children with intellectual disabilities, and children of typical development. This aim is realized through the analysis of a five-point scale, and we have the tables and graphs presented and explained to both coverage areas.

Table 1 presents the frequencies and percentages of the questionnaire for the area of tactile perception for all three groups of respondents.

Table 1. Distribution according to tactile sensitivity

		Always	Often	Occasion-ally	Rarely	Never	Total
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Expressions of trouble during titivation (e.g., face washing, hair cutting, nail cutting)	A	4 (11,4)	14 (40)	11 (31,4)	3 (8,6)	3 (8,6)	35 (100)
	ID	4 (11,4)	6 (17,1)	11 (31,4)	5 (14,3)	9 (25,7)	35 (100)
	C	0 (0)	1 (2,9)	2 (5,7)	16 (45,7)	16 (45,7)	35 (100)
Prefers wearing a long sleeve shirt when it's warm and a short-sleeved T-shirt when it's cold	A	6 (17,1)	4 (11,4)	2 (5,7)	6 (17,1)	17 (48,6)	35 (100)
	ID	2 (5,7)	2 (5,7)	4 (11,4)	7 (20)	20 (57,1)	35 (100)
	C	1 (2,9)	0 (0)	0 (0)	4 (11,4)	30 (85,7)	35 (100)
Avoids walking barefoot especially on sand or grass	A	3 (8,6)	3 (8,6)	8 (22,9)	8 (22,9)	13 (37,1)	35 (100)
	ID	5 (14,3)	3 (8,6)	3 (8,6)	8 (22,9)	16 (45,7)	35 (100)
	C	4 (11,4)	0 (0)	0 (0)	16 (45,7)	14 (40)	35 (100)

		Always	Often	Occasion-ally	Rarely	Never	Total
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Emotionally or aggressively reacts to a touch	A	1 (2,9)	5 (14,3)	8 (22,9)	11 (31,4)	10 (28,6)	35 (100)
	ID	0 (0)	5 (14,3)	5 (14,3)	5 (14,3)	20 (57,1)	35 (100)
	C	0 (0)	3 (8,6)	2 (5,7)	2 (5,7)	28 (80)	35 (100)
Avoids spraying with water	A	1 (2,9)	13 (37,1)	8 (22,9)	6 (17,1)	7 (20)	35 (100)
	ID	3 (8,6)	5 (14,3)	5 (14,3)	8 (22,9)	14 (40)	35 (100)
	C	1 (2,9)	1 (2,9)	1 (2,9)	12 (34,3)	20 (57,1)	35 (100)
Has difficulty standing in line or close to other people	A	4 (11,4)	15 (42,9)	7 (20)	4 (11,4)	5 (14,3)	35 (100)
	ID	1 (2,9)	6 (17,1)	9 (25,7)	5 (14,3)	14 (40)	35 (100)
	C	0 (0)	0 (0)	2 (5,7)	1 (2,9)	32 (91,4)	35 (100)
Rubs or scratches the place where he/she was touched	A	5 (14,3)	6 (17,1)	9 (25,7)	3 (8,6)	12 (34,3)	35 (100)
	ID	2 (5,7)	0 (0)	9 (25,7)	5 (14,3)	19 (54,3)	35 (100)
	C	0 (0)	1 (2,9)	2 (5,7)	3 (8,6)	29 (82,9)	35 (100)

Legend: A- children with autism, ID- children with intellectual disabilities and C- control group

By analysing the total response pool for tactile perception of children with autism, the highest percentage of responses consisted of answers for never 27.3%, often 24.5%, occasionally 21.6%, rarely 16.7%, and the answer always as the lowest response respondents chose 9.8%. By children with intellectual disabilities, the highest percentage of responses consisted in the answer never 45.7%, then occasionally 18.8%, rarely 17.6%, often 11%, and the answer always was the answer that the respondents least selected 6.9%, while by children of typical developmental, the highest percentage of responses is never 69%, then rarely 22%, occasionally 4.1%, often and always

2.4%. By analysing the response to tactile perception, we can notice that children with autism had the most pronounced difficulties on variables „Prefers wearing a long sleeve shirt when it’s warm and a short-sleeved T-shirt when it’s cold“, „Rubs or scratches the place where he/she was touched“, „Expressions of trouble during titivation (e.g., face washing, hair cutting, nail cutting)“, and „Has difficulty standing in line or close to other people“.

By children with intellectual disabilities, difficulties are most pronounced on variables „Expressions of trouble during titivation (e.g., face washing, hair cutting, nail cutting)“ and „Has difficulty standing in line or close to

Table 2. Descriptive data for the area of tactile sensitivity

Subsamples	N	Minimum	Maximum	Arithmetic mean	Standard deviation
Children with autism	35	13	34	22,91	5,506
Children with intellectual disabilities	35	16	35	26,89	5,661
Children of typical development	35	20	35	31,69	3,350
Total	35	13	35	27,16	4,839

other people“ while by children of typical development the greatest difficulties can be noticed on the particle „Avoids walking barefoot especially on sand or grass“, which can be brought in the context of the modern overstretching attitude of the parents.

Table 2 gives the descriptive attitudes of the respondents' views on the Short Sensory Profile: the number of respondents in the group (N), minimum, maximum, the arithmetic mean, and the standard deviation, where the lower results indicate higher sensitivity.

Table 3. Collective data for the area of tactile sensitivity

Subsamples	Typical characteristics	Probable difference	Significant difference	Total
	20-15	14-12	11-4	
	n (%)	n (%)	n (%)	n (%)
Children with autism	5 (14,3)	5 (14,3)	25 (71,4)	35 (100)
Children with intellectual disabilities	13 (37,1)	5 (14,3)	17 (48,6)	35 (100)
Children of typical development	27 (77,1)	6 (17,2)	2 (5,7)	35 (100)

Table 3 presents frequencies and percentage deviations in relation to the normal range (typical characteristics) for the area of tactile perception. Analyzing the results of a group of children with autism of 25 subjects (71.4%), a significant difference was found, i.e. the achieved score ranges from 7 to 26. In 5 respondents (14.3%), a probable difference was determined, i.e. the score is in the range of 27 to 29, while the score of 13 examinees ranges from 30 to 35, which represents typical characteristics.

By 17 subjects with intellectual disabilities (48.6%), a significant difference was identified according to instrument standards and classification of raw scores, i.e.

the achieved score ranges from 7 to 26. By 5 respondents (14.3%), a probable difference was determined, i.e. the score is in the range of 27 to 29, while the score of 13 examinees ranges from 30 to 35, which represents typical characteristics.

Analyzing the results of a group of children of typical development (2 subjects) (5.7%), a significant difference was found, i.e. the score is in the range of 7 to 26. By 6 subjects (17.2%), a probable difference was determined, i.e. the score is in the range of 27 to 29, while the score of 27 examinees ranges from 30 to 35, which represents typical characteristics.

Table 4. Distribution according hearing sensitivity

		Always	Often	Occasion-ally	Rarely	Never	Total
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
If a lot of noise is present he/she is disturbed or has problems in functioning	A	6 (17,1)	7 (20)	9 (25,7)	4 (11,4)	9 (25,7)	35 (100)
	ID	4 (11,4)	8 (22,9)	10 (28,6)	3 (8,6)	10 (28,6)	35 (100)
	C	0 (0)	2 (5,7)	3 (8,6)	9 (25,7)	21 (60)	35 (100)
He/she does not seem to hear what is being said to him (he does not turn on when you speak, he ignores you)	A	8 (22,9)	9 (25,7)	6 (17,1)	6 (17,1)	6 (17,1)	35 (100)
	ID	2 (5,7)	7 (20)	14 (40)	6 (17,1)	6 (17,1)	35 (100)
	C	0 (0)	3 (8,6)	5 (14,3)	6 (17,1)	21 (60)	35 (100)
Cannot work with background noise (fan, air conditioning)	A	4 (11,4)	3 (8,6)	14 (40)	5 (14,3)	9 (25,7)	35 (100)
	ID	4 (11,4)	3 (8,6)	10 (28,6)	4 (11,4)	14 (40)	35 (100)
	C	1 (2,9)	0 (0)	4 (11,4)	5 (14,3)	25 (71,4)	35 (100)

		Always	Often	Occasionally	Rarely	Never	Total
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Has a problem solving a task when the radio is on	A	3 (8,6)	3 (8,6)	14 (40)	5 (14,3)	10 (28,6)	35 (100)
	ID	3 (8,6)	5 (14,3)	7 (20)	5 (14,3)	15 (42,9)	35 (100)
	C	2 (5,7)	0 (0)	4 (11,4)	7 (20)	22 (62,9)	35 (100)
He does not answer when someone calls his name, but you are sure his hearing is okay	A	5 (14,3)	9 (25,7)	8 (22,9)	6 (17,1)	7 (20)	35 (100)
	ID	3 (8,6)	4 (11,4)	14 (40)	7 (20)	7 (20)	35 (100)
	C	0 (0)	1 (2,9)	3 (8,6)	8 (22,9)	23 (65,7)	35 (100)
There are difficulties in maintaining attention	A	14 (40)	8 (22,9)	5 (14,3)	2 (5,7)	6 (17,1)	35 (100)
	ID	10 (28,6)	8 (22,9)	9 (25,7)	3 (8,6)	5 (14,3)	35 (100)
	C	0 (0)	2 (5,7)	5 (14,3)	4 (11,4)	24 (68,6)	35 (100)

Legend: A- children with autism, ID- children with intellectual disabilities and C- control group

By analyzing the overall collection of answers for the area of hearing perception of children with autism, the highest percentage of responses consisted of answers occasionally 26.7%, then responses never 22.4%, always 19% and often 18.6% and the answer rarely had the lowest score that the respondents chose 13.3%. By children with intellectual disabilities, the highest response rate is occasionally 30.5% then never 27.1%, often 16.7%, rarely 13.3%, and then the answer always as the lowest response. By children of typical development, the highest percentage of responses is never 64.8%, followed by rarely 18.6%, occasionally 11.4%, often 3.8% and always 1.4%.

By analyzing the response in the field of hearing perception, we can notice that children with autism had the most pronounced difficulties on particles „There are

difficulties in maintaining attention“ with percentage of 40% “always” responses , „He/she does not seem to hear what is being said to him (he does not turn on when you speak, he ignores you)“ with percentage of 22,9% “always” responses and „He does not answer when someone calls his name, but you are sure his hearing is okay“ with percentage of 14,3% “always” responses. By children with intellectual disabilities the most varied difficulties are on particles „There are difficulties in maintaining attention “with percentage of 28,6% “always” responses and „If a lot of noise is present he/she is disturbed or has problems in functioning“ with percentage of 11,4% “always” responses. While by children of typical development the greatest difficulties can be noticed on the particle „Has a problem solving a task when the radio is on “with percentage of 5,7% “always” responses.

Table 5. Descriptive data for the area of hearing sensitivity

Subsamples	N	Minimum	Maximum	Arithmetic mean	Standard deviation
Children with autism	35	10	29	18,09	4,990
Children with intellectual disabilities	35	9	28	19,57	4,698
Children of typical development	35	19	30	26,49	4,111
Total	105	9	30	21,38	4,599

Table 5 gives the descriptive data of the respondents’ views on the Short Sensory Profile Questionnaire: the number of respondents in the group (N), minimum, maximum, the arithmetic mean, and the standard deviation.

Table 6. Collective data for the area of hearing sensitivity

Subsamples	Typical characteristics	Probable difference	Significant difference	Total
	20-15	14-12	11-4	
	n (%)	n (%)	n (%)	n (%)
Children with autism	7 (20)	5 (14,3)	23 (65,70)	35 (100)
Children with intellectual disabilities	8 (22,9)	8 (22,9)	19 (54,20)	35 (100)
Children of typical development	28 (80)	2 (5,7)	5 (14,3)	35 (100)

By analyzing the obtained scores in Table 6, the frequencies and percentage deviations relative to the normal range (typical characteristics) for the hearing perception are presented.

By 23 subjects with autism (65.7%), a significant difference was found, i.e. the achieved score is in the range of 6 to 19 according to instrument norms of typical performance. By 5 respondents (14.3%), a probable difference was determined, i.e. the score is in the range of 20 to 22, while the score of 7 examinees ranges between 23 and 30, which represents typical characteristics. By 19 subjects with intellectual disabilities (54.2%), a significant difference was determined, i.e. the score is in the range of 6 to 19. By 8 subjects (22.9%), a probable difference is determined, i.e. the score is in the range of 20 to 22, while the score of 8 examinees ranges between 23 and 30, which represents typical characteristics. By 5 typical development respondents (14.3%), a significant difference was found, i.e. the achieved score is in the range of 6 to 19. In the case of 2 respondents (5.7%), a probable difference was determined, i.e. the score is in the range of 20 to 22, while the score of 28 subjects ranges between 23 and 30, which represents typical characteristics.

With single-factor analysis in relation to the type of difficulties of children in the area of hearing perception, the largest statistically significant difference was found at the level of $p < 0,05$: $F = 33,029$ with $p = 0,0001$. By analyzing the descriptive data for this area, it is notable that the arithmetic mean of attitudes of children with autism is 18,09, the arithmetic mean of children with intellectual disabilities is 19,57, and the arithmetic mean of children of typical development is 26,49, which indicates that children with autism have the greatest deficit. *In the area of tactile perception, a statistically significant difference was found at $p < 0.05$: $F = 27.528$ with $p = 0.0001$. By analysing the descriptive data for this area, it is notable that the arithmetic mean for children with autism is 22.91, the arithmetic mean for children with intellectual disabilities is 26.89, and the arithmetic mean for children of typical development is 31.69, which indicates that autistic children have the biggest deficit in the area of tactile perception. By using a post hoc test, the Tukey HSD test statistical significance was established between the group of*

children with disorder of autism spectrum and children of typical development ($F = 44,200$, $p = 0.000$), as well as the group of children with intellectual disabilities and children of typical development ($F = 35,829$, $p = 0.000$). In the case of children with autism, the greatest deficit of the observed processes was determined in relation to children with intellectual disabilities ($F = 44,200$, $p = 0.000$. and children of typical development ($F = 35,829$, $p = 0.000$).

DISCUSSION

Similar results were found in the study of the sensory processes of children with autism and children of typical development, where it was found that 95% of children with autism vs. 16.8% of children of typical development show certain difficulties in the sensory processes (11). Furthermore, Dalgrin and Gillberg state that sensitivity to childhood stimulus is a powerful discriminator between children with and without autism (12). Some earlier studies by Ornitz and associates point out that sensory modulation affects more than 70% of children under 6 years of age with autism, as confirmed by our research (13, 14). Similar data, including no sound response (81%) and sensitivity to loud sounds (53%) were received by Volkmar and associates (15).

On the other hand, children with autism do not differ much from children with intellectual disabilities, where we can see that both groups have much more symptoms of tactile and hearing sensitivity than children of typical development. However, McCormick et al (7) state that children with autism have much more severe hearing difficulties than children with other developmental difficulties. The results of the cross-sectional study suggest that children with autism and ADHD show similarities in sensory processing patterns (i.e., avoiding, sensitivity, registration, seeking), which were elevated as compared to a typical development group. With regard to sensory systems, children with autism showed the highest rate of oral processing differences, followed by ADHD and typical development (5). Compared to the children with other developmental disabilities more children with autism scored within the definite difference range on at least one hyper-reactive domain on the SSP (Short Sensory profile). Hyper-reactivity to the sensory environment was more

common among the autism group compared to the children with other developmental disabilities group for tactile, taste/ smell and visual/auditory sensitivity. Regarding hyposensitivity, a greater proportion of the autism group compared to the children with other developmental disabilities group, scored within the definite difference on the SSP auditory filtering subscale (9). Linke et al. examined the relationship between auditory processing, interhemispheric and thalamocortical network connectivity on a sample of 40 children with autism and 38 children of typical development, and the severity of symptoms of social behaviour (16). They found that atypical sound processing is associated with social, cognitive, and communicative impairments. In addition, the weight of the debilitating sensory process and lower verbal IQ were associated with decreased interhemispheric connectivity of auditory cortices in autism.

CONCLUSION

The results of our research indicate that in the case of children with autism, a statistically significant deficit of

the observed processes was found in relation to children with intellectual disabilities and children of typical development. It was found that 71.4% of children with autistic spectrum disorders have significant difficulties in the area of tactile perception and 65.7% in the area of hearing perception, compared to 48.6% and 54.2% of children with intellectual disabilities. This result does not differ from the results achieved in other studies. Also, qualitative analysis indicates very similar difficulties of tactile and hearing sensitivity between the two observed groups of children with developmental disabilities. Our results support the inclusion of tactile and hearing sensitivity as an atypical sensory response to injection from the environment in the DSM-V diagnostic criteria, but also emphasize that they are not unique to children with autism in relation to intellectual disabilities. This requires great caution when setting diagnosis and it is still recommended that other characteristics of autism have to be taken into account during clinical identification and treatment itself. We can conclude that dysfunction of sensory integration cannot be taken as a key diagnostic criterion, but rather as an additional criterion in diagnosing autism.

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