DIFFICULTIES OF SENSORY INTEGRATION OF THE TACTILE SENSORY SYSTEM OF CHILDREN WITH VISUAL IMPAIRMENT

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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 arrives in 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 them. Visual impairment affects the overall development of the child. Limitations arise regarding interpretation and integration of sensory stimuli, localization of tactile stimuli, emotional attachment, self-confidence, communication, and fine and gross motor skills... A blind child learns about objects and their characteristics through tactile perception. The study aims to examine the prevalence of sensory integration difficulties of the tactile sensory system of children with visual impairment 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 visual impairment, 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 responses, 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 examine the statistical significance of the differences between the subsamples of subjects. The study results show that children with visual impairment have poorer sensory responses except for the mixed type of tactile sensory response, which shows the same results. Poor sensory integration is shown on all variables of the instrument except on the variables „Certain types of fabric, seams, labels, belts, cuffs, etc.“ and „Standing close to other people“, where children with visual impairment show better sensory integration, but this difference is not statistically significant at the level of statistical significance of p<0.05.

KEYWORDS sensory integration, tactile sensory system, visual impairment, children with disabilities, children without disabilities

Introduction

Sensory integration represents the organization of the sense for 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] on the skin and throat, ear canals, and digestive tract... [2]. Most tactile receptors are located in the mouth and hands [5]. The first role of touch in a
child’s life is to establish a connection between the mother and the infant, which 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]. Visual impairment is a condition that refers to various major or minor difficulties and problems in the field of visual perception [8]. Visual impairment affects the overall development of the child. Touch and other skin sensations are important pieces of information about the outside world. As a landmark, the child uses different textures of materials, which help it to know where it is at all times with the help of tactile perception [9]. Limitations arise regarding interpretation and integration of sensory stimuli, localization of tactile stimuli, emotional attachment, self-confidence, communication, and fine and gross motor skills... [10].

The study aims to examine the prevalence of sensory integration of the tactile sensory system of children with visual impairment and to determine the statistical significance of differences concerning children without developmental disabilities.

Methods 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 Visual Impairment. The second subsample of respondents (N=15) consisted of children without disabilities.

Type of Study 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 responses; neutral, avoid, seeks and mixed. Data were collected by observing students and interviewing rehabilitators, teachers and parents of students.

Statistical data analysis
Statistical data analysis 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 Visual impairment 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.

Results
Analysis of frequencies and percentages in subsamples of respondents
Review of Table 1, and based on the analysis of frequencies and percentages of respondents’ responses for the variable „Touching certain parts of the body, hugs and caresses” shows that in children with visual impairment, 53.3% have a neutral sensory response or normal sensory integration. Mixed type of tactile sensory response has 20% of children, and the same number are hypersensitive. Hypersensitive are 6.67% of children. In 60% of cases, children without developmental difficulties show a normal tactile sensory response. Mixed type of reaction has 20% of children, 13.33% are hypersensitive and 6.67 are hyposensitive.

For the variable „Certain types of fabric, seams, labels, belts, cuffs, etc.” the majority of 73.33% of visually impaired children have normal sensory integration. A mixed type of tactile sensory response was observed in 13.33% of children, and the same number were hypersensitive. Children without developmental difficulties show normal tactile sensory response in 66.67% of cases. Mixed and hypersensitive type of tactile sensory response has 13.33%, and 6.67% is hyposensitive.

Normal sensory integration has 73.33% of children with visual impairment for the variable „Clothing, footwear or jewelry that is very narrow or very loose”. Mixed type of tactile sensory response has 13.33%, and the same number are hypersensitive. There are no subjects with a hyposensitive reaction. Children without developmental disabilities show normal tactile sensory response in 80% of cases, and 20.00% of children have a mixed type of tactile sensory response.

For the variable „Contamination of hands, face or other parts of the body with paint, glue, sand, food, lotion”, 66.67% of children with visual impairment have a normal tactile sensory reaction. Mixed tactile sensory response has 26.67%, while 6.67% of children have a hypersensitivity reaction. No subjects react hyposensitivity to this type of tactile sensory input. Children without developmental disabilities show normal tactile sensory response in 80% of cases, and 13.33% of children have a mixed type of tactile sensory response. Hyposensitive are 6.67% of children.

For the variable „Hygienic activities such as washing face and washing hair, combing, cutting nails, brushing teeth”, 60% of children with visual impairment have a neutral tactile sensory reaction. The mixed type of tactile sensory response has 26.67%, and 6.67% of children are hypersensitive and hyposensitive. Children without developmental disabilities show in 86.67% of cases a normal tactile sensory response, and 13.33% of children have a mixed type of tactile sensory response.

For the variable „Bathing, showering or swimming” a large percentage of children with visual impairment, 66.67% have a neutral tactile sensory response. Mixed type of tactile response has 13.33% of respondents, and the same number is hyposensitive. Hypersensitive are 6.67% of children with visual impairment. Children without developmental disabilities show in 86.67% of cases a normal tactile sensory response, and 13.33% of children have a mixed type of tactile sensory response.

The normal sensory reaction has 73.33% of children with visual impairment for the variable “Towel drying”. A mixed type of tactile sensory response has 13.33% of children and 6.67% of children with visual impairment have a hypersensitive and hyposensitive reaction. Children without developmental disabilities show normal tactile sensory response in 93.33% of cases, and 6.67% of children have a mixed type of tactile sensory response.

For the variable “Trying new foods”, 60% of children with visual impairment have a normal sensory response. From baseline, 26.67% are hypersensitive, while 13.33% have a mixed type of tactile sensory response. There are no respondents who react hyposensitivity to this type of sensory input. Children without developmental disabilities show 60% of cases of normal tactile sensory response, and 26.67% of children have a mixed type of tactile sensory response. Hypersensitive is 13.3% of children.

For the variable “Sensation of certain foods in the mouth”, 60% of children with visual impairment have a neutral sensory response, i.e., normal sensory integration. A mixed type of tactile
| Variables                                                                 | Visual impairment |                                                                 | Children without developmental disabilities |                                                                 |
|--------------------------------------------------------------------------|-------------------|----------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------|
|                                                                          | Avoids N / %      | Seeks N / % | Mixed N / % | Neutral N / % | Avoids N / % | Seeks N / % | Mixed N / % | Neutral N / % |
| Touching some parts of the body, hugs and caresses                      | 1                 | 3          | 3          | 8             | 2              | 1          | 3          | 9             |
|                                                                          | 6.67              | 20.00      | 0.00       | 3.33          | 3.33           | 6.67       | 20.00      | 0.00          |
| Certain types of fabric, seams, labels, belts, cuffs, etc.               | 2                 | 0          | 2          | 11            | 2              | 1          | 2          | 10            |
|                                                                          | 3.33              | 0.00       | 13.33      | 73.33         | 3.33           | 6.67       | 3.33       | 66.67         |
| Clothing, footwear or embellishments that are very narrow or very loose  | 2                 | 0          | 2          | 11            | 0              | 0          | 3          | 12            |
|                                                                          | 13.33             | 0.00       | 3.33       | 73.33         | 0.00           | 0.00       | 20.00      | 80.00         |
| Contamination of hands, face or other parts of the body with paint, glue, sand, food, lotion | 1                 | 0          | 4          | 10            | 0              | 1          | 2          | 12            |
|                                                                          | 6.67              | 0.00       | 6.67       | 6.67          | 0.00           | 6.67       | 13.33      | 0.00          |
| Hygienic activities such as washing face and washing hair, combing, cutting nails, brushing teeth | 1                 | 1          | 4          | 9             | 0              | 0          | 2          | 13            |
|                                                                          | 6.67              | 6.67       | 6.67       | 0.00          | 0.00           | 0.00       | 3.33       | 86.67         |
| Bathing, showering or swimming                                          | 1                 | 2          | 2          | 10            | 0              | 0          | 2          | 13            |
|                                                                          | 6.67              | 13.33      | 13.33      | 6.67          | 0.00           | 0.00       | 13.33      | 86.67         |
| Towel drying                                                             | 1                 | 1          | 2          | 11            | 0              | 0          | 1          | 14            |
|                                                                          | 6.67              | 6.67       | 13.33      | 3.33          | 0.00           | 0.00       | 6.67       | 3.33          |
| Trying new foods                                                         | 4                 | 0          | 2          | 9             | 2              | 0          | 4          | 9             |
|                                                                          | 26.67             | 0.00       | 13.33      | 0.00          | 13.33          | 0.00       | 26.67      | 60.00         |
| Sensation of certain foods in the mouth (e.g., dry, crumbly, smooth)     | 2                 | 0          | 4          | 9             | 0              | 0          | 3          | 12            |
|                                                                          | 3.33              | 0.00       | 6.67       | 0.00          | 0.00           | 0.00       | 20.00      | 80.00         |
| Standing close to other people                                          | 1                 | 1          | 4          | 9             | 4              | 0          | 3          | 8             |
|                                                                          | 6.67              | 6.67       | 6.67       | 0.00          | 6.67           | 0.00       | 20.00      | 53.33         |
| Walking barefoot                                                         | 2                 | 2          | 2          | 9             | 2              | 2          | 4          | 7             |
|                                                                          | 3.33              | 13.33      | 13.33      | 60.00         | 13.33          | 3.33       | 6.67       | 46.67         |
| TOTAL                                                                    | 2                 | 1          | 3          | 9             | 1              | 0          | 3          | 11            |
|                                                                          | 13.33             | 6.67       | 20.00      | 0.00          | 6.67           | 0.00       | 20.00      | 73.33         |
Table 2 Differences in the prevalence of sensory integration difficulties of the tactile sensory system between children with visual impairment and children without developmental disabilities

| Variables                                                                 | Subsample              | N  | Rank M | Sum of ranks |
|--------------------------------------------------------------------------|------------------------|----|--------|--------------|
| Touching some parts of the body, hugs and caresses                       | Visual impairment      | 15 | 15.07  | 226.00       |
|                                                                          | Children without       | 15 | 15.93  | 239.00       |
|                                                                          | Total                  | 30 |        |              |
| Certain types of fabric, seams, labels, belts, cuffs, etc.               | Visual impairment      | 15 | 16.00  | 240.00       |
|                                                                          | Children without       | 15 | 15.00  | 225.00       |
|                                                                          | Total                  | 30 |        |              |
| Clothing, footwear or embellishments that are very narrow or very loose  | Visual impairment      | 15 | 14.80  | 222.00       |
|                                                                          | Children without       | 15 | 15.68  | 219.50       |
|                                                                          | Total                  | 30 |        |              |
| Contamination of hands, face or other parts of the body with paint,     | Visual impairment      | 15 | 14.37  | 215.50       |
| glue, sand, food, lotion                                                | Children without       | 15 | 15.68  | 219.50       |
|                                                                          | Total                  | 30 |        |              |
| Hygienic activities such as washing face and washing hair,              | Visual impairment      | 15 | 13.37  | 200.50       |
| combing, cutting nails, brushing teeth                                  | Children without       | 15 | 17.63  | 264.50       |
|                                                                          | Total                  | 30 |        |              |
| Bathing, showering or swimming                                          | Visual impairment      | 15 | 13.80  | 207.00       |
|                                                                          | Children without       | 15 | 17.20  | 258.00       |
|                                                                          | Total                  | 30 |        |              |
| Towel drying                                                             | Visual impairment      | 15 | 13.93  | 209.00       |
|                                                                          | Children without       | 15 | 17.07  | 256.00       |
|                                                                          | Total                  | 30 |        |              |
| Trying new foods                                                        | Visual impairment      | 15 | 15.10  | 226.50       |
|                                                                          | Children without       | 15 | 15.90  | 238.50       |
|                                                                          | Total                  | 30 |        |              |
| Sensation of certain foods in the mouth (e.g., dry, crumbly, smooth)     | Visual impairment      | 15 | 13.80  | 207.00       |
|                                                                          | Children without       | 15 | 17.20  | 258.00       |
|                                                                          | Total                  | 30 |        |              |
| Standing close to other people                                          | Visual impairment      | 15 | 16.47  | 247.00       |
|                                                                          | Children without       | 15 | 14.53  | 218.00       |
|                                                                          | Total                  | 30 |        |              |
| Walking barefoot                                                        | Visual impairment      | 15 | 15.23  | 228.50       |
|                                                                          | Children without       | 15 | 15.77  | 236.50       |
|                                                                          | Total                  | 30 |        |              |

Table 3 Statistical significance of differences in the representation of sensory integration difficulties between children with visual impairment and children without developmental disabilities

| Variables                                                                 | Mann-Whitney U | Wilcoxon W | Z     | P    |
|--------------------------------------------------------------------------|----------------|------------|-------|------|
| Touching some parts of the body, hugs and caresses                       | 106.000        | 226.000    | -3.30 | 0.074|
| Certain types of fabric, seams, labels, belts, cuffs, etc.              | 105.000        | 225.000    | -3.35 | 0.070|
| Clothing, footwear or embellishments that are very narrow or very loose | 102.000        | 222.000    | -5.90 | 0.555|
| Contamination of hands, face or other parts of the body with paint,     | 95.500         | 215.500    | -5.28 | 0.597|
| glue, sand, food, lotion                                                | 80.500         | 200.500    | -1.716| 0.086|
| Hygienic activities such as washing face and washing hair,              | 87.000         | 207.000    | -1.430| 0.153|
| combing, cutting nails, brushing teeth                                  | 89.000         | 209.000    | -1.503| 0.133|
| Bathing, showering or swimming                                          | 106.500        | 226.500    | -2.84 | 0.077|
| Towel drying                                                            | 87.000         | 207.000    | -1.317| 0.188|
| Trying new foods                                                        | 98.000         | 218.000    | -0.672| 0.502|
| Standing close to other people                                          | 108.500        | 228.500    | -1.88 | 0.061|

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sensory response has 26.67% of children, and 13.33% of children have a hypersensitive reaction. There are no subjects who react hyposensitively to this type of tactile sensory input. Children without developmental disabilities show normal tactile sensory response in 80% of cases, and 20% of children have a mixed type of tactile sensory response.

The normal tactile sensory response has 60% of children with visual impairment for the variable "Standing close to other people". 26.67% of children have a mixed type of tactile sensory response. The hypersensitive reaction has 6.67% of children, and the same number of children react hyposensitively to this tactile sensory input. Children without developmental disabilities show normal tactile sensory response in 53.33% of cases. 20% of children have a mixed type of tactile sensory response, and 26.67 are hypersensitive.

For most children with visual impairment, 60% of them have a normal sensory response to the variable "Walking barefoot". From baseline, 13.33% of children with visual impairment have a hypersensitive, hyposensitive and mixed type of tactile sensory response to this type of tactile sensory input. In 46.67% of cases, children without developmental difficulties show a normal tactile sensory response. However, from baseline, 26.67% of children have a mixed type of tactile sensory response, and 13.33% are hypersensitive and hyposensitive.

With an insight into the overall results of frequencies and percentages of respondents' responses to all variables of the measuring instrument, it can be stated that children with visual impairment and children without developmental difficulties have difficulties in the sensory integration of the tactile sensory system.

Children with visual impairment have poorer sensory integration compared to children without disabilities, except for the mixed type of tactile sensory response, where reactions of the tactile sensory system of children with visual impairment and children without disabilities are the same. 20% of children with visual impairment and children without difficulties have a mixed type of tactile sensory response. 60% of children with visual impairment and 73.33% of children without developmental disabilities have normal sensory integration of the tactile sensory system.

13.33% of children with visual impairment and 6.67% without disabilities have a hypersensitive sensory response.

6.67% of children with visual impairment have a hyposensitive sensory response, and there are no children without difficulties who react hyposensitively.

Differences in the prevalence of difficulties in the sensory integration of the tactile sensory system between children with visual impairments and children without developmental disabilities.

With an insight into the ranks of representation matrices of differences in difficulties of sensory integration of tactile sensory system between children with visual impairment and children without developmental disabilities, it can be concluded that there is a difference in sensory integration between respondents and that children with visual impairment show worse results, that is they have poorer sensory integration of the tactile sensory system in relation to children without disabilities, on all variables of the measuring instrument except on the variables "Certain types of fabric, seams, labels, belts, cuffs, etc.", and "Standing close to other people", where children with visual impairment show better sensory integration of the tactile system.

In the further analysis, it was checked whether this difference in the difficulties of sensory integration between children with visual impairment and children without developmental disabilities is statistically significant.

The results of the Mann-Whitney U test and the Wilcoxon W test show that there is no statistically significant difference at the level of statistical significance of p<0.05 in the sensory integration of the tactile sensory system between children with visual impairment and children without developmental disabilities on any variable of the measurement instrument.

Similar studies
There are almost no studies available in the field of sensory integration of children with visual impairment. Potić, Nedović and Sretenović (2020) also state a similar problem, where they point out that they do not find the study in the field of sensory integration in blind people. In their study "Specificity of the sensory profile of blind adolescents", the authors state that the lowest level of dysfunction exists in processing tactile stimuli (M=31.38), explaining that such a result was expected given the characteristics of the blind population. The author’s further state that blind people, in the absence of the sense of sight, rely on other sensory organs to function successfully. Tactile stimuli are of great importance for the organization of behaviour in blind people. The tactile sense plays an important role for blind children because it allows them to receive information from the outside world. Tactile-kinesthetic perception plays an important role in the child’s development and acquaintance with the environment surrounding it.

Conclusions
Children with visual impairment have poorer sensory integration of the tactile sensory system compared to children without disabilities, except for the mixed type of tactile sensory response, where reactions of the tactile sensory system of children with visual impairments and children without disabilities are the same. The mixed type of tactile sensory response has 20% of children with visual impairment and children without difficulties.

Normal sensory integration of the tactile sensory system has 60% of children with visual impairment and 73.33% without developmental disabilities.

Hypersensitive sensory response has 13.33% of children with visual impairment and 6.67% of children without disabilities.

From baseline, 6.67% of children with visual impairment have a hyposensitive sensory response, and there are no children without difficulties who react hyposensitively.

Children with visual impairment show poorer results or have poorer sensory integration of the tactile sensory system compared to children without disabilities on all variables of the measuring instrument except on the variables "Certain types of fabric, seams, labels, belts, cuffs, etc.", and "Standing close to other people", where children with visual impairment show better sensory integration of the tactile sensory system. Still, this difference is not statistically significant at the level of statistical significance of p<0.05.

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Conflict of interest

There are no conflicts of interest to declare by any of the authors of this study.

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