

ease Control and Prevention Center reports.² Sensory abnormalities are present almost over 90% of the diagnosed population.^{3,4}

As for Rutter and Shopler, almost half of the children with ASD have no functional language ability.⁵ Their speech, language and communication problems appear from early childhood and continue during their adult life.⁶ Children with ASD have difficulty in almost every modality of language (phonology, morphology, semantics, syntax, and pragmatics), as well as motor production of speech. One of the underlying reasons for social interaction problems in non-verbal autism is sensory processing/integration.⁷ One of the important things to keep in mind is that their level of communication is linked to their mental capacity, social development, early intervention, health and sensory processing capacity.⁸

To produce an intelligible speech, sensory integration is needed. As for generating a meaningful signal, one should be integrating visual and auditory stimuli and to understand speech in a loud environment, one should differentiate background noises from speech sounds.^{9,10}

When there is sensory-motor integration impairment, motor movements can not be precise.¹¹ It is also known that sensorial stimulation increases the stimulability of motor cortex.¹² Sensorial feedback plays an important role in learning new motor skills.^{13,14} Especially in ASD, there might be some motor speech disorders such as apraxia. Children with ASD, they are known to have 30% higher rate in speech delays and articulation disorders.¹⁵⁻¹⁷ So these kinds of problems might affect speech, language and communication negatively.¹⁸

In clinical practice, as children with ASD have sensory integration problems, they can either be hypersensitive or hyposensitive to the stimuli. These two behavioral response patterns -hyperresponsiveness and hyporesponsiveness - are very well defined and characterized.¹⁹ Sensory integration is a neurological process that organizes senses coming from the body and environment. It can be achieved by using the body effectively in the interaction with the environment (social, emotional and physical, etc.). To produce an adaptive response, information received

through sensory systems such as tasting, touching, smelling, seeing and hearing are perceived, organized and interpreted.²⁰⁻²³

According to Ayres & Tickle, when there is sensory integration problem, academic learning skills, concentration and organization skills, self-regulation, self-control, self-confidence, abstract thinking, reasoning, and hemispheric specialization can be affected and one or more of these skills can not be developed.²⁴ 'Sensory integration' used by Ayres is defined as to produce *appropriate* motor and behavioral responses to stimuli. Ayres found out that individuals with ASD have difficulty in registration (signal detection and interpretation), modulation (signal inhibition or propagation) and interacting with certain objects and motivation. Individuals with ASD generally display stereotypical and repetitive motor behaviors, those are generally associated with sensory disintegration problems.²⁵

In a subgroup of children with ASD, parent-reported levels of sensory hyporesponsiveness and standardized measures of adaptive behavior may be associated. In her study, Liss et al., found that a high level of hyporesponsiveness is related to poorer communication and social performance. To determine developmental differences across various stimuli and contexts more studies with more rigorous methodologies may reveal the pathogenesis of these features.²⁶

Difficulties in sensory information processing are directly related to various behavioral problems and learning difficulties. Although many studies focus on occupational therapy in developing adaptive behaviors in children with ASD, there are not enough studies to guide how to implement these findings in speech and language therapy.⁷

In our study, we aimed to determine the sensory processing skills of the children diagnosed with ASD, to identify the relationship between assessed areas and to find out whether they need occupational therapy in the light of sensory profile results.

The specific research questions were:

1) Is there a correlation between autism severity level and sensory processing skills? If so, which sensorial categories are the most related to communication, social interaction and stereotypical behavior?

2) Should all the children diagnosed with ASD and taking speech and language therapy be referred to occupational therapy on regular basis?

MATERIAL AND METHODS

This study was conducted at Biruni University, Speech and Language Therapy (SLT) Clinics. Participants were randomly selected among the children with ASD who were applied to the SLT Clinics for their speech and language problems. There were 53 participants between 3-9 years old. Written parental consent was obtained before any assessment is done. All of the participants were assessed individually in the SLT Clinics between August 2018 and May 2019.

The secretary of the clinic contacted the families by phone and clinic staff evaluated participants for eligibility. Assessments were conducted in one of the clinic rooms for children at Speech and Language Therapy Clinics. A half day was typically enough to complete all assessments. Test of Early Language Development-Third Edition:Turkish (TELD-3:T) was applied to children. Demographic form, Sensory Profile Test and GARS-2-TV were filled out by trained therapists through asking parents or primary caregivers.

PARTICIPANTS

A total of 53 children (11 female, 42 male) with autism spectrum disorder participated in the study at Biruni University Campus Speech and Language Therapy (SLT) Clinics. The average age of the children was 5.79 ± 1.72 years. The mean of diagnosis age was, 29.11 ± 6.49 . Twenty four children (45.3%) were born with normal vaginal delivery, 29 children (54.7%) were cesarean sections. As for the severity of language disorder with TELD-3:T combined scores were measured, the test scores of 11 children could be calculated (4 very severe, 6 severe, 1 moderate degree). Other children's test scores could not be calculated because 42 children failed to cooperate.

The demographic information of the parents was also collected. The mean age of the mothers was 34.95 ± 3.59 and fathers was 39.64 ± 5.18 . The percentage of intermediate or high school education of mothers were 56.6% and fathers were 28.3%. When

the percentage of university education of parents was compared, the percentage of the mothers was 43.4% and the fathers was 71.7%. All of the fathers had a paid job, but the percentage of mothers' having a paid job was 22.6%. Forty four parents had low-medium, 9 parents had a high income.

To be included in the study, all of the participants must apply for SLT Department at Biruni University. For receiving therapy in our clinics, all of the participants must be evaluated for hearing, visual impairment, and for intellectual abilities. Also assessments from neurology, child psychiatry and ear nose throat should be submitted.

For the inclusion criteria; applicant must be diagnosed with ASD, must apply for speech and language therapy at Biruni University and must be at the age of 3 to 9 during this process. For the exclusion criteria; children can not be younger than 36 months and not older than 8 years and 11 months. As for their assessments, they have not been to occupational therapy, have no other neuropsychological, metabolic, genetic disorders, and have no hearing and visual impairment. Intellectual abilities (formal IQ tests) can not be measured, as their autism severity was high and they were not cooperative to complete these tasks. All the participants should be diagnosed by either pediatric neurologist or psychiatrist according to DSM-V-TR criteria.

This research was carried out in accordance with the Helsinki Declaration and all cases participating in the survey were informed before the evaluation. The study was approved by the Ethics Committee of Non-Interventional Clinical Researches at Biruni University on 26.03.2018 with the decision number of 2018/14-14. Before the study, parents were informed about the content of our study, read and signed the informed consent form that they volunteered to join.

INSTRUMENTS

TELD-3:T which is the adaptation of Test of Early Language Development (TELD-3) in Turkish was used. It is a norm-referenced test to evaluate receptive and expressive language skills of children between 2;0 and 7;11 years old.²⁷ It is used to do the screening of early language development, to identify strengths

and weaknesses in language development, to conduct the study. It has two different but parallel forms as TELD-3:T A and B. Both of these forms have receptive and expressive language subtests. In these subtests, there are questions regarding semantics, morphology and syntax. In each form, there are 76 items. For validity and reliability, it was applied to 1627 Turkish children and it is a highly reliable and valid tool to assess Turkish.²⁸

Gilliam Autism Rating Scale-2-TV (GARS-2-TV) which is adapted from Gilliam Autism Rating Scale -2 is an assessment tool for children between ages of 3-23 displaying characteristic behaviors of ASD. To assess stereotypical behaviors, communication, and social interaction, it has three subtests consisting of 42 items in total. With the scoring of these subtests, autism severity index (ASI) is calculated. As ASI increases, the autism severity increases, as well. It has three scores ranging from <69; 70-84 and 85. ASI is a valid and reliable test for evaluating individuals with ASD in Turkey.²⁹

Sensory Profile Test, developed by Prof. Winnie Dunn, is an assessment tool for sensory modulation, in other words, it is used to determine sensory response types during daily activities and which sensory systems are more affected. It is a valid and reliable assessment tool for functional performance, sensory processing skills, and the effect of sensory processing regarding three parameters such as sensory processing skills, modulation, and behavioral-emotional responses.³⁰ The Turkish validity and reliability study of the test was conducted.³¹

STATISTICAL ANALYSIS

SPSS 22.0 package program was used for the evaluation of data. Mean and Standard Deviation (SD) were calculated for continuous variables. Descriptive statistics for discrete variables were presented by min-max values and with percentages. According to Kolmogorov-Smirnov test, normal and non-distributed data were determined. Spearman correlation coefficient was used to find the relationship between the sensory profile and GARS-2-TV scores. Normally distributed data related to gender, type of birth, parent education level, income level and parent working situation were analyzed by Independent

Samples T test, non-normal distribution data were analyzed by Mann-Whitney U test. The hypothesis was two tailed and $p < 0,05$ was accepted as significant.

RESULTS

In this study, GARS-2-TV was used to determine Autism Disorder Index, 32 children had high (≥ 85), 17 children had moderate (70-84) and 4 children had a low (≤ 69) degree of autism. Boys with autistic spectrum disorder had significantly higher results in GARS-2-TV Autistic Disorder Index scores than girls. This showed that boys in the study have higher autism levels.

According to the results, as the age of children increased, perceptual fine motor problems significantly increased. This might be related to the expectations of families. No statistically significant differences were found between parents' information and Sensory Profile-GARS-2-TV scores ($p > 0.05$).

The results were scored with the Sensory Profile User's Manual guidance.³⁰ From the three main sections; the 'sensory processing' section scores mean was 400.96 ± 106.19 , the 'behavioral and emotional responses' section scores mean was 322.74 ± 86.55 and the 'modulation' section scores mean was 256.64 ± 75.63 (Table 1).

According to statistical analysis of sensory profile and GARS-2-TV scores, there was a statistically significant relationship between 'sensory processing' section of sensory profile and GARS-2-TV scores such as 'communication' (.001), 'social interaction' (.000), 'stereotype' (.012), 'autistic disorder index' (.011) within GARS-2-TV (Table 2).

There was a statistically significant relationship between 'behavioral and emotional responses' section of sensory profile and scores such as 'communi-

N=53	Range	Min.	Max.	Mean	SD
Sensory processing	391	214	605	400.96	106.19
Behavioral and emotional responses	316	167	483	322.74	86.55
Modulation	438	149	587	256.64	75.63

Min= Minimum; Max= Maximum; SD= Standart Deviation.

TABLE 2: Correlations of sensory profile and GARS-2-TV scores.

N=53		Social		Autistic Disorder	
		Communication	Interaction	Stereotype	Index
Sensory Processing	r	-.428**	-.488**	-.344*	-.346*
	p	.001	.000	.012	.011
Behavioral and emotional responses	r	-.384**	-.344*	-.376**	-.396**
	p	.005	.012	.005	.003
Modulation	r	-.378**	-.433**	-.413**	-.38**
	p	.005	.001	.002	.005

GARS-2-TV=Gilliam Autism Rating Scale 2 Turkish Version; *. Correlation is significant at the 0.05 level; **. Correlation is significant at the 0.01 level.

‘categorization’(.005) ‘social interaction’ (.012), ‘stereotype’ (.005), ‘autistic disorder index’ (.003). Also, there was a significant relationship regarding ‘modulation’ and subsections such as ‘standard communication’(.005), ‘standard social interaction’ (.001), ‘standard stereotype’ (.002), ‘autistic disorder index’ (.005) (Table 2).

When the percentage of sensory processing scores were analyzed, ‘multisensory processing’ and

‘behavioral outcomes of sensory processing’ showed the highest percentage (62.3%) and modulation of movement affecting activity level showed the lowest percentage (24.5%) of cases within the ‘definite difference’. ‘Modulation of sensory input affecting emotional responses’ and ‘vestibular processing’ parameters were following the highest parameters (60.4%;58.5%) within the ‘definite difference’. ‘Modulation of affecting activity level’ and ‘sensory processing related to endurance/ tone’ parameters showing the highest percentage (58.5%; 56.7%); ‘behavioral outcomes of sensory processing’ showing the lowest percentage (20.7%) of cases within the ‘typical performance’ (Figure 1).

When the percentage of modulation scores were analyzed, the highest percentages were in the ‘inattention/distractibility’(54.7%) and ‘sensory seeking’ (52.8%); the lowest percentages were in the ‘oral sensory sensitivity’(15.1%) and ‘sedentary’ (17%) parameters of cases within the ‘definite difference’ (Figure 2).

Behavioral and emotional scores’ graphics showed that ‘registration’ and ‘seeking’ parameters had the highest percentages(60.4%) (Figure 3).

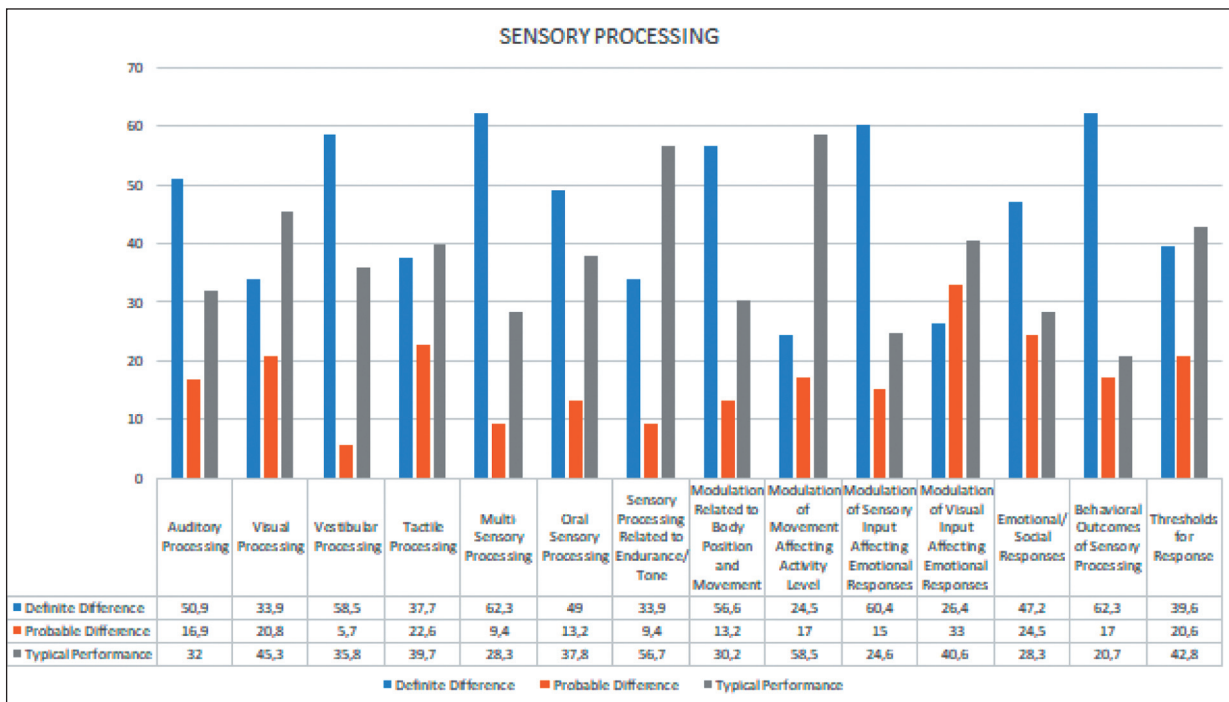


FIGURE 1: Percentages of sensory processing scores.

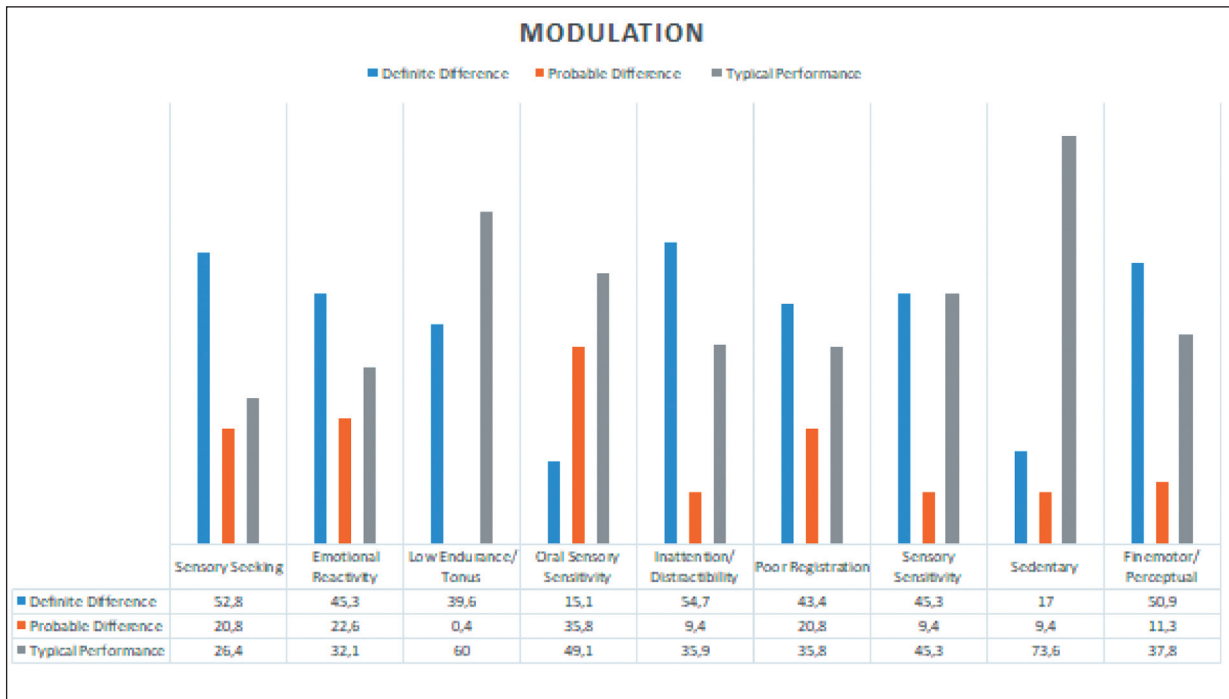


FIGURE 2: Percentages of modulation scores.

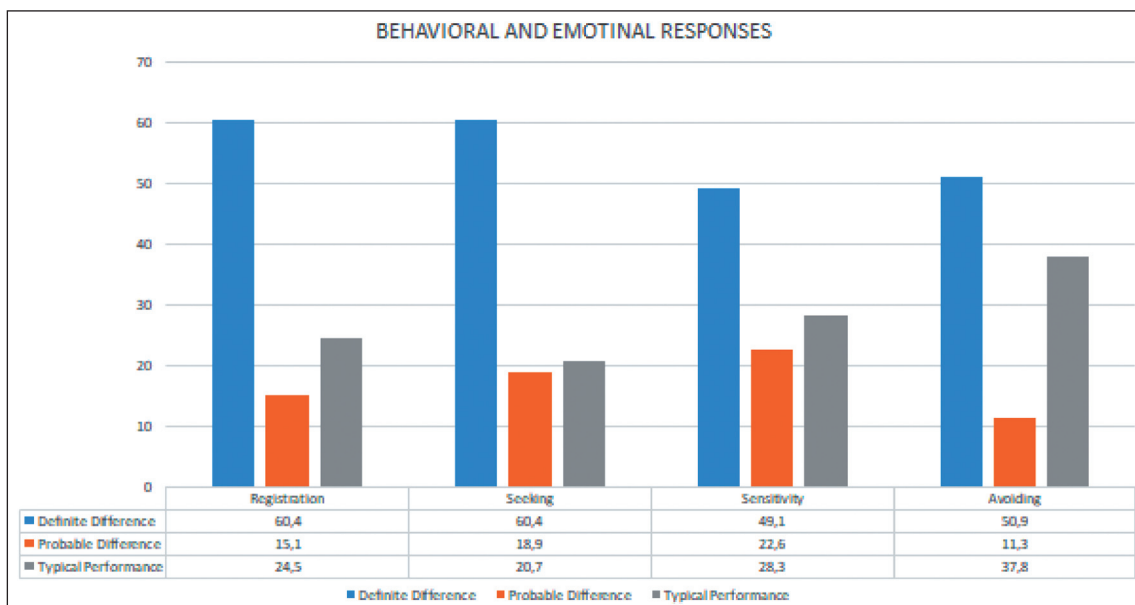


FIGURE 3: Percentages of behavioral and emotional responses scores.

DISCUSSION

In the literature, some studies support the link between autism symptoms and sensory functions.³²⁻³⁵ As clinical researchers and neuroscientists have argued, interventions to sensory functions can lead to improvements in cognitive, linguistic, social ve other

changeable abilities of children with ASD.³⁶ We aimed in the study to find out the correlation between autism severity level and sensory processing skills of autistic individuals.

Many studies have been conducted on the sensory-perception function of the children with ASD, it was found that they had unexpected and different re-

sponses towards stimuli such as sound, light and touching.³⁷⁻³⁹ When a child with ASD has concomitant sensory integration disorder and he is not successful in academic life as his peers, he should be referred to sensory integration therapy. In the therapy, it is aimed to receive appropriate sensory stimuli and construct an adaptive response in an arranged setting.^{40,41} Similarly, in our study, a definite difference was found between the sensory processing parameters such as auditory, vestibular and multi-sensorial processing sections at rates up to 50%.

Dawson and Watling had examined the sensory and motor abnormalities in children with ASD.⁴² In their study, they compared three different intervention techniques. These were sensory integration, traditional occupational therapy, and auditory integration. In this study, there was a literature review and it was also emphasized that sensory integration and auditory integration should be used in children with ASD. In our study, it found that it is important to eliminate the problems related to sensory integration. Because, we found that sensory processing skills problems in children with autism had an impact on communication, social interaction and stereotype behaviors.

As for our study, 53 children with autism were evaluated with Sensory Profile Test, and when we looked at 'behavioral and modulation' section, more than 50 percent of children with autism had a definite difference in 'registration', 'seeking', 'sensitivity' and 'avoiding' responses. It was also evident in Baranek et al.'s study, they declared that there were very few clinical studies related to tactile vulnerability and other subtypes of sensory integration. These problems were very common with individuals with developmental disorders. As a result of this study, it was found out that sensitivity to smell and other sensitivities were very high and other studies should be conducted in those areas.⁴³

Sensory perception disorders were considered one of the reasons why children with ASD have difficulty in expressing their thoughts, needs, and emotions verbally.⁴⁰ In some studies, it was determined that sensory integration problems had a positive correlation with stereotypical behaviors. For that reason, techniques used in sensory integration disorders in-

tervention can be used in behavioral problems.⁴² A well-designed sensory integration therapy intervention is an application that will increase social interaction and adaptive behaviors.

In our study, we found that as the age of children increased, perceptual fine motor problems significantly increased. This may be related to the expectations of families, as GARS-2 TV is solely based on family answers. As for gender, boys with autistic spectrum disorder had significantly higher results in GARS-2-TV Communication and Autistic Disorder Index scores than girls. This showed that boys in the study have higher autism levels, it might be due to the number of girl participants. As for our results, the higher the autism severity index level, the more sensory processing disorders were observed. We also found that autism severity levels were not related to family variables. In a similar study, sensory factors increased the severity of autism, even though variables related to children (age, IQ, gender, etc.) and family (income, etc.) were controlled.⁴⁴ In addition to these findings, sensory problems were directly correlated with autism severity and behavioral problems, but not with IQ.⁴⁵ In some studies, four subtypes as sensory adaptive, taste/smell sensitive, postural inattentive and generalized sensory difference were identified and it was found the four sensory subtypes were not fully correlated with factors such as gender, age, non-verbal IQ and autism severity.⁴⁶ We did not compare groups regarding those subtypes.

In our study, 53 children with ASD participated. Sensory processing scores, 'multisensory processing' and 'behavioral outcomes of sensory processing' showing the highest percentage (62.3%) of cases within the 'definite difference'. 'Modulation of sensory input affecting emotional responses' and 'vestibular processing' parameters were following the highest parameters (60.4%; 58.5%) within the 'definite difference'. The highest percentages modulation sections were in the 'inattention/distractibility' (54.7%) and 'sensory seeking' (52.8%). 'Registration' and 'seeking' parameters in behavioral and emotional responses' section were the highest percentages (60.4%). However, the rate of problems in all sensory parameters was very close. This showed that sensory processing should be considered as a whole. In another

study, the Sensory Processing Scale Assessment (SPS) and SSP parent report were applied to identify sensory problems in 35 ASD and 27 typical developing children. While definite sensory reactivity symptoms were present in children with ASD, these responses were not found in children with typical development.⁴⁷

CONCLUSION

As a result of this study, it was found that children with ASD have to be evaluated with different clinical and behavioral assessments, even though they have undergone the medical diagnosis process. For speech and language therapy, it is necessary to ensure that primary vision, hearing and other sensory modalities of children with ASD are preserved and their level of sensory integration is determined. Multidisciplinary approach must be held, as autism is such a complicated neurodevelopmental disorder.

In our study, we found that there is a relationship between sensory processing problems and autism severity. As sensory processing problems increased, autism symptoms were becoming apparent. In the light of these findings, one of the reasons why children with ASD might be referred to occupational therapy is to help them with their sensory problems. As sensory modulations are inseparable, our findings are parallel with the literature.

In clinical practice, we need to have more studies exploring speech and language abilities and sensory processing skills to have a better understanding. Apart from speech and language therapy sessions, sensory integration needs can also be determined and special intervention programs can be implemented regarding their assessment results.

LIMITATIONS

One of the limitations of our study is that all of the children were non-verbal and they had no verbal output except their primitive vocalizations. Another limitation is that we only used sensory profile for sensory processing skills and all the information were gathered from the parents. It might affect the reliability of data. Lastly, the number of participants were limited, these results should be repeated with other studies.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Remziye Akarsu, Merve Savaş; **Design:** Remziye Akarsu, Merve Savaş; **Control/Supervision:** Remziye Akarsu; **Data Collection and/or Processing:** Remziye Akarsu, Merve Savaş; **Analysis and/or Interpretation:** Remziye Akarsu, Merve Savaş, Fenise Selin Karalı; **Literature Review:** Remziye Akarsu, Merve Savaş, Fenise Selin Karalı; **Writing the Article:** Remziye Akarsu, Merve Savaş, Fenise Selin Karalı; **Critical Review:** Remziye Akarsu, Merve Savaş, Fenise Selin Karalı, Yusuf Çelik; **References and Fundings:** Remziye Akarsu, Merve Savaş; **Materials:** Remziye Akarsu, Merve Savaş.

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