

Sensory processing dysfunction among Saudi children with and without autism

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Abstract. [Purpose] There is a dearth of studies that have examined the occurrence of sensory processing dysfunction and its components in Saudi Arabian children with autism. Therefore, this study investigated the manifestation of sensory processing dysfunction in autism and compared the functional components of sensory processing between Saudi Arabian children with and without autism. [Subjects and Methods] A convenience sample of 46 Saudi Arabian children with autism and 30 children without autism participated in this study. The sensory processing functions of both groups were assessed with the Short Sensory Profile. [Results] The overall findings indicated that 84.8% of children with autism demonstrated definite sensory processing dysfunction. The most prevalent sensory processing dysfunctions involved the under-responsive/seeking sensation (89.13%), auditory filtering (73.90%), and tactile sensitivity (60.87%) domains. Most of the children without autism (66.66%) demonstrated typical sensory function; the most prevalent sensory processing dysfunctions involved the tactile sensitivity (33.3%), under-responsive/seeking sensation (23.33%), and movement sensitivity (20%) domains. [Conclusion] Saudi Arabian children with and without autism have clinically significant sensory dysfunctions. However, the prevalence of those sensory dysfunctions in children with autism is significantly higher than in the children without autism.

Key words: Autism, Sensory integration, Sensory processing dysfunction

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INTRODUCTION

Autism is a profound developmental disorder that appears in childhood, and is considered a severe lifelong-affliction for both affected individuals and their families. Young children with autism have difficulty relating to others¹. Most children with autism have relatively distant relationships with others and interact in a rigid, mechanical, and idiosyncratic manner^{2, 3}. The symptoms of autism include difficulties with communication, social interaction, play, behavior, and sensory processing⁴.

Sensory processing dysfunction (SPD) involves difficulties in receiving, organizing, and interpreting sensory stimuli from the different sensory systems⁵. To understand SPD, it is necessary to clarify how the central nervous system (CNS) codes and interprets sensory information and uses this information to generate motor output⁶. It is hypothesized that the CNS modulates information by creating a continuous interchange between habituation and sensitization⁷. Young children with poor sensory modulation between habituation and sensitization exhibit maladaptive behaviors, such

as hyperactivity, excessive lethargy, and inattentiveness⁶. Moreover, it has been observed that children with autism exhibit problematic behaviors such as irritability, lethargy, stereotypy, and hyperactivity⁸. Sensory and motor problems often present additional challenges to children with developmental problems⁹.

Neurological evidence suggests the existence of abnormal brain connectivity in children with autism, which may result in abnormal sensory processing¹⁰. Several studies also have reported an association between SPD and unfavorable events during pregnancy, delivery, and the neonatal and infant stages¹¹. The prevalence of SPD among children with autism is derived from parental reports, retrospective videotape analysis, and firsthand accounts from affected individuals¹².

Several studies have reported that SPD affects the ability of children with autism to lead normal lives, hinders active exploration of the environment, and impairs activities of daily living (ADL)¹³. Children with developmental disorders including autism exhibit deficits in sensory perception and motor functions, such as difficulties in performing fine motor activities involving vision and body awareness¹⁴. Furthermore, the inclusion of sensory aspects in the diagnosis of autism in the latest *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) is evidence of the prevalence of sensory dysfunctions in this population¹⁵. Rehabilitation therapists have used many forms of sensory-based theories, including sensory integration techniques, to assess and treat children with sensory dysfunctions¹⁶.

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Greenspan and Weider (1997) reported that 100% of the participants diagnosed with autism in their study demonstrated difficulties with auditory responding³. In a comparative study, Tomchek and Dunn (2007) reported that difficulties with the processing of auditory, taste, and olfactory stimuli are the most common sensory processing dysfunctions¹². A recent study reported that children with autism who exhibited SPD-like auditory hypersensitivity also exhibited excessive sympathetic responses to repeated loud noises¹⁷. Visual and tactile processing dysfunctions have also been reported in the literature^{18, 19}. In addition, studies have reported other sensory processing difficulties in children with autism, such as sensory seeking, the inability to register or avoid sensations, and sensory sensitivity^{20, 21}. Previous studies have shown differences in the commonly involved sensory processing functions among different study groups.

Culture is a dynamic set of goals, beliefs, and attitudes shared by a group of people²². Cultures differ in their interpretation of disability. Thus, it is important to gain a better understanding of autism in the Western cultural context and across different cultures²³. Professionals should also avoid the assumption that there is a universal set of attitudes and practices related to autism when working with culturally diverse families²⁴. Professionals must develop cross-cultural competence and sensitivity to serve children with autism. Daley's (2002) suggestion that a treatment method can be developed in the West and "exported" elsewhere is inherently flawed. Non-Western cultures may offer valuable explanations and treatments for culturally diverse children and families. Daley (2002) observed that although there is much evidence to support the need for cross-cultural research in the area of autism spectrum disorders (ASDs), few researchers have attempted a comparative approach or explicitly addressed cultural factors²⁵.

A recent review on the influence of culture and environment on the sensory processing experiences of children with and without autism in two countries, Israel and the United States (U.S.), reported that Israeli children exhibited unusual responses to sensory experiences less frequently than U.S. children did. U.S. children with autism demonstrated significantly greater difficulty in auditory filtering and on the visual/auditory sensitivity domains than Israeli children did²⁶. Another study compared the sensory processing dysfunctions of Chinese children from Hong Kong were compared with children in the U.S. population; the study revealed that the Chinese children differed from the U.S. children on 64.8% of the examined items²⁷. The results from these two studies reveal that sensory processing differs in children from various cultural backgrounds, and thus highlight the need to assess sensory processing in children from every culture. Therefore, this study aimed to investigate the most commonly involved sensory processing functions among Saudi Arabian children with autism.

SUBJECTS AND METHODS

A convenience sample of Saudi Arabian children with and without autism voluntarily participated in this study. A total of 46 children (7 girls and 39 boys) who were officially

diagnosed with autism (mean age, 6.50 ± 2.40 years, range 3 to 10 years) were recruited from the autism center in the northern area of Riyadh. These children received special education services and speech and language therapy session's day from 7:30 am to 12:30 pm, but had never received any kind of formal sensory integration therapy by an occupational therapist. A total of 30 children (6 girls and 24 boys) without autism (mean age of 6.40 ± 2.14 years, range 3 to 10 years), age and gender matched to the children in the autism group were recruited in the control group. In both groups, the parents came from northern Riyadh, and at least one parent understood English and had a college degree.

The aims and procedures of the study were explained to the parents of all the participating children, and written informed consent was obtained prior to the study. The protocols of the study were approved by the research ethics committee of the College of Applied Medical Sciences, King Saud University, Riyadh.

The main instrument used in this study was the Short Sensory Profile (SSP)²⁸, which is a standardized parent questionnaire that was developed as a screening instrument to identify children with sensory processing difficulties and associated behaviors¹³. The SSP uses a 'Likert' scale that is used to score each of 38 SSP items on a scale from 1 to 5; a score of 1 is assigned to behaviors that "always" occur and a score of 5 is assigned to behaviors that "never" occur. The raw scores are used to produce composite scores for seven domains: Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, Under-Responsive/Seeks Sensation, Auditory Filtering, Low Energy/Weak, and Visual/Auditory Sensitivity. The total SSP score ranges from 38 to 190 with cutoff points to define classification categories (i.e., typical performance = total score ≥ 155 ; probable difference = total score between 142 and 154; and definite difference = total score ≤ 141). These cutoff points are based on the normative values (collected by Dunn 1999) from 1,200 typical children. The validity and reliability of the SSP have been reported in the literature. Initial studies on the validity of the SSP demonstrated a discriminant validity of >95% in identifying children with and without sensory modulation difficulties²⁸. The internal reliability for the SSP, calculated using Cronbach's alpha, ranges from 0.70 to 0.90⁷. O'Donnell et al. (2012) have reported that the most reliable score is the SSP total score¹³. Together these findings provide support for the use of the SSP as a valid and reliable measure of sensory processing. The SSP was introduced and explained to the parents of the participating children in this study. The parents were provided with a copy of the SSP to be completed at home and returned to the researcher.

RESULTS

Thirty-nine (84.8%) children with autism demonstrated clinically significant sensory dysfunction with a mean SSP score of 118.74 ± 24.22 (Tables 1, 2). The most prevalent sensory processing dysfunctions in this group were found for the under-responsive/seeking sensation (89.13%), auditory filtering (73.9%), tactile sensitivity (60.87%), low energy/weak (58.7%), and movement sensitivity (50%) domains.

Twenty (66.66%) children without autism demonstrated

Table 1. Comparison of SSP performance between children with and without autism

Section	Typical performance		Probable difference		Definite difference	
	Autism	Without autism	Autism	Without autism	Autism	Without autism
Tactile sensitivity	17.40%	36.60%	21.70%	30%	60.90%	33.30%
Taste/Smell sensitivity	28.26%	80%	19.60%	16.60%	52.20%	3.30%
Movement sensitivity	34.80%	76.70%	15.20%	3.30%	50%	20%
Under-responsive/Seeks sensation	8.70%	63.30%	2.20%	13.30%	89.10%	23.30%
Auditory filtering	17.40%	63.30%	8.70%	23.30%	73.90%	13.30%
Low energy/Weak	30.40%	83.30%	10.90%	10%	58.70%	6.70%
Visual/Auditory sensitivity	45.70%	80%	19.60%	10%	34.80%	10%
Total SSP score	6.50%	66.70%	8.70%	10%	84.80%	23.30%

Table 2. Mean SSP scores of children with and without autism

Section	Mean scores	
	Autism	Without autism
Tactile sensitivity	24.7 ± 5.1	27.5 ± 4.4
Taste/Smell sensitivity	11.7 ± 5	16.6 ± 2.5
Movement sensitivity	10.3 ± 3.6	12.5 ± 2.8
Under-responsive/Seeks sensation	17 ± 5.3	27.3 ± 5.4
Auditory filtering	16.9 ± 5	24 ± 3.5
Low energy/Weak	20.7 ± 7.4	27.6 ± 3.3
Visual/Auditory sensitivity	17.7 ± 4.6	20.7 ± 3.9
Total SSP score	118.7 ± 24.2	156.4 ± 17.4

typical performance. However, a further analysis revealed that the most prevalent sensory processing dysfunctions were found for the tactile sensitivity (33.3%), under-responsive/ seeks sensation (23.33%), and movement sensitivity (20%) domains (Tables 1, 2).

DISCUSSION

This study revealed that Saudi Arabian children both with and without autism exhibit some degree of sensory dysfunction. However, the prevalence of sensory processing dysfunction in children with autism was greater than that in children without autism. Similar results have been reported in other populations^{10, 29–31}. The most common sensory processing dysfunctions in children with autism involve the under-responsive/seeks sensation, auditory filtering, tactile sensitivity, and low energy/weak domains. In contrast, the most common sensory processing functions in healthy children involve the tactile sensitivity, under-responsive/ seeks sensation, movement sensitivity, and auditory filtering domains.

In this study, the prevalence of clinically significant sensory differences in children with autism was 83.8%, which is within the published range (40–88%) for the prevalence of clinically significant sensory differences across various communities and cultural backgrounds^{10, 32–36}. This result confirms that clinically significant sensory differences are a common problem among children with autism in various

communities. Subsequently, this result suggests that autism and sensory processing disorders are genetically and structurally (i.e., physiologically, neurologically, and biochemically) linked. However, the involvement of other factors, such as culture, child-rearing style, and social experiences, may also play roles in sensory experiences and sensory integration and processing abilities^{26, 27}. Current study have also established the association between autism and sensory processing disorders and the variation in prevalence across different sensory processing factors and populations.

It has been reported that cultural and community lifestyles have some degree of effect on the severity and percentage of involvement of sensory processing dysfunctions in children with autism^{26, 27}. Tomchek and Dunn (2007) reported that 58.0% and 55.9% of children with autism score within the range of typical performance on the Low energy/Weak and Movement Sensitivity domains of the SSP, respectively¹⁰, whereas in our study 58.7% and 50.0% of the children with autism demonstrated definite differences on the Low Energy/Weak and Movement Sensitivity domains of the SSP, respectively. The parenting style of Saudi Arabian parents tends toward the protection and nurturing of their children, as mentioned in a previous study describing the cultural belief systems of Muslim parents of children with autism³⁷. This parenting style could decrease the child's opportunity for vestibular/proprioceptive/motor stimulation.

In this study, the results of the control group are comparable with the results of the Tomchek and Dunn study (2007)¹⁰, which indicates that children without autism across different communities may develop some sensory differences. Together these results highlight the need for the screening of sensory processing dysfunction in children without autism to avoid or minimize any SPD complications. The results also emphasize the importance of the availability of occupational therapy services in school-based settings, general practitioner offices, and community health clinics, as some of our study participants may have an unrecognized SPD, Attention Deficit Hyperactivity Disorder (ADHD), or both. Moreover, an unrecognized diagnosis of one or both of these disorders may have affected the results in our group of children without autism. Finally, the results confirm the need for programs to educate parents, teachers, and health care providers about SPD.

The presence of SPD may be responsible for poor social

participation and socio-emotional maturation. A study that performed a comparison of the physical activity levels between children with ASD and typically developing children found that children with ASD engaged in fewer physical activities and for a shorter period of time than typically developing children, according to parental reports; these results suggest that some of the activity in children with ASD is not captured by standard questionnaire-based measures³⁸). Dysfunction in the ability to process sensory stimuli from the surrounding environment reportedly affects the ability in a general population of children to lead productive lives, hinders active exploration of the environment, and impairs daily living activities¹³).

This study confirmed that a low percentage of Saudi Arabian children without autism and a high percentage of Saudi Arabian children with autism have clinically significant sensory differences. More studies are needed to confirm these conclusions. Further studies also are necessary to identify the patterns of sensory processing in people living with autism globally and locally, and examine the effectiveness of sensory integration strategies in Saudi Arabian children with autism. Moreover, these results suggest that the frequent screening of sensory processing function is needed even among children without autism to avoid or minimize any health complications.

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