

PREVALENCE OF SENSORY PROCESSING DISORDER IN 3-7 YEARS-OLD CHILDREN WITH AUTISM

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ABSTRACT

Introduction: Sensory processing system receives processes, interprets and responds to sensory stimulation in the environment. There are different ways to respond to sensory stimuli. The sensory system that develops normally, responds to demands of environment successfully that allows them to engage in everyday life. On the other hand, some systems have deviation from normal receiving, processing, integrating and responding to sensory stimulation, which might have occurred because of structural and biochemical abnormalities in the central nervous system (CNS). These abnormal responses are divided to over responsiveness or under responsiveness. Unusual sensory processing of such kind is present in some kind of clinical conditions like autism. Autism is a kind of neurodevelopment disorders and children suffering from it have trouble in communication and social interaction and have some stereotype behaviors. *Methods:* The intervention study included 30 participants. These participants had a primary diagnosis of autism based on DSM-V, didn't have any comorbid neurologic disorder and were 3-7 years age. Sensory functions of the children were measured by sensory profile. The mothers of the participants completed the sensory profile (based on their child's sensory behavior during the day), PSAM (Parental Self Agency Measure), CPRS (Child-Parent Relationship Scale) and GARS (Gilliam Autism Rating Scale) about their child and Sensory Profile Adolescent-Adult about themselves based on their own sensory behavior during the day. *Result:* Our findings show 20% of participants had no problem in their sensory processing and the remaining had at least one sensation impaired in their body. 27% of the participants had impairment in one sense, 6.5% in two senses, 10% in three senses, 20% in four senses, 6.5% in five senses, 6.5% in six senses and 3.5% in seven senses. 43.5% of the participants had auditory, 27% visual, 43.5% proprioception, 20% touch, 43.5% taste/smell and 27% had issues in their movement sensations. The highest percentage quoted was for auditory and visual sensory sensitivity, for proprioception and movement was sensation seeking, for touch was sensation avoiding and sensation seeking and for taste/smell was sensation avoiding. The highest percent of sensory processing style of mothers is sensory sensitivity (53.3%). *Conclusions:* Most of the autistic children had trouble in sensory processing. Their dominant sensory processing style was sensory seeking and their mother's was sensory sensitivity. The dominant impairment senses studied were auditory, taste/smell and proprioception.

KEYWORDS: Autism, sensory processing disorder, low registration, sensation-seeking, sensory sensitivity, sensation avoiding

INTRODUCTION

Sensation and perception are stages of processing of senses in human systems, such as vision, auditory, vestibular, taste and smell senses. Sensation is a low-level function of biochemical and neurological events that have an effect on the receptor cells of a sensory organ (Carlson et al. 2010). Perception is the mental process that represents awareness of the real-world and seeks for causes of the sensory input (Gazzaniga, Heatherton, Halpern and Heine, 2010). In other words perception is a higher brain function about interpreting events (Myers, 2004). Detection is the goal of sensation, whereas creating useful information of the environment is the goal of perception (Gazzaniga et al. 2010). Sensory processing system receives processes, interprets and responds to sensory stimulation around. There are different ways to respond to the sensory stimuli. Sensory system that develops normally, responds to demands of environment successfully that allows them to engage in everyday life (Humphry, 2002). Some systems have deviation from normal receiving, processing, integrating and responding to sensory stimulation, which might be because of structural and biochemical abnormalities in the central nervous system (CNS). This abnormal responsive to stimulus are divided into

over responsiveness or under responsiveness (Bundy, Lane, Murray, and Fisher, 2002). Dunn (1997) analyzed data of sensory processing system from more than 1000 children. The two factors that Dunn studied in detail are the neurological threshold and self-regulation strategies. Neurological threshold is a spectrum from high threshold (hypo sense, they need more stimulation to be stimulate) to low threshold (hyper sense, they were stimulate quickly). Self-regulation strategies can be active or passive. These two factors combine and lead to four patterns of sensory processing including low registration (high threshold and passive), sensation-seeking (high threshold and active), sensory sensitivity (low threshold and passive) and sensation avoiding (low threshold and active). Every pattern has a cut of point for abnormality. These abnormalities could be existing in perception of all senses, including vision, taste/smell, sound, touch, as well as proprioceptive and kinesthetic (O'Neill and Jones, 1997; Gabriels, Cuccaro, Hill, Ivers, and Goldson, 2005).

Unusual sensory processing is present in certain kinds of clinical conditions including attention deficit/hyperactivity disorder, fragile X syndrome, schizophrenia, William's syndrome and autism (Khodabakhshi, Abedi and Malekpour, 2014). Autism is one of the neurodevelopmental disorders that manifests early during the development of the child. Autistic children have trouble in communication and social interaction and have some stereotype behaviors (DSM-V). Prevalence of autism has increased lately. In 1975, one in 5000 births, where as in 2014, one in 68 births were diagnosed with an autism spectrum disorder or ASD (Autism Speak, 2014). The prevalence of sensory processing disorder (SPD) in children having autism has been reported in many studies, being as high as 80 to 90 percent (Rogers and Ozonoff, 2005, Horder, Wilson, Mendez and Murphy, 2013; Andrésa, Cerezuelab, Cerverac and Mínguezc, 2015). Dawson and Watling (2000) reported that abnormalities in sensory processing are associated with higher levels of inflexible, stereotypic, and repetitive behaviors. In this study, the sensory profile was used to assess the percentage of autistic children suffering from sensory processing disorder. Moreover, the level of impairment in each sensation their pattern was studied. We also checked pattern of sensory processing in the mothers of the participants to find any relationship between their patterns and prevalence of autism in their children.

MATERIALS AND METHODS

Methods

Participants

The participants were 30 Iranian children with a diagnosis within the Autism Spectrum Disorder (28 boys and 2 girls), ranging from 3 years and 1 months to 7 years and 5 months ($M=4$ years and 6 months, *Table 1*) in age. The inclusion criterion was a clinical diagnosis within the Autism spectrum disorder according to fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-V). This diagnosis was based on a multidisciplinary assessment by a specialized team; consisting of a psychiatrist and psychologists. Children with a physical disability, a known genetic or other neurological disorder (e.g., seizures) were excluded.

Procedure

In this study mothers were asked to fill the sensory profile (based on their child's sensory behavior during the day), PSAM (Parental Self Agency Measure), CPRS (Child-Parent Relationship Scale) and GARS (Gilliam Autism Rating Scale) about their children. Moreover they filled the Sensory Profile Adolescent-Adult capturing their own sensory behavior during the day.

Materials

The Sensory Profile (3-10 years): The Sensory Profile (Dunn and Westman, 1995) is a questionnaire with 125-items that distinguishes sensory abnormality. This profile is filled by parents based on the frequency of the child's response to items in different sensory categories including auditory, visual, taste/smell, etc. Tasting and smelling are in one category. The tactile sensation is divided to three parts: tactile, proprioception and movement. The frequency is determined on a Likert scale from always (1) to never (5). Every sense can be categorized into three parts, typically performance (processes normally), probable difference (partially impaired) and definite difference (totally impaired).

GARS: Gilliam Autism Rating Scale that was developed by James E. Gilliam (1995), is used for identifying children and adolescence with autism disorders and evaluating the progress during the timeline. The GARS has four parts: stereotype behavior, social interaction, communication and developmental disturbance. It consists of 56 items and each item is determined on a Likert scale from never (0) to mostly (3).

PSAM: The Parental Self Agency Measure that was developed by Dumka, Stoerzinger, Jackson and Roosa (1996), is a general measure of parents' or carers' feelings about their own parenting ability and their overall confidence in their ability to act successfully in the parental role. It also includes parent's assessment of their ability to manage their children's behavior. It consists of 10 items and each item is responded on a 7-point Likert scale from '1 = rarely' to '7 = always'.

CPRS: The Child-Parent Relationship Scale that was developed by Pianta (1992) gauges the relationship between children and their parents and consist of 15 items. Each item is responded on a 5-point Likert scale from '1 = never' to '7 = always'.

Sensory Profile Adolescent-Adult (11-65 years): The Sensory Profile Adolescent-Adult (Dunn, 1997) is a measure of an individual's response to sensory events in daily life. The individual completes a Self-Questionnaire assessing the frequency of his responses to certain sensory processing and activity level events as described in 60 items.

Statistical analysis

In order to examine the relationship between symptoms of autism and the number of senses impaired, a correlation analysis was conducted between child-parent relationship and parental self-efficacy. Also percentages were taken out for determining the dominant impairment senses, the dominant sensory processing style of children and their mothers and intensity of sensory processing disorder. The data of this study was analyzed in SPSS.

Table 1: demographic data

participants	Age (y/m/d)	sex
1	3/2/2	boy
2	4/8/12	girl
3	3/3/13	boy
4	6/3/13	boy
5	3/7/13	boy
6	3/10/5	boy
7	3/11/14	boy
8	3/8/7	boy
9	4/2/17	boy
10	4/1/29	girl
11	3/11/15	boy
12	6/3/2	boy
13	4/8/14	boy
14	4/7/10	boy
15	7/5/11	boy
16	7/5/11	boy
17	3/1/4	boy
18	5/8/26	boy
19	5/7/12	boy
20	4/5/8	boy
21	5/2/4	boy
22	5/2/1	boy
23	4/4/22	boy
24	4/8/29	boy
25	3/1/8	boy
26	5/8/10	boy
27	3/1/1	boy
28	3/4/4	boy
29	3/1/15	boy
30	4/10/27	boy

RESULT

The participants of the study were 30 children (28 boys and two girls). Mean of their age was four years and six months. The scores of GARS, CPRS and PSAM, and Sensory processing style of the mothers are shown in Table 2.

Table 2: Scores for GARS, CPRS and PSAM, and Sensory processing style of mothers

Participants	GARS	CPRS	PSAM	Sensory processing style of mothers
1	98	54	53	Sensation seeking
2	92	62	53	Sensory sensitivity
3	105	57	64	Sensation seeking
4	87	45	30	Sensory sensitivity
5	63	61	36	Low registration
6	97	62	58	Sensory sensitivity
7	102	49	34	Sensory sensitivity
8	78	56	39	Sensory sensitivity
9	48	58	64	Sensation seeking
10	73	47	44	Sensory sensitivity
11	75	46	39	Sensation avoiding
12	85	46	46	Low registration
13	82	34	55	Sensory sensitivity
14	92	46	31	Sensory sensitivity
15	70	58	51	Sensory sensitivity
16	50	47	52	Sensory sensitivity
17	67	60	42	Sensory sensitivity
18	63	51	54	Sensory sensitivity
19	97	66	64	Sensation seeking
20	77	62	40	Low registration
21	58	62	47	Sensory sensitivity
22	70	59	55	Low registration
23	74	58	51	Sensation seeking
24	83	59	57	Sensation seeking
25	85	54	43	Sensory sensitivity
26	83	52	41	Sensory sensitivity
27	75	58	41	Sensation avoiding
28	87	56	52	Sensory sensitivity
29	88	54	27	Sensation seeking
30	88	56	37	Sensation avoiding

The higher the score in GARS, the more the presence of autistic features in a child. In case of CPRS and PSAM, the higher the score, the better the relationship between mother and her child and self-efficacy of mother. The highest and the lowest scores found on GARS were 105 and 48 respectively whereas, for CPRS was 66 and 34 and for PSAM was 64 and 27 respectively. There is relationship between GARS and number of impairment senses and between CPRS and number of impairment senses. No relationship was found between PSAM and number of impairment senses.

The Sensory processing style of mothers is shown in Table 3 according to which the highest percentage for sensory processing style of mothers was sensory sensitivity (53.3%) followed by sensory seeking (23.3%), low registration (13.3%) and sensory avoiding (10%).

Table 3: scores and percentages for sensory processing style of mothers

Sensory processing style of mothers	Sensation avoiding	Sensory sensitivity	Sensation seeking	Low registration
number	3	16	7	4
percent	10%	53.3%	23.3%	13.3%

The intensity of impairment in each sense for every participant was evaluated under three categories; Definite Difference (DD, totally impaired), Probable Difference (PD, partially impaired) and Typical performance (TP, processes normally). The two categories which need intervention are *DD and PD*. The intensity and the number of senses impaired for each participant is shown in Table 4.

Table 4: The intensity and number of impairment senses in each sense for every participant

participants	auditory	visual	proprioception	touch	Taste/smell	movement	The number of impairment senses
1	TP	DD	TP	TP	DD	PD	4
2	TP	PD	PD	DD	TP	TP	3
3	TP	TP	PD	PD	DD	DD	5
4	PD	TP	TP	TP	TP	TP	1
5	TP	TP	TP	TP	TP	PD	1
6	PD	PD	TP	TP	TP	TP	2
7	DD	DD	DD	DD	DD	TP	6
8	PD	PD	PD	TP	DD	DD	5
9	PD	TP	TP	TP	TP	TP	1
10	TP	TP	DD	TP	TP	TP	1
11	TP	TP	PD	TP	PD	PD	4
12	TP	TP	DD	TP	DD	DD	4
13	DD	DD	DD	DD	DD	PD	7
14	PD	TP	DD	PD	DD	PD	6
15	DD	TP	TP	TP	TP	TP	1
16	TP	TP	TP	TP	TP	TP	0
17	TP	TP	TP	TP	TP	TP	0
18	TP	TP	TP	TP	TP	TP	0
19	PD	PD	PD	PD	TP	TP	4
20	PD	TP	TP	TP	TP	TP	1
21	TP	TP	TP	TP	TP	TP	0
22	TP	TP	TP	TP	TP	TP	0
23	TP	TP	TP	TP	DD	TP	2
24	TP	TP	PD	TP	DD	PD	4
25	PD	TP	TP	TP	DD	TP	3
26	TP	TP	DD	TP	TP	TP	1
27	TP	TP	TP	TP	TP	TP	0
28	TP	TP	DD	TP	PD	TP	3
29	DD	TP	TP	TP	TP	TP	1
30	DD	PD	TP	TP	DD	TP	4

*DD: Definite Difference, PD: Probable Difference and TR: Typical performance

The percentages for DD, PD and TP for every sense are shown in Table 5. In this research 43.5% of the participants had auditory, 27% visual, 43.5% proprioception, 20% touch, 43.5% taste/smell and 27% movement sensations impaired that needed intervention. The scores for DD and PD were added then the percentages were calculated.

Table 5: Percentages for impaired senses requiring intervention

senses	auditory	visual	proprioception	touch	Taste/smell	movement
intensity of disorder						
TP	17	22	17	24	17	22
PD	8	5	6	3	2	4
DD	5	3	7	3	11	4
Percent	43.5%	27%	43.5%	20%	43.5%	27%

In this study, 20% of participants had no problem in their sensory processing, whereas the rest of them had at least have one impairment sense in their body, 27% of the participants had impairment in one sense, 6.5% in two senses, 10% in three senses, 20% in four senses, 6.5% in five senses, 6.5% in six senses and 3.5% in seven senses. The data is shown in Table 6.

Table 6: number and percentage of participants having impaired senses

Number of impairment senses	Seven senses	Six senses	Five senses	Four senses	Three senses	Two senses	One sense	Without impairment sense
Number of participants	1	2	2	6	3	2	8	6
percent	3.5%	6.5%	6.5%	20%	10%	6.5%	27%	20%

Each impaired sense was categorized according to a sensory processing style. The highest percentage of the processing style for auditory and visual is sensory sensitivity, for proprioception and movement is sensation seeking, for touch is sensation avoiding and sensation seeking and for taste/smell is sensation avoiding. The percentages acquired for sensory processing styles are sensation seeking (38%), sensation avoiding (28%), sensory sensitivity (24%) and low registration (10%) respectively. These data's are shown in Table 7.

Table 7: Scores for sensory processing style in each sense of body

Number of impairment senses	Sensation avoiding	Sensory sensitivity	Sensation seeking	Low registration	total
auditory	1	6	4	2	13
visual	2	4	0	2	8
proprioception	0	3	9	1	13
touch	3	0	3	0	6
Taste/smell	11	1	1	0	13
movement	0	1	6	1	8
total	17	15	23	6	61
percent	28%	24%	38%	10%	100%

CONCLUSIONS

The purpose of this study was to determine the frequency of sensory processing disorder in autism spectrum disorder. In this study majority of the participants (80%) had trouble in sensory processing. This is in line with the findings of Nadon, Feldman, Dunn and Gisel (2012) whose study reported 78-90% of autistic children having trouble in sensory processing. Moreover Tomchek and Dunn (2007) reported that the prevalence of sensory integration problem in autism

spectrum disorder being 95%. The dominant sensory processing style in autistic children is sensory seeking which corresponds to the findings of Tomchek and Dunn (2007). Based on DSM-V one of the troubles in children with Autism, are some stereotypical behaviors. Gabriels, Agnew, Miller, Gralla, Pan, Goldson, Ledbetter, Dinkins and Hooks (2008) reported there is a correlation between stereotypical behaviors and sensory processing problems. There is a positive correlation between autism symptoms and number of impairment senses (0.65). It means that the more autistic symptoms (and more stereotypical behavior), the more the sensory processing problems. Children with autism spectrum disorder motivate themselves with stereotypical behaviors and first trait of sensory seeking style is motivation. The dominant impairment senses in this study were auditory, taste/smell and proprioception. In the research conducted by Tomchek and Dunn (2007) the most prevalent impairment was in the sense of auditory followed by tactile sensation. The dominant sensory processing style found in mothers was sensory sensitivity and the most dominant characteristic of this style was being sensitive about stimulation. Due to limited research we cannot depend on these results. There is a possibility that those mothers who have a sensory sensitive style are more sensitive to symptoms of their children and therefore refer to clinics for treatment or there is a possible correlation between the two factors.

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