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RESEARCH ARTICLE

Sensory processing disorders in Indian children with Autism spectrum disorder

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Abstract:

Sensory processing disorder (SPD) is common in children with autism spectrum disorder (ASD). The current cross-sectional study evaluated the prevalence of SPD in Indian children with ASD and its association with autism severity and sleep disturbances. Children who visited an inpatient residential facility attached to the Developmental Pediatrics Unit in a tertiary care center in south India from January 2016 to December 2016 with a diagnosis of ASD were included. The sample of 83 children comprised predominantly boys (83.1%). At least one sensory abnormality was found in 75 children (90%). Among sensory sections, auditory processing (62.7%) and oral sensory processing difficulties (45.8%) were reported maximum, while low registration (73.5%) and sensory avoidance (68.6%) were commonly reported among sensory quadrants. Children with severe autism had a higher proportion of auditory processing difficulty when compared to children with mild-moderate autism (80.8% vs 54.4% respectively; p=0.028). Children with sleep problems had also a higher proportion of auditory processing difficulty when compared with children having no sleep concerns (92.9% vs 7.1% respectively; p=0.013). The high prevalence of SPD and its association with autism severity and sleep disturbances in Indian children with ASD necessitate early screening for SPD for children with autism in low- and middle-income settings.

Keywords: autism spectrum disorder, sensory impairments

Introduction:

Children with Autism Spectrum Disorder (ASD), apart from having deficits in social communication and restricted repetitive behavior, show a wide range of abnormalities in their

sensory perception(Lord et al., 2020). As per the Diagnosis and Statistical Manual, 5th edition (DSM - V), diagnostic criteria of ASD include sensory processing disorder (SPD), defined as "Hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment" (American Psychiatric Association, 2013).

Incidence of SPD in children with ASD varies widely with some studies showing as high as 100%(Jorquera-Cabrera et al., 2017; Suarez, 2012).These abnormalities may involve auditory processing, vestibular processing, and processing of visual stimuli, tactile information, and olfactory sensory information. In addition, there can be inappropriate responses to multiple sensory stimuli processing, integration, and modulation as suggested in the quadrant model (Dunn, 1997).

Site-specific population-based prevalence of ASD in India ranged from 0.5 to 1.7% in 2-6 year-olds and 0.2-1.9% in 6-9 year-olds (Arora et al., 2018), and a systematic review showed a pooled prevalence of around 0.1%, while highlighting inadequate quality evidence (Chauhan et al., 2019). There is a dearth of SPD data in Indian children with ASD. A hospital-based prevalence study done in north India showed that all children with severe autism had SPD with the maximum number having auditory processing disorders(Kadwa et al., 2019). In this background, the current analysis was conducted to assess the incidence of various SPD in children with ASD in a tertiary care center in south India and their associations with autism severity and co-morbidities.

Materials and Methods:

All children welcomed to an inpatient residential facility attached to the Developmental Paediatrics Unit in a tertiary care center in south India from January 2016 to December 2016 with a diagnosis of ASD were included in this cross-sectional analysis. Children were diagnosed by a multidisciplinary team of developmental pediatricians, psychologists, and therapists using DSM-V criteria (American Psychiatric Association, 2013). The current study was approved by the Institutional Review Board. All admitted families had given written consent for anonymized data to be used for audit and research activities.

Measures:

Demographic information was collected from parents/caregivers. Co-morbidity information collected included the presence of seizures and sleep concerns.

The Childhood Autism Rating Scale™, Second Edition (CARS™-2)

The Childhood Autism Rating Scale™ – second edition (CARS™-2)(Schopler, 2010) was used to analyze autism symptom severity in children and was scored by the psychologist with inputs from parent/s. This 15-item rating scale can be used from two years of age onwards and has good validity and reliability with raw scores ranging from 15-60 (Chlebowski et al., 2010).

The Sensory Profile

The Sensory Profile assesses the sensory difficulties of children using parent reports and has 125 items. The Likert scale responses areconverted into a score with lower scores indicating greater symptoms and can be categorized under typical performance, probable difference, and definite difference. Items can be grouped under four quadrants as per Dunn's model (*viz* low registration, sensory seeking, sensory sensitivity and sensory avoidance) and five sections (*viz* auditory processing, visual processing, vestibular processing, tactile

processing and oral sensory processing) (Dunn & Brown, 1997; Dunn & Westman, 1997).

Data entry and analysis:

Data entry and analysis were done using the SPSS package 16.0. Continuous and categorical variables were summarized using mean (SD) and count (proportion) respectively. Sensory performances under each domain and section were described using proportions. Probable and definite differences reported were considered together as atypical sensory performance or SPD(Dunn & Brown, 1997). Associations were evaluated between sensory abnormalities and demographic variables such as age, sex, and parent education; autism severity and presence of co-morbidities such as sleep disturbances, and seizures using chi-square tests. Severe autism was considered if CARS™-2 score was (≥37) (Dunn & Westman, 1997).

Results:

The sample of 83 children had a median age of 47.92 months and comprised 69 boys (83.1%) (Table 1). The median CARSTM-2 score was 34.3 with 32.5% showing severe autism symptoms. Above 70% of parents were at least graduates.

At least one sensory abnormality was found in 75 children (90%). "Definite difference" in sensory processing was found in 65 out of 83 children (78.3%) while "probable difference" was present in the remaining 10 children. Auditory processing (62.7%) and oral sensory processing difficulties (45.8%) were reported maximum. Difficulties in visual processing, tactile processing, and vestibular processing were respectively 38.5%, 44.6%, and 30.1%. Quadrant analysis revealed that low registration (73.5%) and sensory avoidance (68.6%) were commonly reported. Sensory-seeking behavior and sensory sensitivity were found in 22.9% and 51.8% respectively.

Children with severe autism had a higher proportion of auditory processing difficulty when compared to children with mild-moderate autism (80.8% vs 54.4% respectively; p=0.028) (Table 2). There was no significant difference in SPD in other sensory quadrants and sections between children with severe autism and those with mild-moderate autism. Children with sleep problems had a higher proportion of auditory processing difficulty when compared with children having no sleep concerns (92.9% vs 7.1% respectively; p=0.013).There was no statistically significant relationship between demographic factors such as sex and age of the child, and prevalence of seizures and other sensory abnormalities.

Discussion:

The current analysis from a hospital-based sample has shown a high prevalence of 90% of at least one sensory abnormality in children with ASD. Auditory processing disorder was the most reported with its higher prevalence associated with severe autism symptomatology and sleep problems.

A close relationship has been reported between ASD and SPD in the literature including significant associations between SPD and core features of ASD, medical co-morbidities such as sleep and feeding concerns, and secondary behaviors including anxiety and problem behaviors(Ben-Sasson et al., 2009; Glod et al., 2015). It has been hypothesized that sensory behaviors as demonstrated in the SPD might affect the 'priori' brain constructs resulting in autistic behavior(Pellicano, 2013). It is also possible that this close association might be differing manifestations of aberrant brain connectivity with complex interlinkage(Posar & Visconti, 2018). However, there is a consensus that SPD cause a significant impact on the quality of life of

individuals with ASD (Ben-Sasson et al., 2009; Posar & Visconti, 2018; Suarez, 2012).

Early identification of SPD in children with ASD can help not only in specific sensory interventions and environmental modifications but also in planning and integrating the overall autism interventions with sensory needs (Ayres, 1979). A high prevalence of SPD in ASD as seen in the current study has been reported in the literature (Ben-Sasson et al., 2009; Glod et al., 2015; Jorquera-Cabrera et al., 2017; Suarez, 2012). A hospital-based study in north India reported that all children with severe autism had SPD while only 40% with mild-moderate ASD had SPD concerns (Kadwa et al., 2019), similar to our findings.

Sensory quadrant analysis in our study showed a high prevalence of low registration and sensory avoidance. Low registration is considered sensory hypo-responsiveness while sensory sensitivity is considered hyperresponsiveness (American Psychiatric Association, 2013). Sensory hyperresponsiveness and sensory seeking behaviors increase till the age of 6-9 years of age with a decrease in later years, but there is limited exploration of sensory hypo responsiveness including avoidance and low registration in individuals with ASD (Ben-Sasson et al., 2009; Glod et al., 2015; Posar & Visconti, 2018). Another quadrant dimension of 'enhanced sensory perception' has been added recently to address sensory experiences in individuals with ASD (Ausderau et al., 2014; Posar & Visconti, 2018).

The current analysis found a high prevalence of auditory processing disorder in children with severe autism similar to reports in systematic reviews(Ben-Sasson et al., 2009; Posar & Visconti, 2018). Auditory processing difficulties can manifest as 'apparent deafness' where the child does not respond to name calls, increased sensitivity to high-pitched sounds, and repetitive verbal stereotypy, all among the core symptoms of ASD. In addition to uni-sensory auditory perception, integration of auditory to visual and other sensations can also be impaired, which can manifest as poor integrated social communication (Ben-Sasson et al., 2009; Posar & Visconti, 2018).

Children with sleep concerns had a high prevalence of auditory processing disorders in the present study consistent with other analyses (Ben-Sasson et al., 2009; Posar & Visconti, 2018). Hyperarousal associated with auditory sensitivity can impair sleep initiation and sleep depth(Posar & Visconti, 2018).

The current study had many limitations including hospital-based small sample size and parent report measures. Subjective parent reporting can be affected by the phase of parental understanding, engagement, and acceptance as well as culture-specific experiences (Desai et al., 2012). Nevertheless, the present analysis highlighted the high prevalence of SPD and its association with autism severity and sleep disturbances in Indian children with ASD necessitating early screening for SPD for children with autism in low-and-middle-income settings. Along with specific autism interventions, an intervention plan for SPD also should be included for such children. An integrated plan can help in improving adaptive behavior and quality of life in children with ASD.

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Conflicts of interest : There are no conflicts of interest

References:

1. American Psychiatric Association, DSM-5 Task Force. (2013). Diagnostic and statistical manual of mental disorders: DSM-5™ (5th ed.). American Psychiatric Publishing, Inc.. https://doi.org/10.1176/appi.books.9780890425596
2. Arora NK, Nair MKC, Gulati S, Deshmukh V, Mohapatra A, Mishra D, et al. Neurodevelopmental disorders in children aged 2–9 years: Population-based burden estimates across five regions in India. Persson LÅ, editor. PLOS Medicine. 2018 Jul 24;15(7):e1002615.
3. Ausderau K, Sideris J, Furlong M, Little LM, Bulluck J, Baranek GT. National Survey of Sensory Features in Children with ASD: Factor Structure of the Sensory Experience Questionnaire (3.0). Journal of Autism and Developmental Disorders. 2013 Oct 6;44(4):915–25.https://doi.org/10.1007/s10803-013-1945-1
4. Ayres, J. Sensory integration therapy. In Sensory Integration and the Child.1979 Western Psychological Services.
5. Ben-Sasson A, Hen L, Fluss R, Cermak SA, Engel-Yeger B, Gal E. A meta-analysis of sensory modulation symptoms in individuals with autism spectrum disorders. *J Autism Dev Disord*. 2009;39(1):1-11. doi:10.1007/s10803-008-0593-3
6. Chauhan A, Sahu JK, Jaiswal N, et al. Prevalence of autism spectrum disorder in Indian children: A systematic review and meta-analysis. Neurol India. 2019;67(1):100-104. doi:10.4103/0028-3886.253970
7. Chlebowski C, Green JA, Barton ML, Fein D. Using the childhood autism rating scale to diagnose autism spectrum disorders. *J Autism Dev Disord*. 2010;40(7):787-799. doi:10.1007/s10803-009-0926-x
8. Desai MU, Divan G, Wertz FJ, Patel V. The discovery of autism: Indian parents' experiences of caring for their child with an autism spectrum disorder. *Transcult Psychiatry*. 2012;49(3-4):613-637. doi:10.1177/1363461512447139
9. Winnie Dunn. The Impact of Sensory Processing Abilities on the Daily Lives of Young Children and Their Families: A Conceptual Model. *Infants & Young Children.* 1997. Vol. 9(4):23-35. DOI: 10.1097/00001163-199704000-00005
10. Dunn W, Brown C. Factor analysis on the Sensory Profile from a national sample of children without disabilities. Am J Occup Ther. 1997;51(7):490-499. doi:10.5014/ajot.51.7.490
11. Dunn W, Westman K. The sensory profile: the performance of a national sample of children without disabilities. *Am J Occup Ther*. 1997;51(1):25-34. doi:10.5014/ajot.51.1.25
12. Glod M, Riby DM, Honey E, Rodgers J. Psychological Correlates of Sensory Processing Patterns in Individuals with Autism Spectrum Disorder: A Systematic Review. Review Journal of Autism and Developmental Disorders. 2015 Apr 15;2(2):199–221.
13. Jorquera-Cabrera S, Romero-Ayuso D, Rodriguez-Gil G, Triviño-Juárez JM. Assessment of Sensory Processing Characteristics in Children between 3 and 11 Years Old: A Systematic Review. Frontiers in Pediatrics [Internet]. 2017 Mar 30;5(57). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5371598/
14. 1.Kadwa RA, Sahu JK, Singhi P, Malhi P, Mittal BR. Prevalence and Characteristics of Sensory Processing Abnormalities and its Correlation with FDG-PET Findings in Children with Autism. The Indian Journal of Pediatrics. 2019 Oct 15;86(11):1036–42.

15. Lord C, Brugha TS, Charman T, Cusack J, Dumas G, Frazier T, et al. Autism spectrum disorder. Nature Reviews Disease Primers. 2020 Jan 16;6(1):1–23.
16. Pellicano E. Sensory Symptoms in Autism: A Blooming, Buzzing Confusion? Child Development Perspectives [Internet]. 2013 Apr 11;7(3):143–8. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/cdep.12031
17. Posar A, Visconti P. Sensory abnormalities in children with autism spectrum disorder. J Pediatr (Rio J). 2018;94(4):342-350. doi:10.1016/j.jped.2017.08.008
18. Schopler, E., Van Bourgondien, M.E., Wellman, G.J., Love, S.R The Childhood Autism Rating Scale, Second Edition (CARS2)-manual.2010Westerm Psychological Sevices.
19. Suarez MA. Sensory processing in children with autism spectrum disorders and impact on functioning. Pediatr Clin North Am. 2012;59(1):203-xiii. doi:10.1016/j.pcl.2011.10.012

Table 1: Demographic profile (n=83).

Factors	Range
Age in months- range (median)	24- 101 (47.92)
Sex	Female-14 (16.9%) Male- 69 (83.1%)
CARS™-2 score – range (median)	28-48 (34.3)
Father's educational status	<12th standard- 23 (27.7%) Graduate and above- 60 (72.3%)
Mother's educational status	<12th standard- 24 (28.9%) Graduate and above- 59 (71.1%)
Seizures	Present- 6 (7.2%) Absent- 77 (92.8%)
Sleep dysfunction	Present- 14 (16.9%) Absent- 69 (83.1%)

CARS™-2 - Childhood Autism Rating Scale™ – second edition

Table 2: Association between prevalence of sensory processing disorders and severity of autism.

	Mild-moderate autism n=57	Severe autism n= 26	Statistical significance
Sensory sections			
Auditory processing	31 (54.4%)	21 (80.8%)	**.028**
Visual processing	22 (38.6%)	10 (38.5%)	1.000
Tactile processing	25 (43.9%)	12 (46.2%)	1.000
Vestibular processing	17 (29.8%)	8 (30.8%)	1.000
Oral sensory processing	23 (40.4%)	15 (57.7%)	.161
Sensory quadrants			
Low registration	41 (71.9 %)	20 (76.9 %)	.790
Sensory seeking	15 (26.3%)	4 (15.4%)	.399
Sensory avoidance	39 (68.4%)	18 (69.2%)	1.000
Sensory sensitivity	31 (54.4%)	12 (46.2%)	.636