Article

Sensory Processing in Children and Adolescents with Attention Deficit Hyperactivity Disorder

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Indu Rani[1], Vivek Agarwal[1], Amit Arya[1], and Pooja Mahour[1]

Abstract

Objective: The aim is to assess the sensory processing difficulties in children and adolescents with ADHD. **Methods:** In all, 38 ADHD children of the age group 6–14 years and 34 age- and gender-matched typically developing controls were included in the study. Sensory processing was assessed on Child Sensory Profile-2. The child behavior checklist and Weiss functional impairment rating scale were applied to assess behavioral problems and functional impairments, respectively. **Results:** A significantly higher sensory processing difficulties were seen in children with ADHD than typically developing controls. There were positive correlations between the scores of Child sensory profile 2 with internalizing (with Sensitivity $p = .036$, Avoiding $p = .001$, and Auditory $p = .029$) and externalizing T scores (with Seeking $p = .031$, Movement $p = .025$, and Visual $p = .018$) of CBCL and also with scores of Weiss functional impairment rating scale (with Seeking $p = .001$, Sensitivity $p = .019$, and Registration $p = .045$). **Conclusions:** Sensory problems were common in children with ADHD and add to the functional impairments. (*J. of Att. Dis. 2023; 27(2) 145-151*)

Keywords

Sensory processing, healthy control, ADHD, sensory seeking, functioning

Introduction and Background

Attention deficit hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorder seen in children and adolescents (hereafter referred to as children unless specified). The core features of the disorder are inattention, hyperactivity, and impulsivity. With these core symptoms, sensory processing difficulties were also seen in the children with ADHD. Research data have suggested that around 50–60% of children with ADHD have sensory processing difficulties (Dellapiazza et al., 2021; Mimouni-Bloch et al., 2018). Sensory processing refers to the ability to register, interpret, and respond to different types of information taken in through our senses. In Dunn's Sensory Processing Framework: *seeking* means the degree to which sensory input is *obtained* by the child, *avoiding* means the degree to which sensory input *bothers* the child, *the sensitivity* means the degree to which sensory input is *detected* by the child, and *registration* means the degree to which sensory input is *missed* by the child. Sensory processing difficulties can be in the form of over-responsivity, under-responsivity, sensory seeking, and sensory discrimination difficulties (Dunn, 1999). As per Bundy and Lane, there are two major categories of sensory integration: dyspraxia and sensory modulation dysfunction. Sensory modulation can be divided into patterns of over-responsivity and under-responsivity (Bundy & Lane, 2020). To date, sensory processing dysfunction has not been covered in any of the DSM or ICD diagnoses. However, hypo-responsiveness (under-responsive) and hyper-responsive (over-responsive) behaviors were included as newly added criteria for autism spectrum disorders (ASD) in the latest version of the DSM (Association, 2013). The terms sensory integration, sensory modulation, and sensory processing have been used with variable consistency in the literature; however, many authors had used the term sensory modulation disorder (SMD) for sensory modulation difficulties (Keating et al., 2022).

Preliminary studies have shown that children with ADHD have impaired sensory-motor abilities and more sensory processing difficulties as compared to typically developing children (Ben-Sasson et al., 2009; Delgado-Lobete et al., 2020; Dellapiazza et al., 2021; Dunn &

[1]Department of Psychiatry, King George's Medical University, Lucknow, Uttar Pradesh, India

Corresponding Author:
Dr. Indu Rani, Department of Psychiatry, King George's Medical University, Lucknow, Uttar Pradesh 226003, India.
Email: indurani1619@gmail.com

Bennett, 2002; Little et al., 2017; Mangeot et al., 2001; Miller et al., 2012; Mimouni-Bloch et al., 2018; Pfeiffer et al., 2015). Children with ADHD may show various behavioral problems due to these sensory issues such as aggression and delinquency (Mangeot et al., 2001). Some or all sensory systems may be affected including auditory, gustatory, visual, olfactory, tactile, proprioceptive, and vestibular systems.

Sensory processing difficulties are affected by the presence of comorbidities in ADHD. It was seen that sensory auditory processing difficulties, that is, hypo and hyper-responsiveness to sound were correlated to comorbid oppositional defiant disorder (ODD) and anxiety, respectively (Ghanizadeh, 2009). Tactile defensiveness was also high in children with ADHD and was correlated to ODD symptoms (Ghanizadeh, 2008).

Sensory processing difficulties can cause impairment in the functioning of children with ADHD in various ways. The affected children were not able to fully participate in sensory and motor play due to which they are not able to play with their peer group and thus these difficulties hamper the emergence and development of cognitive and social skills (Davis et al., 2009). These children may experience discomfort with everyday life situations which may also significantly disrupt the daily life routines in the home and school (Ahn et al., 2004; Dunn & Bennett, 2002; Hofmann & Bitran, 2007; Jerome & Liss, 2005; Johnson-Ecker & Parham, 2000). The sensory problems related to receiving and processing cause the child to respond inappropriately in different settings like home and school as well as in the community (Dunn & Bennett, 2002).

The data on sensory issues and their clinical correlates in ADHD children are scarce in the Indian context; hence, this study was planned to assess the sensory processing difficulties in children and adolescents with ADHD.

Materials and Method

This was a cross-sectional study conducted at a tertiary center in north India. The study was approved by the Institutional Ethics Committee with letter no. 61/Ethics/2021 with Ref. code: 102nd ECM II B-Thesis/P102. The study sample consisted of all children and adolescents between the age group of 6 and 14 years who fulfilled DSM-5 (Association, 2013) criteria for Attention Deficit Hyperactivity Disorder. Due to ongoing COVID pandemic restrictions, patients visits were reduced; thus, we have included all old (currently on treatment/had taken treatment) and new cases (treatment naive) in the study. Children with comorbid intellectual disability, autism spectrum disorders, psychotic disorders, bipolar affective disorder, obsessive compulsive disorder, and depressive disorder were excluded. Age and gender group matched siblings of cases of Dissociative Disorders attending Child and Adolescent Psychiatry OPD were screened on selection criteria for the typically developing children and those without any psychiatric or medical illness were included in the study. Written informed consent was taken from the parent/guardian. Assent was taken from the study subjects in the healthy control group. Socio-demographic and clinical details were recorded on the semi-structured socio-demographic and clinical proforma. Socio-demographic variables included were age, gender, domicile, religion, education, type of family, and family income. Clinical variables included were treatment is taken, comorbidities, and duration of illness. IQ assessment was done by a consultant clinical psychologist using colored progressive matrices (CPM) and standard progressive matrices (SPM) and children with IQ $>$ 70 were included.

All the subjects were screened on Kiddie Schedule for Affective Disorders and Schizophrenia present and lifetime version (KSADS-PL, Kaufman et al., 2016) for psychiatric disorders. KSADS-PL is a semi-structured interview. It is a 0- to 3-point rating scale with 0 indicating no information is available; scores of 1 suggest the symptom is not present; scores of 2 indicate sub-threshold presentation, and scores of 3 indicate threshold presentation of symptoms. It is used to screen for major depressive disorder, bipolar affective disorder, schizophrenia, schizoaffective disorder, generalized anxiety, obsessive-compulsive disorder, attention deficit hyperactivity disorder, autism, conduct disorder, anorexia nervosa, bulimia, post-traumatic stress disorder, etc. Psychiatric disorders which are not covered by K-SADS-PL were assessed clinically. Diagnosis was made as per DSM-5 (Association, 2013) criteria.

Sensory assessment of study participants was done on Child Sensory Profile-2 (Dunn, 2014) which is valid for children of age 3–14 years and 11 months. The Child Sensory Profile 2 is a set of evaluation-based, clinician-assisted, caregiver, and teacher questionnaires, used in the English language to identify the effect of sensory processing on functional participation of the child in the home, school, and community contexts. The paper forms contain the Score Summary, which provides the following: an area to record demographic information, a scoring grid to summarize the child's scores in the designated sensory patterns, an area to plot raw score totals into performance categories which reflect where that child's responses fall in comparison to peers (aligned with the bell curve to make reporting easier), and a space to document percentile range equivalents to allow meaningful comparison with other standardized measures. The tool is consist of four quadrants, one sensory section, and one behavioral section. The frequency of the child's responses to various sensory experiences using a 5-point scale: Rating 5 (Almost Always = 90% or more), Rating 4 (Frequently = 75%), Rating 3 (Half the Time = 50%), Rating 2 (Occasionally = 25%), and Rating 1 (Almost Never = 10% or less). When a rating of 1 to 5 is not

Table 1. Sociodemographic Variables of the Children With ADHD and the Typically Developing Controls.

Variables	Groups	Group: ADHD $N=38$	Group: Typically developing controls $N=34$	Chi-squared test/Wilcoxon–Mann–Whitney U test: χ^2 or W	p Value
Mean (SD) of age (years) of groups		8.45 (2.27)	8.35 (2.47)	684.00	.666
Domicile (%)	Rural	6 (15.8)	11 (32.4)	2.730	.099
	Urban	32 (84.2)	23 (67.6)		
Religion (%)	Hindu	27 (71.1)	26 (76.5)	0.271	.603
	Muslim	11 (28.9)	8 (23.5)		
Type of family (%)	Nuclear	21 (55.3)	21 (61.8)	0.312	.576
	Joint	17 (44.7)	13 (38.2)		

Variables	Group: ADHD $N=38$		Group: Typically developing controls $N=34$	Fisher's exact test/Wilcoxon–Mann–Whitney U test: χ^2 or W	p Value
Gender (%)	Male	36 (94.7)	32 (94.1)	.013	1.000
	Female	2 (5.3)	2 (5.9)		
Education level of children (%)	Illiterate	1 (2.6)	0 (0.0)	6.330	.123
	Up to primary school	35 (92.1)	28 (82.4)		
	More than primary school	2 (5.3)	6 (17.6)		
Monthly family income (INR)	Mean (SD) in INR	36,921.05 (50,135.70)	15,558.82 (8,934.75)	877.000	.009
IQ	Mean ± SD	92.1 ± 6.4		94.8 ± 5.8	

applicable, a sixth option is available: Does Not Apply = 0. The cut scores for the Child Sensory Profile 2 are based on the means and standard deviations for each summary score. These scores provide a classification system to categorize a child's tendency for specific behaviors (Dunn, 2014).

Behavioral problems were assessed using a parent rated checklist, that is, Child behavior checklist (CBCL; Achenbach & Rescorla, 2001). It is used to detect emotional and behavioral problems in children and adolescents. It includes affective problems, anxiety problems, somatic problems, ADHD problems, oppositional defiant problems, conduct problems, obsessive compulsive disorder (OCD), and posttraumatic stress disorder (PTSD). The CBCL 6–18 is to be used in 6–18 years age group of children. It consists of a total of 113 questions, rated on a 3-point Likert scale (0 = absent, 1 = occurs sometimes, and 2 = occurs often). T scores are computed for total scores. T scores >63 are clinically significant and scores between 60 and 63 are considered in borderline range of psychopathology (Achenbach & Rescorla, 2001).

Weiss functional impairment rating scale-parent report (WFIRS-P; Weiss et al., 2018), original version, 50 items 4-point Likert scale used to assess the functional impairments on six clinically relevant domains. These domains include family, school learning behavior, life skills, child's self-concept, social activities, and risky activities. Any domain with at least two items scored 2, one item scored 3, or a mean score >1.5 is impaired.

Statistical Analysis

Data obtained were analyzed statistically by SPSS Version 28. The Chi square test was used to measure the association between socio-demographic variables. Nonparametric methods, Wilcoxon–Mann–Whitney U test and Fisher's exact test, were used for comparing the two groups in socio-demographic variables and sensory profile. Correlations between CBCL and WFIRS-P scores with sensory profile scores were explored using Spearman correlation.

Observation and Results

A total of 38 children with ADHD and 34 healthy controls were included. The mean age of children with ADHD was 8.45 ± 2.27 years, the majority were male (94.7%), from the nuclear family (55.3%), and urban (84.2%) with upper-middle socioeconomic status (Table 1). The majority of children with ADHD were of combined subtype (73.7%). Most

Table 2. Comparison of Raw Scores and Atypical Sensory Profile Percentages on Child Sensory Profile 2 Between ADHD Cases and Typically Developing Controls.

Sensory profile quadrants and sections		Groups		Wilcoxon–Mann–Whitney *U* test	
		ADHD (*N* = 38), Mean (*SD*)	Typically developing controls (*N* = 34), mean (*SD*)	*W*	*p* Value
Quadrants	Seeking raw score	52.32 (10.22)	21.53 (1.74)	1,292.000	.001
	Avoiding raw score	35.84 (11.17)	21.03 (1.27)	1,240.500	.001
	Sensitivity raw score	38.47 (11.20)	21.09 (1.31)	1,206.500	.001
	Registration raw score	37.66 (9.88)	22.21 (0.54)	1,258.000	.001
Sensory section	Auditory raw scores	16.68 (7.10)	9.62 (1.23)	1,122.000	.001
	Visual raw scores	11.82 (2.63)	6.00 (0.00)	1,292.000	.001
	Touch raw scores	22.11 (6.99)	11.00 (0.00)	1,258.000	.001
	Movement raw scores	20.24 (5.21)	8.12 (0.33)	1,290.000	.001
	Body position raw scores	11.89 (3.32)	8.00 (0.00)	1,139.000	.001
	Oral raw scores	13.92 (4.50)	11.71 (1.34)	867.000	.012
Behavioral section	Conduct raw scores	24.47 (5.15)	11.15 (1.71)	1,289.000	.001
	Social emotional raw scores	25.61 (10.07)	14.15 (0.36)	1,165.500	.001
	Attentional raw scores	24.82 (6.51)	10.06 (0.24)	1,238.000	.001

of them were on treatment (63.2%) and the mean (SD) of duration of illness was 4.20 ± 2.13 years and the mean (SD) IQ was 92.1 ± 6.4. Around 31.6% had psychiatric comorbidity in which ODD was seen in (21.1%) followed by separation anxiety disorder (18.4%) and conduct disorder (2.6%) (Table 1).

Children with ADHD showed significantly more problems in all the quadrants, sensory sections and behavioral sections of child sensory profile 2. In children with ADHD, highest mean raw scores were seen in Seeking (52.32 ± 10.22), touch (22.11 ± 6.99), and Social behavioral section (25.61 ± 10.07) (Table 2).

Attentional section raw scores on child sensory profile showed significant positive correlations with raw scores of Avoiding (rho value = 0.5, *p* value = .002), Sensitivity (rho value = 0.8, *p* value = .001), and Registration (rho value = 0.5, *p* value = .002) in quadrants and Auditory (rho value = 0.6, *p* value = .001) and Visual (rho value = 0.5, *p* value = .002) in sensory sections.

Internalizing T scores of CBCL showed significant positive correlation with raw scores of avoiding (rho value = 0.51, *p* = .001) and sensitivity (rho value = 0.34, *p* value = .036) while externalizing T scores showed significant positive correlation with only seeking quadrant (rho value = 0.33, *p* value = .043). In sensory and behavioral sections, internalizing T scores were also significantly positively correlated with auditory (rho value = 0.35, *p* value = .029) while externalizing T scores showed significant positive correlation with touch (rho value = 0.37, *p* value = .021) and movement (rho value = 0.5, *p* value = .002) raw scores.

There are positive correlations between the raw scores of the quadrants of Child sensory profile 2 and the WFIRS-P scores in different domains (Table 3).

Discussion

In the present study, children with ADHD had shown high scores on all the quadrants, sensory section, and behavioral section as compared to typically developing children which was suggestive of that the children with ADHD had more impaired sensory processing as compared to typically developing controls. Our findings are in accordance with the similar studies conducted previously (Delgado-Lobete et al., 2020; Little et al., 2017; Pfeiffer et al., 2015). The children with ADHD in the study had highest scores on sensory seeking, had attentional problems, and had more difficulties in touch and movement processing which could be due to high seeking (high neurological threshold) for stimuli in ADHD children (Dellapiazza et al., 2021; Dunn, 1997).

Attentional Raw Scores from behavioral section of child sensory profile 2 showed a significant positive correlation with raw scores of Avoiding, Sensitivity and Registration in quadrants and Auditory and Visual in sensory sections. These results were suggestive of the attention problems of children with ADHD were associated with an atypical sensory profile and more sensory difficulties were associated with more attentional problems(Dellapiazza et al., 2021).

In our study, internalizing T scores showed significant positive correlations with Avoiding, Sensitivity, and Auditory scores. The externalizing T scores showed significant positive correlations with Sensory Seeking, Touch, and

Table 3. Correlation Between Child Sensory Profile 2 Quadrants Raw Scores and Weiss Functional Impairment Rating Scale-Parent Version (WFIRS-P) Scores of Children With ADHD.

	WFIRS-P scores											
	Family		School learning and behavior		Life skills		Social activities		Risky activities		Total scores	
Child Sensory profile 2 quadrants	Correlation coefficient (rho)	*p* Value	Correlation coefficient (rho)	*p* Value	Correlation coefficient (rho)	*p* Value	Correlation coefficient (rho)	*p* Value	Correlation coefficient (rho)	*p* Value	Correlation coefficient (rho)	*p* Value
Seeking raw score	.64	.001*	.5	.002*	.08	.625	.37	.023*	.43	.007*	.6	.001*
Avoiding raw score	.3	.065	.03	.873	−.12	.473	.43	.007*	.02	.916	.28	.086
Sensitivity raw score	.35	.031*	.15	.375	.11	.493	.34	.039*	−.06	.708	.38	.019*
Registration raw score	.41	.012*	.18	.277	0	.990	.55	.001*	−.01	.961	.33	.045*

*Significant at $p < .05$, Spearman correlation.

Movement processing scores. Our results were suggestive that ADHD children with more seeking, movement, and touch processing difficulties showed more externalizing behavioral problems. Our results also suggest that with an increase in sensory processing difficulties, behavioral problems also got increased. They were consistent with the findings of previous studies which reported that more difficulties in sensory processing were associated with more behavioral impairments in ADHD children (Ben-Sasson et al., 2009; Dunn, 1997) and that higher levels of sensory difficulties among children with ADHD were related to greater levels of aggressive or delinquent behavior (Mangeot et al., 2001). This can be explained by Dunn's model of sensory processing which stated that the ADHD child with an avoidant and sensitive behavior shows a low neurological threshold, he would resist non-familiar stimulus and would feel more anxious or withdraw themselves from those circumstances which cause internalizing behavioral problems (Dunn, 1997). In contrary to this, children with high neurological thresholds would have sensory seeking behaviors and they used to engage in aggressive, hyperactive and risky behaviors to obtain sensory stimulation which causes an increase in their externalizing behavioral problems (Dunn, 1997).

Although symptoms of ADHD itself cause functional impairments, the sensory processing difficulties may add to them. Our results showed that sensory processing difficulties were significantly correlated with the different domains of the Weiss functional impairment rating scale-parent version (WFIRS-P). In the present study, mean scores of the Social activities domain showed a positive significant correlation with scores of all the quadrants which were similar to previous studies (Sanz-Cervera et al., 2017). Parental stress had relation with the sensory problems in ADHD children and our results also showed that the mean scores of family domain showed a positive significant correlation with scores of all the quadrants except avoiding. Previous study had found that Sensory-motor functioning had a significant association with cognitive processing and academic performance (Davis et al., 2009) and our study also showed that School and learning behavior and risky activities domains showed a significant positive correlation with Seeking scores. Also, the mean of total scores of WFIRS-P showed a significant positive correlation with scores of seeking, sensitivity, and registration quadrants scores. Our results were suggestive that most of the ADHD children in our study had multiple sensory processing difficulties which could add to the impairments in the different domains of the functioning caused by the disorder itself. Thus, a complete evaluation of sensory processing difficulties in ADHD is also necessary to improve the overall functioning of the child.

The present study is one of the first Indian studies to assess sensory issues in children with ADHD on Child Sensory Profile 2. The strength of this study is that age- and gender-matched typically developing children were also taken for comparison and we had excluded other confounding comorbidities which might have obscured the findings regarding the sensory issues.

Limitations of the present study are small size due to the restrictions implemented in COVID-19 pandemic, as it was a time-bound study. The findings cannot be generalized as it was clinical sample. Any correlation of sensory issues with gender and subtypes of ADHD was not seen in the present study due to predominantly male sample and combined subtype of ADHD. As the sample had both new and follow-up cases, so effects of medications on sensory issues could not be ruled out.

Future research should focus on the long-term effects of early intervention targeting sensory issues in the management of ADHD.

Conclusions

Sensory processing difficulties were found in multiple sensory modalities in the children with ADHD. The children with ADHD in our study had highest scores on sensory

seeking and most of them had difficulties in movement and touch processing. Sensory processing difficulties showed significant correlations with the behavioral problems and different domains of functioning in the children with ADHD. It is important to assess and manage sensory processing in children with ADHD for better outcome (Davis et al., 2009; Ghanizadeh, 2009; Pfeiffer et al., 2015).

Author Contributions

All authors had contributed in the study and have approved the final version of the manuscript for publication.

Declaration of Conflicting Interests

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ORCID iD

Indu Rani https://orcid.org/0000-0002-6492-2296

References

Achenbach, T. M., & Rescorla, L. (2001). *Manual for the ASEBA school-age forms & profiles: An integrated system of multi-informant assessment*. ASEBA.

Adams, J. N., Feldman, H. M., Huffman, L. C., & Loe, I. M. (2015). Sensory processing in preterm preschoolers and its association with executive function. *Early Human Development*, *91*(3), 227–233.

Ahn, R. R., Miller, L. J., Milberger, S., & McIntosh, D. N. (2004). Prevalence of parents' perceptions of sensory processing disorders among kindergarten children. *The American Journal of Occupational Therapy*, *58*(3), 287–293. https://doi.org/10.5014/ajot.58.3.287

Association, A. P. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.

Ben-Sasson, A., Carter, A. S., & Briggs-Gowan, M. J. (2009). Sensory over-responsivity in elementary school: Prevalence and social-emotional correlates. *Journal of Abnormal Child Psychology*, *37*(5), 705–716.

Bundy, A. C., & Lane, S. (2020). *Sensory integration: Theory and practice* (3rd ed.). F.A. Davis.

CADDRA. (n.d.). *ADHD assessment forms for children*. Retrieved January 10, 2022, from https://www.caddra.ca/public-information/children/forms/

Davis, A. S., Pass, L. A., Finch, W. H., Dean, R. S., & Woodcock, R. W. (2009). The canonical relationship between sensory-motor functioning and cognitive processing in children with attention-deficit/hyperactivity disorder. *Archives of Clinical Neuropsychology*, *24*(3), 273–286. https://doi.org/10.1093/arclin/acp032

Delgado-Lobete, L., Pértega-Díaz, S., Santos-Del-Riego, S., & Montes-Montes, R. (2020). Sensory processing patterns in developmental coordination disorder, attention deficit hyperactivity disorder and typical development. *Research in Developmental Disabilities*, *100*, 103608. https://doi.org/10.1016/j.ridd.2020.103608

Dellapiazza, F., Michelon, C., Vernhet, C., Muratori, F., Blanc, N., Picot, M.-C., & Baghdadli, A. (2021). Sensory processing related to attention in children with ASD, ADHD, or typical development: Results from the ELENA cohort. *European Child & Adolescent Psychiatry*, *30*(2), 283–291.

Dunn, W. (1997). The impact of sensory processing abilities on the daily lives of young children and their families: A conceptual model. *Infants & Young Children*, *9*(4), 23–35.

Dunn, W. (1999). *Sensory profile: User's manual*. Psychological Corp.

Dunn, W. (2014). *Sensory profile 2*. Pearson.

Dunn, W., & Bennett, D. (2002). Patterns of sensory processing in children with attention deficit hyperactivity disorder. *Occupation, Participation and Health*, *22*(1), 4–15. https://doi.org/10.1177/153944920202200102

Dunn, W., & Westman, K. (1997). The sensory profile: The performance of a national sample of children without disabilities. *The American Journal of Occupational Therapy*, *51*(1), 25–34. https://doi.org/10.5014/ajot.51.1.25

Ghanizadeh, A. (2008). Tactile sensory dysfunction in children with ADHD. *Behavioural Neurology*, *20*(3), 107–112. https://doi.org/10.3233/BEN-2008-0221

Ghanizadeh, A. (2009). Screening signs of auditory processing problem: Does it distinguish attention deficit hyperactivity disorder subtypes in a clinical sample of children? *International Journal of Pediatric Otorhinolaryngology*, *73*(1), 81–87.

Hofmann, S. G., & Bitran, S. (2007). Sensory-processing sensitivity in social anxiety disorder: Relationship to harm avoidance and diagnostic subtypes. *Journal of Anxiety Disorders*, *21*(7), 944–954. https://doi.org/10.1016/j.janxdis.2006.12.003

Jerome, E., & Liss, M. (2005). Relationships between sensory processing style, adult attachment, and coping. *Personality and Individual Differences*, *38*, 1341–1352. https://doi.org/10.1016/j.paid.2004.08.016

Johnson-Ecker, C. L., & Parham, L. D. (2000). The evaluation of sensory processing: A validity study using contrasting groups. *The American Journal of Occupational Therapy*, *54*(5), 494–503. https://doi.org/10.5014/ajot.54.5.494

Kaufman, J., Birmaher, B., & Axelson, D. (2016). Schedule for Affective Disorders and Schizophrenia for School-Aged Children: Present and Lifetime Version (K-SADS-PL) DSM-5 November 2016 working draft. New Haven, Yale University, Child and Adolescent Research and Education

Keating, J., Gaffney, R., Bramham, J., & Downes, M. (2022). Sensory modulation difficulties and assessment in children with attention deficit hyperactivity disorder: A systematic review. *European Journal of Developmental Psychology*, *19*(1),110–144. https://doi.org/10.1080/17405629.2021.1889502

Little, L. M., Dean, E., Tomchek, S. D., & Dunn, W. (2017). Classifying sensory profiles of children in the general population. *Child: Care, Health and Development*, *43*(1), 81–88. https://doi.org/10.1111/cch.12391

Mangeot, S. D., Miller, L. J., McIntosh, D. N., McGrath-Clarke, J., Simon, J., Hagerman, R. J., & Goldson, E. (2001). Sensory

modulation dysfunction in children with attention-deficit–hyperactivity disorder. *Developmental Medicine and Child Neurology*, *43*(6), 399–406.

McIntosh, D. N., Miller, L. J., Shyu, V., & Hagerman, R. J. (1999). Sensory-modulation disruption, electrodermal responses, and functional behaviors. *Developmental Medicine and Child Neurology*, *41*(9), 608–615. https://doi.org/10.1017/s0012162299001267

Miller, L. J., Nielsen, D. M., & Schoen, S. A. (2012). Attention deficit hyperactivity disorder and sensory modulation disorder: A comparison of behavior and physiology. *Research in Developmental Disabilities*, *33*(3), 804–818.

Mimouni-Bloch, A., Offek, H., Rosenblum, S., Posener, I., Silman, Z., & Engel-Yeger, B. (2018). Association between sensory modulation and daily activity function of children with attention deficit/hyperactivity disorder and children with typical development. *Research in Developmental Disabilities*, *83*, 69–76.

Pfeiffer, B., Daly, B. P., Nicholls, E. G., & Gullo, D. F. (2015). Assessing sensory processing problems in children with and without attention deficit hyperactivity disorder. *Physical & Occupational Therapy in Pe diatrics*, *35*(1), 1–12.

Reynolds, S., & Lane, S. J. (2008). Diagnostic validity of sensory over-responsivity: A review of the literature and case reports. *Journal of Autism and Developmental Disorders*, *38*(3), 516–529. https://doi.org/10.1007/s10803-007-0418-9

Sanz-Cervera, P., Pastor-Cerezuela, G., González-Sala, F., Tárraga-Mínguez, R., & Fernández-Andrés, M.-I. (2017). Sensory processing in children with autism spectrum disorder and/or attention deficit hyperactivity disorder in the home and classroom contexts. *Frontiers in Psychology*, *8*, 1772. https://doi.org/10.3389/fpsyg.2017.01772

Weiss, M. D., McBride, N. M., Craig, S., & Jensen, P. (2018). Conceptual review of measuring functional impairment: Findings from the Weiss Functional Impairment Rating Scale. *Evidence-Based Mental Health*, *21*(4), 155–164. https://doi.org/10.1136/ebmental-2018-300025

Author Biographies

Dr. Indu Rani, MD, is working in Department of Psychiatry, K. G. Medical University Lucknow, Uttar Pradesh, India. Her main areas of interest include child and adolescent psychiatry, executive functioning, sensory processing in ADHD.

Dr. Vivek Agarwal, MD, is Professor and Head of Department of Psychiatry, K. G. Medical University Lucknow, Uttar Pradesh, India. His main areas of interest are ADHD, Mood disorders, executive functioning and metacognition in Adolescent OCD, Dissociative Disorders, Brain stimulation in children and adolescents.

Dr. Amit Arya, MD, is an Additional Professor in the Department of Psychiatry, K. G. Medical University Lucknow, Uttar Pradesh, India. His areas of interest include cognition, neural network connectivity in ADHD, ASD, Gaming addiction, childhood bipolar disorders.

Dr. Pooja Mahour, PhD, is currently working as Additional Professor Cum Child Psychologist in the Department of Psychiatry, K. G. Medical University Lucknow, Uttar Pradesh, India. Her areas of interest include Child and Adolescents Psychology-Specific Learning Disorder and it's Intervention Meta cognition based therapy and Mindfulness based interventions.