RESEARCH PAPER

Association Between Sensory Processing And Attention-Deficit/Hyperactivity Disorder Symptoms In Typically Developing Preschoolers: A Cross-Sectional Study

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Abstract

Background: Preschool years are marked by rapid changes in attention, self-regulation, communication, and participation. At this age, children also differ considerably in how they notice, filter, and respond to sensory information. Understanding whether these sensory-processing patterns are related to early attention and behavioural symptoms may help clinicians and educators identify children who warrant closer developmental observation. This study examined sensory processing patterns and their association with attention-deficit/hyperactivity disorder (ADHD) symptom scores in typically developing preschoolers.

Materials and Methods: A cross-sectional observational study was conducted in preschool settings over one year using purposive sampling. Children aged 3–5 years were eligible. A total of 194 children were assessed using the Child Sensory Profile 2 (CSP-2) and the ADHD Rating Scale-IV Preschool Version. Descriptive statistics were used to summarize participant characteristics and sensory-processing scores. Normality was assessed using the Kolmogorov–Smirnov test, and Spearman's rank correlation coefficient was used to examine associations between sensory-processing domains and ADHD total scores. Statistical significance was set at $p<0.05$.

Results: The sample included 99 boys (51.03%) and 95 girls (48.97%). Most children were classified as "just like the majority of others" for seeking (87.63%), avoiding (81.96%), and sensitivity (72.16%). Registration showed a different distribution: 48.97% were classified as "just like the majority of others," whereas 42.27% were classified as "much more than others." Twenty children (10.31%) screened as suspicious for ADHD. ADHD total scores showed significant positive associations with avoiding ($\rho=0.155$, $p=0.031$), registration ($\rho=0.278$, $p<0.001$), and the overall sensory profile score ($\rho=0.339$, $p<0.001$). Seeking ($\rho=0.025$, $p=0.730$) and sensitivity ($\rho=0.134$, $p=0.063$) were not significantly associated with ADHD total scores.

Conclusion: Sensory-processing patterns, particularly registration, were associated with ADHD symptom scores in this preschool sample. The findings support the value of considering sensory behaviour alongside developmental and behavioural screening. Importantly, the screening findings should not be interpreted as a diagnosis of ADHD. Longitudinal studies using multiple informants and clinical diagnostic assessments are needed to clarify the developmental significance of these associations.

Keywords: sensory processing; preschool children; ADHD symptoms; Child Sensory Profile 2; sensory registration.

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Introduction

The preschool period is a time of remarkable developmental change. Children are learning to manage increasingly complex sensory environments while also developing attention, language, motor skills, social participation, and behavioural self-regulation. The way a child notices and responds to information from the body and the surrounding environment can influence how comfortably that child participates in play, classroom routines, and everyday interactions.1234

Sensory integration refers broadly to the organization of sensory information so that an individual can respond effectively to the demands of everyday life.4 Dunn's conceptual model describes four sensory-processing patterns—seeking, avoiding, sensitivity, and registration—within the relationship between neurological thresholds and behavioural responses.5 These patterns are better understood as dimensions that may vary between children rather than as fixed categories. Differences can be observed across visual, auditory, tactile, vestibular, proprioceptive, olfactory, and gustatory experiences and may affect participation and regulation.456

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental condition characterized by developmentally inappropriate levels of inattention and/or hyperactivity-impulsivity. Sensory-processing differences have also been described in children with ADHD and may coexist with difficulties involving attention, behavioural regulation, impulsivity, and emotional regulation.78 Previous studies have reported relationships between ADHD characteristics and sensory modulation, sensory sensitivity, or sensory over-responsivity.910 However, these relationships may look different at different stages of development, making the preschool period particularly important for investigation.

The present study focused on children who were not selected from a clinically diagnosed ADHD population. This distinction is important because early childhood behaviours can be influenced by developmental stage and context, and screening scores do not by themselves establish a clinical diagnosis. The Child Sensory Profile 2 (CSP-2) provides a structured caregiver-reported description of sensory-processing patterns, while the ADHD Rating Scale-IV Preschool Version was developed to assess ADHD symptoms in preschool-aged children.1112

The objective of this study was to describe sensory-processing patterns in typically developing preschoolers and to determine whether CSP-2 scores were associated with ADHD symptom scores.

2. Materials and Methods

2.1 Study design and setting

A cross-sectional observational study was conducted in preschool settings over a one-year period. The study population comprised children aged 3–5 years. Purposive sampling was used, and 194 children were included in the final analysis.

2.2 Participants

Children aged 3–5 years of either sex were eligible. Children with previously diagnosed neurological, cardiovascular, or musculoskeletal disorders were excluded. Caregivers who did not understand English were also excluded because the study questionnaires were administered in English. Institutional ethics committee approval was obtained, and written informed consent was obtained from parents or caregivers before participation. Participation was voluntary, confidentiality was maintained, and caregivers were informed that they could withdraw without consequence.

2.3 Sample size

The planned sample size was 194. The thesis describes a correlation-based calculation using a two-sided α of 0.05, 80% power, and an expected correlation coefficient of 0.20.

2.4 Assessment tools

Sensory processing was assessed using the Child Sensory Profile 2 (CSP-2), a caregiver-report questionnaire that characterizes sensory-processing patterns across four quadrants: seeking, avoiding, sensitivity, and registration.

Table 1. Participant characteristics.

Characteristic	n	%
Male	99	51.03
Female	95	48.97
Total	194	100.00

3.2 Sensory-processing profile

The mean scores were 28.294±9.648 for seeking, 27.701±11.090 for avoiding, 35.280±17.650 for sensitivity, and 52.310±28.880 for registration. Registration showed the widest apparent shift toward the "much more than others" category, with 82 children (42.27%) classified in this group.

Table 2. Descriptive statistics for CSP-2 sensory-processing quadrants.

CSP-2 quadrant	Mean	SD	Median	Range
Seeking	28.294	9.648	24.00	18–70
Avoiding	27.701	11.090	24.00	14–88
Sensitivity	35.280	17.650	28.50	15–91
Registration	52.310	28.880	44.00	19–108

Evidence supporting the reliability of the Sensory Profile caregiver questionnaire has been reported previously.11

ADHD symptoms were assessed using the ADHD Rating Scale-IV Preschool Version, a developmentally adapted measure for preschool-aged children. In this study, the scale was completed by the parent or caregiver.12

2.5 Data collection procedure

Following institutional approval and informed consent, eligible children were screened. Data collection was completed in two rounds. In the first round, groups of approximately 10–15 parents or caregivers received an explanation of the CSP-2 and completed the relevant questionnaire components. The therapist completed observational components during the child's play-based assessment. In the second round, outstanding questionnaire components were completed and the ADHD Rating Scale-IV Preschool Version was administered to the parent or caregiver.

2.6 Statistical analysis

Descriptive statistics were used to summarize demographic characteristics, sensory-processing quadrant scores, the overall sensory profile score, and ADHD symptom scores. Normality was examined using the Kolmogorov–Smirnov test. Because the study variables were reported as non-normally distributed, Spearman's rank correlation coefficient was used to examine associations between CSP-2 domains and the ADHD total score. Statistical significance was set at $p<0.05$. The thesis reports the use of SPSS version 19 for normality testing and Minitab version 19 for descriptive statistics, graphs, and correlation analyses.

2.7 Ethical considerations

The study received institutional ethics committee approval. Written informed consent was obtained from parents or caregivers before participation.

3. Results

3.1 Participant characteristics

A total of 194 preschool children participated. The sample included 99 boys (51.03%) and 95 girls (48.97%). The reported mean age was approximately 4.33 years. The age distribution should be verified against the raw dataset before final submission because the source thesis contains an internally inconsistent maximum age value.

Table 3. Distribution of participants across CSP-2 interpretation categories.

CSP-2 interpretation	Seeking n (%)	Avoiding n (%)	Sensitivity n (%)	Registration n (%)
Just like majority of others	170 (87.63)	159 (81.96)	140 (72.16)	95 (48.97)
Less than others	13 (6.70)	20 (10.31)	4 (2.06)	—
More than	8	8	20	17 (8.76)

others	(4.12)	(4.12)	(10.31)	
Much more than others	3 (1.55)	7 (3.61)	30 (15.46)	82 (42.27)

For seeking, avoiding, and sensitivity, most children were classified as "just like the majority of others." Registration differed: 95 children (48.97%) were classified as "just like the majority of others," while 82 (42.27%) were classified as "much more than others." The overall Sensory Profile Total score had a mean of 143.58±45.06, median of 139, and range of 77–281.

3.3 ADHD symptom profile

Twenty children (10.31%) screened as suspicious for ADHD, whereas 174 (89.69%) were within the normal range. The mean inattention score was 10.742±2.978, the mean hyperactivity/impulsivity score was 11.216±2.686, and the reported mean ADHD total score was 22.000±4.494.

Table 4. ADHD screening interpretation.

ADHD screening interpretation	n	%
Suspicious for ADHD	20	10.31
Within normal range	174	89.69
Total	194	100.00

3.4 Association between sensory processing and ADHD symptoms

Seeking was not significantly associated with ADHD total score (ρ=0.025, p=0.730). Avoiding showed a weak positive association (ρ=0.155, p=0.031). Sensitivity showed a weak positive association that did not reach statistical significance (ρ=0.134, p=0.063). Registration demonstrated a weak but statistically significant positive association with ADHD total score (ρ=0.278, p<0.001). The overall Sensory Profile Total score also showed a statistically significant positive association with ADHD total score (ρ=0.339, p<0.001).

Table 5. Spearman correlations between sensory-processing variables and ADHD total score.

Sensory variable	Spearman ρ	p value	Interpretation
Seeking	0.025	0.730	Not significant
Avoiding	0.155	0.031	Weak positive; significant
Sensitivity	0.134	0.063	Not significant
Registration	0.278	<0.001	Weak positive; significant
Sensory Profile Total	0.339	<0.001	Positive; significant

4. Discussion

This study explored sensory-processing patterns and their relationship with ADHD symptom scores in 194 preschool children who were not selected from a clinically diagnosed ADHD population. The main finding was that registration and the overall sensory profile score were significantly associated with ADHD symptom scores. Avoiding also showed a statistically significant association, although the magnitude of the relationship was small. Seeking and sensitivity were not significantly associated with ADHD total scores.

One of the most striking observations was the distribution of registration scores. More than two-fifths of the children were classified as "much more than others" in this domain. In practical terms, registration relates to how readily a child notices and responds to sensory information. A child who does not consistently register information from the environment may appear less responsive, slower to orient to cues, or less immediately engaged in a busy setting. These behaviours can overlap with the everyday concerns that lead adults to describe a young child as inattentive. The present findings do not establish that one causes the other, but they suggest that the sensory context deserves attention when such behaviours are observed.5,6,17

The significant association between registration and ADHD symptoms is broadly compatible with previous reports describing sensory-processing differences in children with ADHD.7,15,16 At the same time, the present study is informative because the children were preschoolers from the general preschool population rather than a group already diagnosed with ADHD. This perspective may be useful during a developmental period when attention and behavioural regulation are still changing rapidly.

Avoiding was also positively associated with ADHD symptom scores, although the correlation was weak. Children who avoid certain sensory experiences may have difficulty participating comfortably in environments containing competing sounds, movement, touch, or other sensory demands. Previous work has discussed sensory over-responsivity in relation to ADHD traits, but the small effect observed here warrants a cautious interpretation.9,10

Sensitivity was elevated in a substantial minority of children but was not significantly associated with ADHD total score. This finding differs from some previous reports linking ADHD traits with sensory sensitivity.910 Differences in developmental stage, caregiver perception, sampling, and assessment methods may contribute to the variation across studies. A non-significant result in the present sample should therefore not be interpreted as evidence that sensory sensitivity is unrelated to attention or behaviour in all preschool children.

The finding that 10.31% of children screened as suspicious for ADHD requires particular care in interpretation. This percentage represents a screening classification within this sample, not the prevalence of clinically diagnosed ADHD. A diagnosis requires a comprehensive developmental and clinical assessment, consideration of impairment across settings, and appropriate clinical judgment. The present study did not include a diagnostic assessment or a clinically diagnosed ADHD comparison group.12,13,14

The study has several strengths. It included 194 preschool children, had relatively balanced representation of boys and girls, used established assessment instruments, and selected a non-parametric correlation method after examining distributional assumptions. The study also addresses an age group that is clinically important but comparatively challenging to characterize because developmental variability is substantial.

Several limitations should temper interpretation. The dependence on caregiver questionnaires raises the

possibility of subjective bias, as parental opinions may differ due to expectations or cultural norms. The cross-sectional design precludes causal inference, and the lack of a clinical ADHD-diagnosed group restricts generalizability to clinical groups. Furthermore, contextual factors such as socioeconomic status, school setting, and cultural views about conduct were not examined.17,18,19.

5. Conclusion

Sensory-processing patterns varied among the preschool children studied, with particularly marked variation in the registration domain. ADHD symptom scores were significantly associated with avoiding, registration, and the overall sensory profile score, whereas seeking and sensitivity were not significantly associated with ADHD total scores. These findings suggest that sensory behaviour may be useful to consider alongside developmental and behavioural screening when preschool children present with attention or regulation concerns. However, sensory screening findings should be regarded as indicators of possible functional or developmental concerns, not as diagnostic evidence of ADHD.

6. Clinical and Research Implications

The findings have a practical implication for preschool care: when a child appears inattentive, unusually slow to respond to cues, overwhelmed by particular sensory experiences, or difficult to engage in everyday routines, it may be useful to consider both the child's behaviour and the sensory demands of the environment. This does not mean that sensory processing explains every attention or behavioural difficulty. Rather, a broader developmental view may help clinicians, educators, and caregivers identify appropriate supports and decide when further assessment is warranted.

Future studies should use longitudinal designs to determine whether early sensory-processing patterns predict later behavioural outcomes. Research should also incorporate multiple informants, objective measures of attention and activity, clinically diagnosed comparison groups, and more detailed analysis of environmental and developmental factors. Intervention studies are needed to determine whether sensory-based or multidisciplinary approaches meaningfully improve attention, self-regulation, participation, and day-to-day functioning.2325

7. Limitations

The dependence on caregiver questionnaires raises the possibility of subjective bias, as parental opinions may differ due to expectations or cultural norms. The cross-sectional design precludes causal inference, and the lack of a clinical ADHD-diagnosed group restricts generalizability to clinical groups. Furthermore, contextual factors such as socioeconomic status, school setting, and cultural views about conduct were not examined.17,18,19.

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