

“Prevalence of Sensory Processing Difficulties among Toddlers Attending Early Intervention Clinics in Kerala.”

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Abstract

Background: Sensory processing difficulties (SPD) are frequently observed in children with developmental delays and may significantly impact functional performance, behavior, and the parent–child relationship. Early identification of sensory processing patterns is crucial for effective intervention planning during early childhood. **Objectives:** This study aims to assess the prevalence of sensory processing difficulties among toddlers with developmental delay, characterize common sensory processing patterns (over-responsive, under-responsive, and sensory seeking), and evaluate associations between sensory processing difficulties and selected demographic and clinical variables. **Methods:** A prospective observational study was conducted over three months (December 2025 to February 2026) at the Early Intervention Clinic, Department of Pediatrics, Institute of Maternal and Child Health, Kozhikode. One hundred toddlers aged 12–36 months with a diagnosis of developmental delay were recruited through convenient sampling. Data collection involved a Demographic and Clinical Data Sheet and the Toddler Sensory Profile (a caregiver-reported questionnaire). Analysis was performed using SPSS version 25. Descriptive statistics (frequency, percentage, mean, and median) summarized the data, and the Chi-square test assessed associations between sensory processing difficulties and selected variables. **Results:** The prevalence of sensory processing difficulties in the cohort was 68%. Sensory seeking behaviors were most frequent (66.2%), followed by over-responsiveness (61.8%) and under-responsiveness (54.4%). Statistically significant associations were identified between sensory processing difficulties and both gestational age ($p < 0.05$) and type of developmental delay ($p < 0.05$). No significant correlation was observed with gender or birth weight. **Conclusion:** Sensory processing difficulties are highly prevalent among toddlers with developmental delay, particularly among those born preterm and those exhibiting autism spectrum features or global developmental delay. Incorporating early screening and targeted sensory-based interventions into early intervention programs is recommended to enhance developmental outcomes.

Keywords: Sensory processing difficulties, developmental delay, toddlers, sensory seeking, early intervention, prevalence.

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Introduction

Early childhood is recognised as a critical period marked by rapid brain development. Within the first three years of life, sensory experiences significantly influence motor skills, emotional regulation, cognitive growth, and social interaction. Sensory processing describes how the nervous system receives, organises, and responds to environmental and bodily inputs. Sensory integration, as defined by Macaluso & Driver (2005), involves processing multimodal sensory inputs for functional outcomes that enable effective interaction with one's surroundings. It is believed that inputs from distinct sensory organs are managed in specialised brain regions, while communication between and within these areas constitutes functional integration.⁽⁵⁾ Assessing sensory integrative function is essential in clinical evaluation, particularly for children with developmental disabilities. Competent sensory processing is fundamental for

developing motor abilities, communication, social engagement, and everyday functioning, especially during early childhood. Nonetheless, a considerable number of toddlers and preschoolers encounter sensory

processing difficulties (SPD)—including over-responsiveness, under-responsiveness, or excessive seeking of sensory input—which can disrupt daily activities and learning. Such challenges may present as difficulties with routine tasks like eating, dressing, playing, or participating in social situations.⁽¹⁾ Dysregulation in processing sensory information—including touch, smell, taste, sound, movement, or body position—can result in hyper-sensitivity (avoidance or heightened reactions to stimuli such as loud noises, bright lights, or physical contact), hypo-sensitivity (requiring intense sensory stimulation to perceive input), sensory-seeking behaviours (frequent pursuit of strong sensory experiences, such as crashing into objects or

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banging toys), or mixed patterns of response (under-responsivity, seeking, and/or avoidance) (Dunn, 2007). Human development encompasses physical, cognitive, and psychosocial changes throughout the lifespan, with developmental disabilities representing a significant global concern. Common examples include attention deficit/hyperactivity disorder (ADHD), specific language disability (SLD), autism spectrum disorder (ASD), intellectual disability (ID), and other developmental delays. There are nearly 240 million children worldwide living with disabilities.(2) While international research on sensory processing difficulties has expanded, evidence from low- and middle-income contexts such as India remains scarce. Particularly in Kerala, where advanced healthcare systems and expanding early childhood programmes exist, limited data are available regarding the prevalence of sensory processing difficulties among toddlers accessing early intervention services. The state's infrastructure presents an opportunity to examine how commonly these challenges occur in young children attending such programmes. Understanding their prevalence and patterns is vital for early detection, precise intervention planning, and appropriate allocation of resources.(3) Early intervention clinics serve a crucial function in identifying developmental delays and disorders during the formative years. Toddlers seen at these clinics often exhibit diverse developmental concerns; however, sensory processing issues are frequently under-recognised or overshadowed by other symptoms.(15,17) Investigating the prevalence of sensory processing difficulties within this population may inform professional training, optimise referral pathways, and guide parent-mediated interventions.(4) Accordingly, it is necessary to estimate the **prevalence of sensory processing difficulties** among toddlers attending early intervention clinics in Kerala and explore associated demographic and clinical characteristics. Outcomes from this research will enhance understanding of sensory processing challenges in the local context and support the development of tailored intervention frameworks to improve developmental trajectories in young children. Additionally, these findings may inform nursing strategies to optimise future outcomes for affected children.

Need and Significance of the Study

Children diagnosed with developmental delays often have underlying health conditions that affect their nervous systems, resulting in deficits across motor, intellectual, language, behavioural, and sensory functions. Sensory issues, including both hypo- and hypersensitivity, can present as distinct disorders or as part of broader neurodevelopmental conditions. Health professionals are responsible for minimising these differences' impact on a child's social, emotional, and behavioural development through early detection and referral for treatment.

Toddlers with Sensory Processing Difficulties (SPD) frequently display poor attention, irritability, feeding challenges, delayed motor skills, and trouble interacting socially. If not identified early, these difficulties may

lead to long-term developmental, behavioural, and academic problems. While SPD is well-studied in Western countries, **information from India, and especially Kerala, is limited** regarding the number of affected toddlers in early intervention settings. Clinics in Kerala often treat children with developmental delays, autism, cerebral palsy, and other high-risk conditions where SPD is common. However, sensory issues are often **under-diagnosed or overlooked**, as focus tends to be placed on speech, motor, or cognitive delays. Preterm children are more likely to develop sensory processing difficulties. (1)

Without local prevalence data, it is difficult for clinicians, nurses, therapists, and policymakers to plan screening, intervention services, or training programs effectively. As such, this study aims to establish the **extent of sensory processing difficulties** among toddlers attending early intervention clinics in Kerala and to raise awareness about this often neglected area of development.

The study has far-reaching implications for **clinical practice, early intervention, nursing, parents, and policy planning**. By assessing the prevalence of SPD, professionals will be better equipped to identify at-risk toddlers early. Early detection enables timely, sensory-based interventions, which can greatly enhance a child's functional abilities and participation in daily life. The findings will help occupational therapists, physiotherapists, speech therapists, and nurses design **customised, sensory-based intervention plans**. The research also supports making sensory screening a routine part of early assessments. Nurses in pediatric and intervention settings will use this knowledge to recognise sensory-related behaviours, educate families, and contribute more to multidisciplinary care. Increased understanding of SPD's nature and frequency will drive parental awareness and prevent misinterpretation of behaviour as “stubborn” or “naughty,” encouraging more supportive parenting strategies. Ultimately, this study will provide evidence for healthcare administrators and policymakers to strengthen **early intervention programmes**, allocate resources, and integrate sensory integration services into child development clinics throughout Kerala.

Objectives

Primary Objective

- To determine the prevalence of sensory processing difficulties in toddlers with developmental delay.

Secondary Objectives

- To identify types of sensory processing patterns (over-responsive, under-responsive, sensory seeking).
- To determine the association between sensory processing difficulties and selected demographic/clinical variables (age, gender, type of delay, birth history).

Methods and materials

Study setting: This study was conducted in the Early Intervention Clinic, Department of pediatrics, of the Institute of Maternal and Child Health, Kozhikode.

Period: A prospective observational study was conducted in the Early Intervention Clinic over a period of 3 months from December 2025 to February 2026.

Population

Toddlers aged 12–36 months diagnosed with developmental delay.

Sample Size

The sample size was calculated using the formula $n = Z^2pq/d^2$. Assuming prevalence (p) of 50%, confidence level of 95% ($Z = 1.96$), and allowable error of 10%, the calculated sample size was 96. The final sample size was rounded to 100 participants.

Sampling Technique

Convenient sampling.

Inclusion Criteria

- Toddlers aged 12–36 months.
- Diagnosed with developmental delay.
- Parent willing to participate.

Exclusion Criteria

- Severe medical instability.
- Diagnosed severe sensory impairments (blindness, profound deafness).

Operational definition

□ **Sensory Processing Difficulties:** Challenges in organizing and responding appropriately to sensory input, measured using a standardized tool (e.g., Toddler Sensory Profile).

□ **Toddlers:** Children aged 12–36 months.

□ **Developmental Delay:** Delay in one or more developmental domains (motor, speech, cognitive,

social), diagnosed by a pediatrician or developmental specialist.

Data Collection Tools and Techniques

Following the acquisition of informed consent from parents, data were gathered utilizing a Demographic and Clinical Data Sheet, as well as a caregiver-reported questionnaire evaluating sensory processing patterns (Toddler Sensory Profile). The researcher conducted data collection over a three-month period.

Data Processing and Analysis

Following data collection, each set was reviewed for inconsistencies and completeness according to the codes assigned during the process. The data were subsequently entered into SPSS version 25 for Windows. Descriptive statistical methods were employed to determine percentages, means, and medians. The relationships between variables and sensory processing difficulties were analyzed using the chi-square test.

Results

1. Demographic Characteristics of Child Participants

The study included **100 toddlers with developmental delays**, with an average age of **29.4 ± 3.6 months** (ranging from 24 to 36 months). Boys made up the majority (**63.3%**) compared to girls (**36.7%**), and nearly half were first-born children (**46.7%**).

Most participants were born at term (**71.7%**), while **21.7%** were preterm. A birth weight of 2.5–3.5 kg was most common (**65.0%**), and caesarean delivery occurred most frequently (**48.3%**).

Among diagnoses, Global Developmental Delay (GDD) was most prevalent (**40.0%**), with speech/language delay (**23.3%**) and motor delay (**18.3%**) following. Features associated with autism spectrum disorder were seen in **11.7%** of cases.

The majority of children received more than one type of therapy, most often occupational therapy (**68.3%**) and speech therapy (**55.0%**).

Table 1. Demographic Characteristics of Children (N = 100)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	38	63.3
	Female	22	36.7
Birth Order	1 st	28	46.7
	2 nd	20	33.3
	≥3 rd	12	20.0
Gestational Age	Preterm	13	21.7
	Term	43	71.7
	Post-term	4	6.6
Birth Weight	<2.5 kg	14	23.3
	2.5–3.5 kg	39	65.0
	>3.5 kg	7	11.7
Mode of Delivery	NVD	24	40.0
	Assisted	7	11.7

Variable	Category	Frequency (n)	Percentage (%)
	LSCS	29	48.3
Primary Diagnosis	GDD	24	40.0
	Motor Delay	11	18.3
	Speech Delay	14	23.3
	Autism features	7	11.7
	Others	4	6.7

Figure 1. Gender distribution of toddlers with developmental delay attending the early intervention clinic (N = 100). The majority of participants were male (63.3%) compared to females (36.7%).

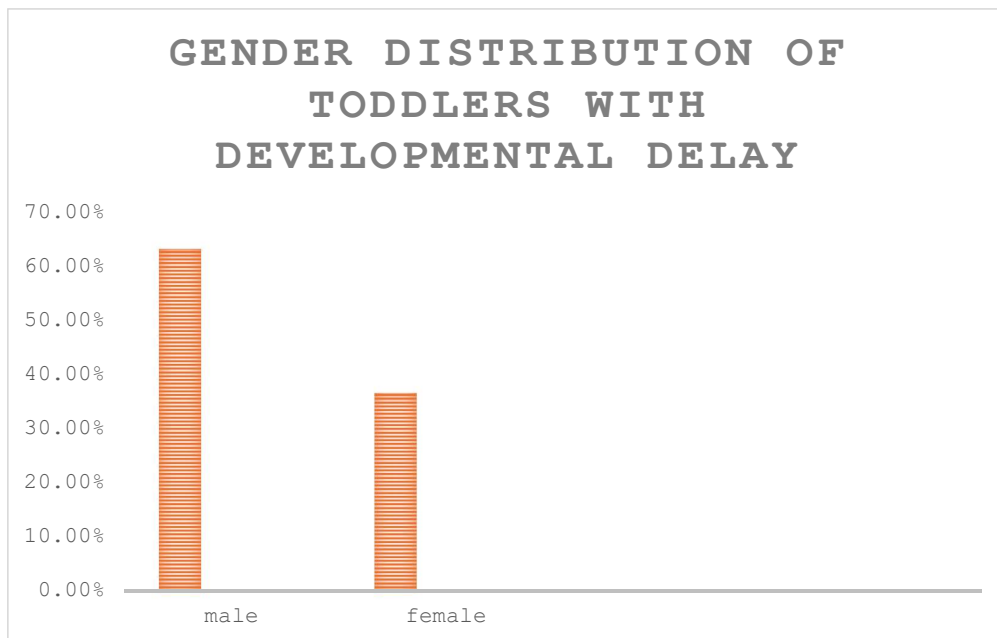


Figure 1. Gender distribution of toddlers with developmental delay

Figure 2. Distribution of primary diagnosis among toddlers (N = 100). Global Developmental Delay was the most common diagnosis (40%), followed by Speech/Language Delay (23.3%) and Motor Delay (18.3%), Autism features (11.7%) and others (6.7%).

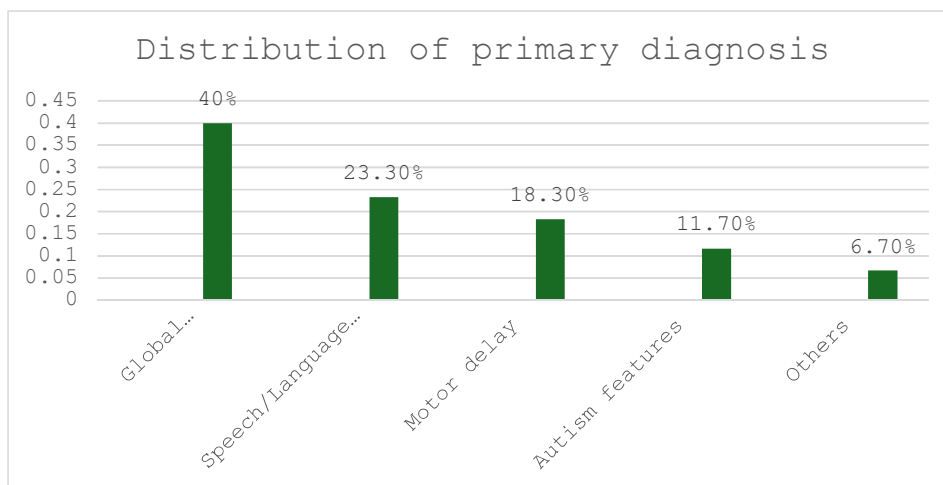


Figure 2. Distribution of primary diagnosis among toddlers

Parent/Caregiver Characteristics

Most primary caregivers were mothers (83.3%), with an average age of 31.8 ± 4.7 years. Nearly half (46.7%) had completed high school or higher secondary education, and 28.3% held a graduate degree or higher. The majority of families lived in a nuclear family setup (70.0%) and were based in urban locations (58.3%). In terms of socioeconomic status, 35.0% of families reported a monthly income ranging from ₹20,001 to ₹40,000.

Table 2. Demographic Characteristics of Parents/Caregivers (N = 60)

Variable	Category	Frequency (n)	Percentage (%)
Primary Caregiver	Mother	50	83.3
	Father	6	10.0
	Grandparent	4	6.7
Education	No formal	4	6.7
	Primary	6	10.0
	High school	18	30.0
	Higher secondary	10	16.7
	Graduate	15	25.0
	Postgraduate	7	11.6
Occupation	Homemaker	36	60.0
	Private	11	18.3
	Govt	5	8.3
	Self-employed	6	10.0
	Daily wage	2	3.4
Family Type	Nuclear	42	70.0
	Joint	14	23.3
	Extended	4	6.7
Residence	Rural	25	41.7
	Urban	35	58.3
Marital Status	Married	56	93.3
	Single/Separated	4	6.7

Figure 3. Distribution of primary caregivers of participating children (N = 100). Mothers constituted the predominant caregivers (83.3%), followed by fathers (10%) and grandparents (6.7%).

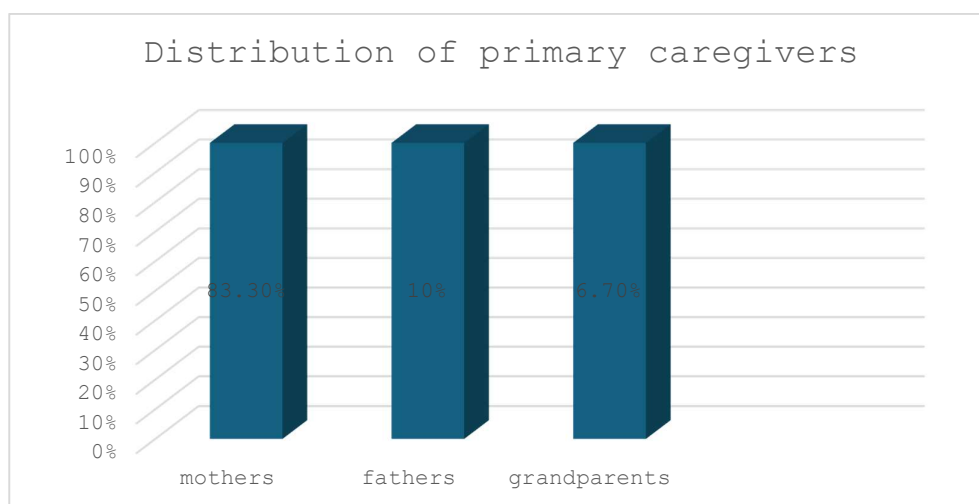


Figure 3. Distribution of primary caregivers of participating children

Figure 4. Distribution of family type among participants (N = 100). Most children belonged to nuclear families (70%), with fewer from joint (23.3%) and extended families (6.7%).

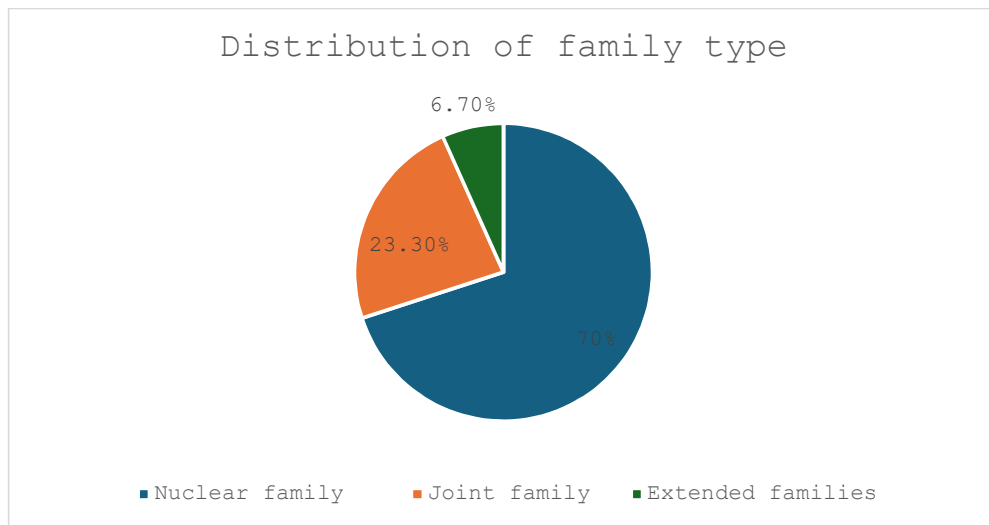


Figure 4. Distribution of family type among participants

2. Prevalence of sensory processing difficulties among toddlers with developmental delay

Among 100 toddlers evaluated using the toddler sensory profile 68% found to have sensory processing difficulties (SPD), while 32% showed typical sensory processing. Accordingly, the prevalence of SPD in this cohort was 68%.

Table 3 : Prevalence of sensory processing difficulties among toddlers with developmental delay(N=100)

Sensory Processing difficulties	Frequency (n)	Percentage (%)
Present	68	68.0
Absent	32	32.0

Figure 5: Prevalence of sensory processing difficulties among toddlers with developmental delay(N=100) sensory processing difficulties were identified in 68% of participants, as assessed by the Toddler sensory profile.

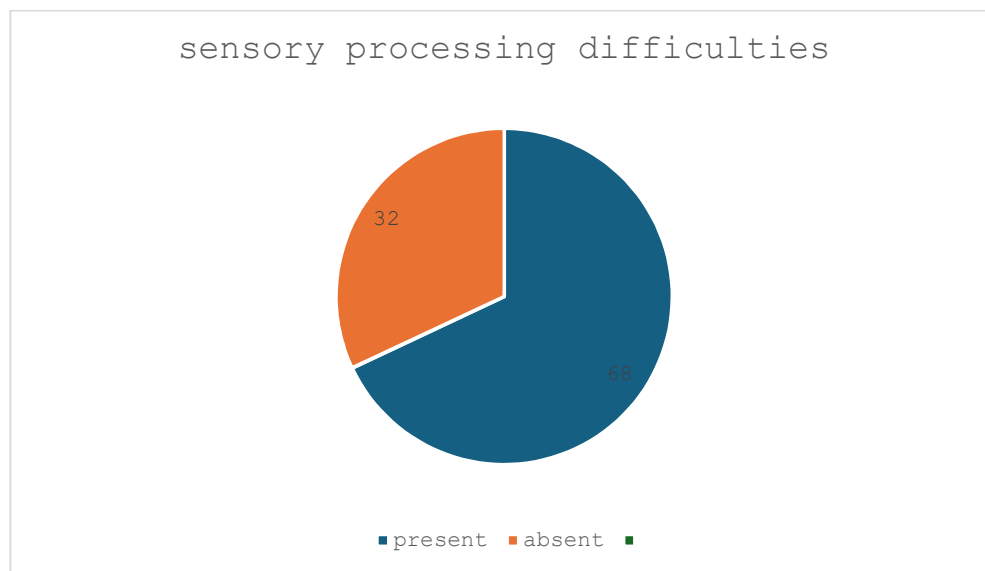


Figure 5: Prevalence of sensory processing difficulties

3. Distribution of types of sensory processing patterns

Among the 68 children identified with sensory processing difficulties, various sensory processing patterns were noted ,and some children exhibited more than one pattern.

Over responsive pattern : observed in 42 children (61.8%)

Under responsive pattern : found in 37 children (54.4%)

Sensory seeking pattern : seen in 45 children (66.2%)

Sensory seeking behavior was most common, followed by over-responsiveness.

Table 4 : Types of sensory processing patterns among children with SPD (n=68)

Sensory Pattern	Frequency (n)	Percentage (%)
Over-responsive	42	61.8
Under-responsive	37	54.4
Sensory seeking	45	66.2

Figure 6. Distribution of sensory processing patterns among toddlers with SPD (n = 68).

Sensory seeking represented the most prevalent pattern, with over-responsive and under-responsive patterns observed in decreasing frequency.

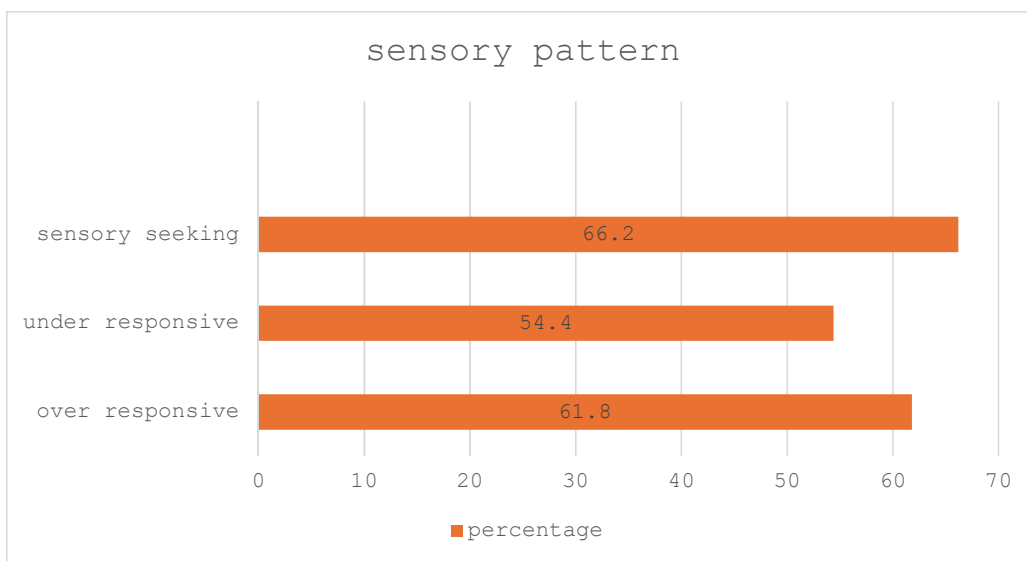


Figure 6. Distribution of sensory processing patterns

4. Association between Sensory Processing Difficulties and Selected Variables

The relationship between sensory processing difficulties and specific demographic or clinical variables was assessed using chi-square analysis.

4.1 Association with Gender

Sensory processing difficulties were identified in 72% of males and 60% of females. Despite this difference, the association between gender and sensory processing difficulties was not statistically significant ($\chi^2 = 1.84$, $p = 0.175$).

4.2 Association with Gestational Age

A greater proportion of preterm children (84.6%) exhibited SPD than term children (62.8%). This difference was found to be statistically significant ($\chi^2 = 4.32$, $p = 0.038$).

4.3 Association with Type of Developmental Delay

Sensory processing difficulties were most common in children with:

- Autism features – 85.7%
- Global Developmental Delay – 75.0%
- Motor Delay – 63.6%
- Speech Delay – 57.1%

There was a **statistically significant** association between developmental delay type and SPD ($\chi^2 = 9.76$, $p = 0.021$).

4.4 Association with Birth Weight

A higher proportion of SPD was observed among children with low birth weight (<2.5 kg) at 78.6%, compared to 64.1% among those with normal birth weight. However, this difference did not reach statistical significance ($\chi^2 = 2.11$, $p = 0.146$).

Table 5 : Association between Sensory Processing Difficulties and Selected Variables

Variable	Category	SPD Present n (%)	SPD Absent n (%)	χ^2	p-value	Significant at $p < 0.05$
Gender	Male	45 (72.0)	18 (28.0)	1.84	0.175	
	Female	23 (60.0)	14 (40.0)			
Gestational Age	Preterm	11 (84.6)	2 (15.4)	4.32	0.038	*
	Term/Post-term	57 (62.8)	30 (37.2)			

Primary Diagnosis	GDD	18 (75.0)	6 (25.0)			
	Motor Delay	7 (63.6)	4 (36.4)			
	Speech Delay	8 (57.1)	6 (42.9)			
	Autism features	6 (85.7)	1 (14.3)			
	Others	2 (50.0)	2 (50.0)	9.76	0.021	*
Birth Weight	<2.5 kg	78.6%		2.11	0.146	
	Normal	64.1%				

Discussion

The present study was undertaken to ascertain the prevalence of sensory processing difficulties (SPD) in toddlers aged 12–36 months with developmental delay attending the Early Intervention Clinic, Department of Pediatrics, Institute of Maternal and Child Health, Kozhikode, and to evaluate associated demographic and clinical factors.

Prevalence of Sensory Processing Difficulties

This investigation revealed that **68% of toddlers with developmental delay exhibited sensory processing difficulties**, as measured by the *Toddler Sensory Profile*. This result indicates that over two-thirds of developmentally delayed toddlers receiving early intervention services face substantial challenges in sensory processing. These findings are consistent with previous literature, which demonstrates a high frequency of sensory processing abnormalities among children with developmental disorders, with reported prevalence rates ranging from 40% to 80%. (3,4) Variations in these rates across studies may be attributed to differences in assessment methods, age ranges, diagnostic classifications, and sampling approaches. The present findings highlight sensory processing difficulties as frequently co-occurring features in children with developmental delay, underscoring the critical importance of early identification for effective individualized intervention planning.

Types of Sensory Processing Patterns

Among children identified with SPD, sensory seeking behavior was the predominant pattern (66.2%), followed by over-responsive (61.8%) and under-responsive patterns (54.4%). Many participants manifested more than one sensory pattern, reflecting the multifaceted nature of sensory processing difficulties. Sensory seeking behaviors—such as excessive movement, crashing, or persistent touching—may represent attempts at self-regulation. Clinically, sensory seeking tendencies can interfere with attention, structured learning, and social participation. The prominence of sensory seeking behaviors in this study may be attributable to the young age group, as toddlers often engage actively with their environment through sensory exploration, and modulation issues may amplify these behaviors. Over-responsiveness (sensory defensiveness) was also highly prevalent, with affected children frequently avoiding tactile, auditory, or movement stimuli, impacting feeding, play, and social interaction. Under-responsiveness, signified by diminished reactions to sensory inputs, may contribute to delays in motor and

communication milestones. The coexistence of multiple patterns emphasizes the necessity for comprehensive sensory assessments rather than concentrating on a singular sensory domain. (13)

Association with Gender

A greater proportion of males demonstrated sensory processing difficulties compared to females; however, this association did not reach statistical significance. The higher representation of males in the sample may reflect increased referral rates for boys concerning developmental concerns. Existing literature also suggests a greater prevalence of neurodevelopmental disorders—including those characterized by sensory abnormalities—in males. Nevertheless, the lack of statistical significance in this study indicates that sensory processing difficulties are not restricted to a specific gender and should be evaluated in both boys and girls presenting with developmental delay.

Association with Gestational Age

A statistically significant relationship was observed between preterm birth and sensory processing difficulties, with preterm children exhibiting a higher prevalence of SPD than term children. This aligns with neurodevelopmental evidence associating premature birth with altered maturation of sensory systems. Immature neural pathways, experiences in neonatal intensive care, and early environmental stressors likely contribute to atypical sensory integration. These observations underscore the importance of routine sensory screening for children born preterm, particularly those with developmental delay.(1)

Association with Type of Developmental Delay

The study found a significant correlation between the type of developmental delay and sensory processing difficulties. Children displaying autism spectrum features recorded the highest prevalence of SPD, followed by those diagnosed with Global Developmental Delay (GDD). This is well-supported in the literature, which recognizes sensory abnormalities as core components of autism spectrum disorders. Similarly, GDD is associated with widespread neurological immaturity affecting various domains, including sensory modulation and integration. Children with speech/language delay and motor delay exhibited notable rates of SPD, suggesting that sensory dysfunction may influence or exacerbate communication and motor difficulties, further highlighting the interconnectedness of developmental domains. (20)

Clinical Implications

The findings have several implications for early intervention:

Routine Sensory Screening: Sensory evaluation should be integral to the assessment of toddlers with developmental delay.

Individualized Intervention Planning: Recognition of specific sensory patterns enables clinicians to tailor occupational therapy, sensory integration strategies, and parent education programs.

Parent Education: Educating caregivers about sensory behaviors facilitates improved home management and can mitigate parental stress.

Strengths of the Study

- Focused on early childhood (12–36 months), facilitating early detection.
- Utilized a standardized caregiver-reported assessment tool.
- Examined associations with a range of demographic and clinical variables.

Limitations of the Study

- Convenience sampling limits external validity.
- Single-center design restricts generalizability.
- Reliance on caregiver reports may introduce bias.
- Cross-sectional methodology precludes causal inference.

Future investigations employing larger, multicenter samples and longitudinal designs are warranted to elucidate the developmental trajectories of sensory processing difficulties.

Conclusion

The current research reveals that many toddlers with developmental delays experience significant sensory processing challenges, especially those born prematurely or displaying characteristics of autism spectrum disorder or global developmental delay. Sensory seeking is noted as the most frequent sensory pattern observed.

These results highlight the importance of conducting early sensory screenings and providing specific interventions in early intervention clinics, aiming to enhance children's developmental progress and support the well-being of their families.

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