Research Paper

Sensory Profile in Infant/Toddler: Birth to 36 Months

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ABSTRACT

Objectives: Sensory processing patterns refer to a person's ability to receive and respond to sensory events which are important to succeed in daily routine activities. This study aims to determine the sensory processing patterns in infants/toddlers.

Methods: This is a cross-sectional study. A total of 518 infants/toddlers participated in this study. Their ages ranged from birth to 36 months. Parents completed the infant/toddler sensory profile for all participants.

Results: No significant difference was observed between girls and boys in sensory processing from birth to 6 months; however, there is a significant difference between girls and boys in low registration, sensory sensitivity, and sensory avoidance from 7-36 months. In addition, no significant difference was detected between children born by cesarean and those born through natural childbirth in terms of sensory processing (quadrants and scores) from birth to 6 months and 7-36 months. There is a significant difference between preterm and full-term children (birth to 6 months) in auditory processing. The findings also indicate only a significant difference in oral sensory processing between the preterm and full-term children (7-36 months).

Discussion: We discussed sensory processing patterns in children and their differences based on different factors. The results of this study can provide considerations for Iranian occupational therapists and psychologists.

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Highlights

• Sensory processing has an essential role in daily activities and has also been noticed as a predictor of several abilities in children.

• Health professionals, such as occupational therapists and psychologists need to assess sensory processing by using several standard sensory instruments.

• This study investigated the sensory processing patterns in children in the age range of birth to 36 months and determined the differences between sensory processing patterns based on gender, prematurity, and types of delivery.

• There is no significant difference between girls and boys in sensory processing from birth to 6 months, but sensory processing indicates a significant difference from 7-36 months. There is no significant difference between children born by cesarean and those born through natural childbirth in the sensory processing for all children.

• There is a significant difference between preterm and full-term children (birth to 6 months) in auditory processing. The findings also indicate only a significant difference in oral sensory processing between the preterm and full-term children (7-36 months).

Plain Language Summary

Infants and toddlers receive and process sensory stimuli in different ways. Sensory processing patterns (methods of receiving sensory information) are very important for participation in daily activities, playing, cognitive functions, and social relationships. Therefore, it is one of the areas studied during childhood and can help in interventions and educational planning for children.

1. Introduction

All the behavior, emotional, attention, and motor reactions are related to how the human brain processes sensory inputs from multiple sensory systems [1]. Sensory processing is known as receiving, modulating, integrating, and organizing sensory stimuli along with behavioral responses to sensory events [2]. Sensory processing includes a variety of areas, for example, smell, touch, taste, sight, hearing, and movement [3]. Based on Dunn's sensory processing model, children exhibit behaviors that fall into 4 sensory processing patterns: avoidance (actively avoiding sensory stimuli); sensitivity (more significant understanding of sensory stimuli); seeking (intensive interest in sensory stimuli); and registration (no response or delay in responding to sensory stimuli) [4].

The sensory processing concept refers to normal reactions to different sensory experiences and outlines why sufficient sensory processing is substantial to adapting and interacting with the environment [5]. Some children have difficulty sitting and concentrating, their thoughts are confused, and they protect themselves from others or can explode with anger. These behaviors can be caused by inadequate sensory processing and can impact learning performance [6]. Overreaction or hypoactivity can happen in all of these cases [3]. Sensory difficulties adversely impact development, learning ability, and psychological and physical functioning. Sensory processing difficulties are often relevant to social, behavioral, and communicative issues [5]. Also, sensory processing sensitivity is linked with some adverse outcomes, such as poor health, depression, anxiety, and low life satisfaction [7].

Sensory integration and sensory processing disorders affect 5% to 16% of typically developing children and up to 80% of children with developmental disabilities [8]. So far, some studies have examined sensory processing in children and its relationship to various variables. De Paula Machado et al. examined the relationship between sensory processing and prematurity along with motor and cognitive development in children aged 12 months. Prematurity negatively interferes with sensory processing patterns, especially in the tactile and vestibular areas, while better sensory processing contributes to better motor function at 12 months [1]. Jirikowic et al. studied atypical sensory processing patterns in children with prenatal alcohol exposure. The results of the study demonstrated that atypical process-

ing patterns are higher in children with higher levels of prenatal alcohol exposure [8]. In a study, Asadi Gandomani et al. surveyed the relationship between sensory processing patterns and behavioral patterns in children in the age range of 3-11 years [9]. The results showed a significant relationship between sensory processing patterns and behavioral problems.

Adequate sensory processing facilities a person's engagement in the world and purposeful activities [1]. Health professionals need to assess this aspect by using several standard sensory instruments [5]. This study aims to determine the sensory processing patterns in children in the age range of birth to 36 months. This study also investigates the differences between sensory processing patterns in children based on gender, prematurity, and types of delivery.

2. Materials and Methods

Study procedure

This was a cross-sectional study and included two groups of participants selected via the convenience sampling method in North Khorasan Province, Iran. The first group consisted of parents of children in the age range of birth to 6 months (n=207). The second group involved parents of children in the age range of 7-36 months (n=311).

The parents were informed about the process and purpose of the study. The children's conditions were investigated through an initial interview with the parents. Consent was received from all parents to participate in this study. Eventually, parents were selected and provided with the infant/toddler sensory profile (ITSP).

A total of 750 questionnaires were distributed, 612 questionnaires were returned and 94 were deleted because of missing data. Finally, 518 valid ITPS were investigated in this study. This article is extracted from the project approved by the Iran National Science Foundation (Code: 98015803).

Materials and procedure

The ITPS is developed to assess sensory processing abilities in children in the age range of birth to 36 months [10]. This profile has been separated into two groups: birth to 6 months and 7-36 months. The infant version consists of 36 items, and the toddler version consists of 48 items. ITSP is scored 1-5 (1=almost always and 5=almost never). The items form 4 patterns of sensory processing (quadrants): sensitivity, seeking, avoiding, and low registration. In addition, 5 sensory systems are determined: oral, visual, auditory, tactile, and vestibular sensory processing [2].

Each sensory quadrant has 3 score categories, and the middle range scores indicate typical function. Scores lower than the middle range represent that the child displays the sensory behaviors more than peers and is hypersensitive, while scores higher than the middle range represent that the child displays the sensory behaviors less than peers and is hyposensitive [11].

Reliabilities for this profile were calculated in the range of 0.69-0.85 [10]. Many studies examined the validity of ITSP [10, 12, 13]. The Cronbach α coefficient was in the range of 0.17-0.83 for birth to 6 months and 0.42-0.86 for 7-36 months. The test-retest correlation coefficient was calculated at 0.74 for quadrant scores and 0.86 for section scores. These coefficients indicate the validity and reliability of the ITSP [10].

Statistical analysis

Data analysis was performed using descriptive and inferential statistical methods. Mean±SD were used to describe the data and an independent t test was used to infer the data.

3. Result

This study recruited 518 parents of infants/toddlers in the age range of birth to 36 months. The infants have a mean age of 4.23±1.55 months and include 85 girls and 101 boys (the gender of 21 participants was not specified). The toddlers had a mean age of 18.76±8.73 months and included 135 girls and 161 boys (the gender of 15 participants was not specified).

Table 1 shows no significant difference between girls and boys in sensory processing (quadrants and scores) from birth to 6 months. The findings for 7-36 months also indicate no significant difference between girls and boys in sensory seeking; however, there is a significant difference between girls and boys in low registration, sensory sensitivity, and sensory avoidance. Girls and boys did not display significant differences in sensory processing patterns, oral, and general processing; however, there was a significant difference in auditory, visual, tactile, and vestibular processing.

Table 1. Comparison of mean of the scores of sensory profile component based on sex

Sensory Quadrant	Sex	Mean±SD		t		Sig.	
		Infant (0-6)	Toddler (7-36)				
Low registration	Girl	48.48±8.83	46.69±4.95	1.47	3.87	0.14	0.001
	Boy	50.27±7.53	44.08±6.37				
Sensory seeking	Girl	11.57±4.13	27.33±7.58	1	1.41	0.31	0.15
	Boy	10.93±4.44	26.11±7.18				
Sensory sensitivity	Girl	26.55±5.42	36.65±6.28	0.14	2.35	0.88	0.01
	Boy	26.67±4.91	34.95±6.12				
Sensory avoidance	Girl	19.12±4.01	44.52±5.9	1.10	2.05	0.27	0.04
	Boy	19.72±3.34	43.03±6.43				
General processing	Girl	17.97±3.57	11.56±2.25	0.21	1.04	0.83	0.29
	Boy	17.87±3.21	11.29±2.11				
Auditory	Girl	31.27±5.59	36.51±4.94	1.15	2.84	0.25	0.005
	Boy	32.15±4.90	34.80±5.34				
Visual	Girl	24.03±3.89	19.96±2.83	0.15	3.23	0.87	0.001
	Boy	23.95±3.55)	18.83±3.09				
Tactile	Girl	21.74±5.44	44.17±7.37	1.55	1.97	0.12	0.04
	Boy	22.83±4.10	42.39±8.03				
Vestibular	Girl	26.18±4.37	18.28±2.79	0.26	3.52	0.79	0.001
	Boy	26.34±3.86	17.02±3.29				
Sensory oral	Girl	-	24.40±5.26	-	0.98	-	0.32
	Boy	-	23.83±4.68				

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Table 2 indicates no significant difference between children born by cesarean and those born through natural childbirth in sensory processing (quadrants and scores) from birth to 6 months and 7-36 months.

Table 3 shows a significant difference between the preterm and full-term children (birth to 6 months) in auditory processing; however, the sensory processing patterns in both groups do not show any significant differences. The findings also indicate only a significant difference in oral sensory processing between the preterm and full-term group (7-36 months), and there is no significant difference in sensory processing (quadrants and sections).

4. Discussion

This study aimed to investigate the sensory profile in infants/toddlers and compare it based on gender, type of delivery, and prematurity. The findings of the present study show that the mean scores of sensory processing patterns in preterm infants (birth to 6 months) based on the scores determined by Dunn et al. is as follows: sensory seeking and sensory avoidance are in the range of typical performance and sensory sensitivity is in the range of more than others [10]; meanwhile, sensory processing patterns for full-term infants are similar to premature infants.

Table 2. Comparison of mean of the scores of sensory profile component based on types of delivery

Sensory Quadrant	Childbirth	Mean±SD		t		Sig.	
		Infant (0-6)	Toddler (7-36)				
Low registration	Natural	49.83±7.16	45.67±5.67	0.52	0.63	0.60	0.52
	Cesarean	49.18±8.98	45.21±5.94				
Sensory seeking	Natural	11.31±4.88	26.88±7.88	0.40	0.19	0.68	0.85
	Cesarean	11.59±3.67	26.70±6.44				
Sensory sensitivity	Natural	26.87±4.86	35.10±6.49	0.23	2.63	0.81	0.009
	Cesarean	26.68±5.09	37.11±5.80				
Sensory avoidance	Natural	19.45±3.46	43.34±6.50	0.16	1.82	0.87	0.07
	Cesarean	19.54±3.76	44.73±5.72				
General processing	Natural	18.0±3.07	11.31±2.18	0.13	1.39	0.89	0.16
	Cesarean	18.06±3.52	11.68±2.04				
Auditory	Natural	32.21±4.63	36.01±5.04	0.74	1.14	0.45	0.25
	Cesarean	31.62±5.56	35.30±5.15				
Visual	Natural	24.35±3.53	19.19±3.13	1.07	1.38	0.28	0.16
	Cesarean	23.74±3.74	19.70±2.81				
Tactile	Natural	22.28±4.61	43.01±8.22	0.46	1.35	0.64	0.20
	Cesarean	22.62±4.77	44.31±7.19				
Vestibular	Natural	26.03±4.07	17.43±3.16	1.08	1.28	0.28	0.20
	Cesarean	26.70±3.97	17.91±2.88				
Sensory oral	Natural	-	23.90±4.98	-	1.59	-	0.11
	Cesarean	-	24.85±4.61				

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The mean scores of preterm toddlers (7-36 months) indicate that the low registration, sensitivity, and avoidance pattern are in the range of more than others and probable difference. The mean scores of full-term infants are as follows: low registration is in the range of typical performance, the sensitivity is in the range of more than others/definite differences, and avoidance is in the range of more than others/probable difference.

In the present study, sex differences were not reported among girls and boys in the age range from birth to 6 months in 4 quadrants. This finding is consistent with [14]. Their findings also displayed no sex difference among girls and boys from birth to 6 months in sensory processing patterns. The findings also showed that girls and boys (7-36 months) showed a significant difference in low registration, sensitivity, and avoidance; while the seeking pattern was not different between girls and boys. Yeung et al. stated that children in the age range of 7-36 months, older boys, showed a higher frequency of sensory avoidance, low registration, and sensory sensitivity. This is probably because boys around the age of 3 engage in more strenuous physical activity than girls of the same age. Therefore, caregivers are more likely to observe such behaviors, which leads to a higher reported frequency. However, the primary mechanism should be considered in future studies [5].

Table 3. Comparison of mean of the scores of sensory profile component based on prematurity

Sensory Quadrant	Premature	Mean±SD		t		Sig.	
		Infant (0-6)	Toddler (7-36)				
Low registration	Yes	48.85±9.57	44.45±5.38	0.83	1.67	0.40	0.09
	No	50.04±7.38	46.01±5.47				
Sensory seeking	Yes	10.63±3.85	26.71±6.19	0.97	0.05	0.33	0.95
	No	11.38±4.43	26.78±7.25				
Sensory sensitivity	Yes	26.04±5.36	36.95±5.36	0.91	1.24	0.36	0.21
	No	26.86±4.87	35.59±6.55				
Sensory avoidance	Yes	19.73±3.96	43.14±6.24	0.35	0.79	0.72	0.42
	No	19.50±3.42	43.98±6.11				
General processing	Yes	17.87±3.67	11.28±2.23	0.33	0.80	0.73	0.42
	No	18.07±3.14	11.58±2.13				
Auditory	Yes	31.46±6.39	35.30±5.60	2.24	0.87	0.02	0.38
	No	32.10±4.60	36.06±4.89				
Visual	Yes	22.97±4.13	19.57±3.19	0.70	0.29	0.48	0.76
	No	24.33±3.12	19.42±2.84				
Tactile	Yes	22.70±5.07	44.47±6.40	0.54	1.16	0.58	0.24
	No	22.25±4.51	42.94±7.87				
Vestibular	Yes	25.60±4.11	17.69±3.28	1.38	0.03	0.16	0.97
	No	26.61±4.0	17.67±3.0				
Sensory oral	Yes	-	22.92±4.32	-	2.05	-	0.04
	No	-	24.57±4.74				

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Another purpose of the study was to investigate whether there is a difference between sensory processing (quadrants and sections) between infants/toddlers born naturally or through cesarean. The results demonstrated that there is no statistically significant difference in sensory processing between the two groups. There is a significant difference between preterm and full-term children in auditory processing from birth to 6 and oral sensory for children ages 7-36 months. This may be due to a lack of normal sensory experiences during the last weeks of life, while the sensory system in preterm infants develops outside the womb. Thus, these infants are exposed to a variety of stimuli that they are not developmentally able to manage [15]. Staying in a neonatal intensive care unit imposes stressful conditions on the infant, such as changing diapers, intubation, and intense light and sound that impact the size and function of the brain [1].

Wickremasinghe et al. suggested that children born prematurely are at risk for atypical scores in the auditory, tactile, and vestibular processing and quadrants [16]. Bart et al. concluded that full-term children had better sensory integration than those preterm [17]. Cabral et al. demonstrated no significant relationship between motor function and sensory processing in preterm and full-term children [18].

Practical implications

In recent decades, the emphasis on early identification and intervention has increased. According to the impact of sensory processing on various aspects of daily activities, it is important to identify that children have problems with the sensory profile in early childhood. Recognizing the sensory processing problems in infants/toddlers allows occupational therapists and psychologists to prevent secondary problems in the later developmental stages.

5. Conclusion

The present study can contribute to the literature in the field of sensory processing. The findings of this study show a significant difference in the sensory profile between boys and girls, preterm and full-term children in some areas. We believed the type of delivery could affect the patterns of sensory processing; however, in this study, no difference was observed between the two groups, that is, children born by cesarean and those born through natural childbirth. It is suggested that future research survey this issue.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles were considered in this article.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

No conflict of interest was reported by the authors.

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