

Prevalence of dysfunction in sensory integration in kindergarten children

Sem S. Surja¹, Hendry Irawan¹, Theresia Ilyan¹, Jessica Fedriani¹,
Satyadharma M. Winata¹, Irene²

Abstract

Background Children with dysfunction in sensory integration (DSI) have difficulty effectively and efficiently interacting with their environment. It has been estimated that 5 to 10% of children without disabilities have DSI. Late assessment and intervention in children with this problem may significantly impact further development. To date, there is no available data on DSI prevalence in Indonesian children, which is crucial for better understanding of the DSI burden in the community.

Objective To estimate the prevalence of DSI in North Jakarta children using standardized screening tools.

Methods Parents of kindergarten children from two private schools in North Jakarta were given questionnaire packets including the *Family Information Questionnaire* and *Winnie Dunn's Short Sensory Profile* (SSP) to assess demographic data and parents' perceptions of their children with regards to DSI.

Results Of 264 questionnaire packets distributed, 117 packets were returned (44.3%). Most children were of Chinese ethnicity and aged 3 to 5 years. Of the 117 children, 49 children (41.9%) met the criteria for DSI (definite difference), 33 children (28.2%) were in the probable difference category for DSI, and 35 children (29.9%) were in the category of typical performance. The scores for the parameters of under-responsive and visual/auditory sensitivity were the most commonly observed in subjects in the definite difference category. From all questionnaire packets, a total of 18.56% of children in selected kindergartens in North Jakarta met the screening criteria for DSI, while an additional 12.5% were likely to have the disorder.

Conclusion Based on parental reports, we find that 18.56% of children from two private kindergartens in North Jakarta had DSI, while an additional 12.5% are likely to have the disorder. [Paediatr Indones. 2013;53:223-7].

Keywords: dysfunction in sensory integration, short sensory profile, screening, parents' report

Sensory integration (SI) is the organization of sensation. In other words, SI is the neurological process that organizes sensory input from the body and the environment so that one can sense the body and effectively interact with the environment. Sensory input in this regard includes stimuli to the five basic senses (visual, auditory, gustatory, olfactory, and tactile), vestibular senses (related to the earth's gravity and balance), proprioceptive senses (position and movement), and visceral senses. This integration is a sustainable process that consists of reception, integration, and customization of obtained information which can determine the appropriate reaction to a situation.¹ Sensory processing in humans involves reception of a physical stimulus, transduction of the stimulus into a neural impulse, and perception or the conscious experience of sensation.²⁻⁴ A child with good sensory processing will be adaptive to their environment. These processes are foundational for learning, perception, and action.

Impairment of the integration process may occur in some or all sensory systems, including the tactile, auditory, visual, gustatory, olfactory, proprioceptive,

From Atma Jaya Catholic University Medical School,¹ and the Department of Child Health,² Atma Jaya Catholic University, Jakarta, Indonesia.

Reprint requests to: Sem S. Surja, Atma Jaya Catholic University Medical School, Taman Aries A8/23, West Jakarta, Indonesia. Tel. +62-82122293945. E-mail: samuel_sem@hotmail.com.

and vestibular systems.^{2,5,6} Such impairment is called dysfunction in sensory integration (DSI) and causes difficulty in modulating, discriminating, coordinating, or organizing sensations in an adaptive manner.⁷ It has been estimated that 5-10% of children without disabilities have DSI.¹ An American study showed that 5.3% of students enrolled in kindergarten met the screening criteria for DSI.⁸ Children with DSI are maladaptive, as shown by excessive responses to normal sensory input or even ignoring of the incoming input. It is difficult for such children to effectively and efficiently interact with their surrounding environment because they cannot process, integrate, or properly respond to incoming sensory stimuli. These sensory disorders may negatively affect a child's developmental and functional abilities in the behavioral, emotional, motor, and cognitive domains.^{2,3} Impairments in functional ability usually become apparent when children enter school and may persist through adulthood.

To date, there has been no available data on DSI prevalence in Indonesian children. This data is crucial in order to elucidate the DSI burden in the community. Therefore, the objective of this study was to systematically estimate the prevalence of DSI in children. We chose two kindergartens in North Jakarta, because of their proximity to our institution. This study may be considered to be a pilot study to estimate the prevalence of DSI in Indonesia, with the hope that immediate follow-up will benefit children with DSI to live up to their full potential.

Methods

This prospective study was performed at two private kindergartens in North Jakarta from May to June 2009. Parents of kindergarten children were surveyed

using the *Family Information Questionnaire* and *Short Sensory Profile* (SSP), a standardized self-report questionnaire filled by parents to assess their children's behavioral responsiveness to sensation.⁹ Written informed consent was obtained from subjects' parents prior to the study.

Subjects were kindergarten children from the Tarakanita Kindergarten 4 or BPK Penabur Kindergarten 10. Every parent who had active kindergarten children filled the questionnaires completely. Questionnaires were collected from 117 subjects, which represented 44.3% of parents enrollment (n = 264) in the selected kindergartens.

The *Family Information Questionnaire* was used to assess the children's demographic data (e.g., age and birth date), parental information (e.g., education), and parents' perception of their children with regards to DSI.

The SSP is a screening questionnaire used to assess DSI in children. It was developed as a short form of the *Sensory Profile Questionnaire*. The SSP is a 38-item parent-report screening tool that evaluates functional behaviors related to DSI. This questionnaire consists of seven categories: tactile sensitivity, taste/smell sensitivity, movement sensitivity, under-responsive/ seeks sensation, auditory filtering, low energy/weak, and visual/auditory sensitivity. Parents made subjective, global ratings of their children for each item, using a scale of 1- 5, with 1 representing always, as the child responds in this manner every time, and 5 representing never, as the child never responds in this fashion. Higher scores represented better functional performance in seven sensory profile's categories. Finally, the data was analyzed using *Winnie Dunn's SSP classification* (Table 1).¹⁰

Definite difference was defined as the child responds to stimuli definitely more or less than others. Probable difference was defined as the child responds

Table 1. Winnie Dunn's *Short Sensory Profile* classification ¹⁰

Sensory profiles	Typical performance	Probable difference	Definite difference
Tactile sensitivity	35-30	29-27	26-7
Taste/smell sensitivity	20-15	14-12	11-4
Movement sensitivity	15-13	12-11	10-3
Under-responsive/ seeks sensation	35-27	26-24	23-7
Auditory Filtering	30-23	22-20	19-6
Low energy/ weak	30-26	25-24	23-6
Visual/auditory sensitivity	25-19	18-16	15-5
Total score	190-155	154-142	141-38

Table 2. Demographic characteristics of subjects compared to the general population of Indonesia

Characteristics	Children in study n=117	Children in Indonesia n=40,796,467
Gender, n (%)		
Males	59 (50.43)	20,729,566 (50.81)* ¹²
Females	58 (49.57)	20,066,901 (49.19)* ¹²
Children's age, n (%)		
2 years	3 (2.56)	n/a
3 years	39 (33.33)	n/a
4 years	54 (46.16)	n/a
5 years	18 (15.39)	n/a
6 years	3 (2.56)	n/a
Religion, n (%)		
Moslem	1 (0.9)	(88.58) ¹³
Christian	45 (38.5)	(5.79) ¹³
Roman Catholic	24 (20.5)	(3.07) ¹³
Buddhist	30 (25.6)	(0.61) ¹³
Hindu	n/a	(1.73) ¹³
Others	17 (14.5)	(0.22) ¹³
Ethnicity, n (%)		
Chinese	55 (47)	(0.86) ¹⁴
Javanese	2 (1.7)	(41.71) ¹⁴
Betawi	2 (1.7)	(2.51) ¹⁴
Bangka	1 (0.9)	n/a
Batak	1 (0.9)	(3.72) ¹⁴
Bugis	2 (1.7)	(2.49) ¹⁴
Minahasa	3 (2.6)	(0.33) ¹⁴
Others	51 (43.6)	(48.38) ¹⁴

*0-9 years old; n/a=not available

to stimuli probably more or less than others. Typical performance was defined as the child responds to stimuli just like their peers. Scores were interpreted as follows: a definite difference was indicated by scores greater than two standard deviations from the mean for children who were developing typically in the normal population; a probable difference was indicated by scores greater than one and less than two standard deviations; a typical performance was indicated by scores that fell within one standard deviation of the mean.¹¹

Prior to the beginning of the survey, permission letters were sent to the principals of selected kindergartens. If principals granted permission, they were sent questionnaire packets, including the *Family Information Questionnaire*, the SSP and an informed consent form, to be distributed to the parents. Packages were distributed to the children at school to be passed to their parents. Parents were given one week to fill and return the questionnaires to the schools.

Results

Of 264 questionnaire packets sent to subjects from two kindergartens in North Jakarta, 117 were returned (**Figure 1**), representing an enrollment of 44.3% of all parents. *Family Information Surveys* were used to summarize characteristics of subjects. Most children assessed in this study were Chinese and aged 4 years. There were 59 males and 58 females (**Table 2**).

Parents of subjects ranged in age from 26 to 60 years. Most parents were university graduates (**Table 3**).

Table 3. Education levels of subjects' parents who filled the questionnaires

Educational level attained	Subjects' parents	
	n	%
Junior high school or below	1	0.85
Senior high school	17	14.53
University or above	82	70.09
Unknown	17	14.53

Table 4. Short sensory profiles results

Sensory profiles	Typical performance (%)	Probable difference (%)	Definite difference (%)
Tactile sensitivity	42.7	25.6	31.6
Taste/smell sensitivity	47.0	23.1	29.9
Movement sensitivity	41.9	31.6	26.5
Under-responsive/seeking sensation	34.2	25.6	40.2
Auditory filtering	38.5	29.1	32.5
Low energy/ weak	70.9	13.7	15.4
Visual/auditory sensitivity	35.0	29.9	35.0
Total score	29.9	28.2	41.9

Discussion

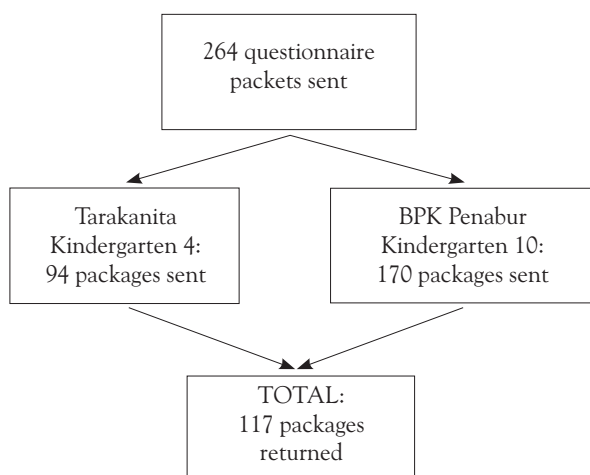


Figure 1. Study profile

From 117 questionnaire packets returned, we found that 49 children (41.9%) met the criteria for DSI (definite difference) based upon parents' reports, 33 children (28.2%) were in the probable difference category and the remaining 35 children (29.9%) were in the typical performance category of the general population (Table 4). The most commonly observed parameters of subjects in the definite difference category were under-responsive and visual/auditory sensitivity. Because the parental response rate was low, we calculate from all questionnaire packets, a total of 18.56% (49/264) of children in selected kindergartens in North Jakarta met the screening criteria for DSI, while an additional 12.5% (33/264) were likely to have the disorder.

Calculating DSI prevalence in children without disabilities is an important step in identifying the burden of DSI problems in Indonesia. Based on parents' reports, as assessed using the SSP, 18.56% of children in two selected private kindergartens met the definite difference criteria for DSI. This calculation was made by assuming that all non-subjects were in the typical performance SI category. The rate increased to 41.9% if all non-subjects were excluded.

The prevalence suggested in this study (18.56%) was outside the range of DSI prevalence hypothesized by Ayres, which was 5 to 10% of children without disabilities.¹ Another previous study also had a result of 5.3% prevalence,⁸ suggesting a relatively high DSI prevalence in selected kindergartens in North Jakarta. However, further studies involving many more subjects from representative kindergartens should be conducted, in order to adequately establish the DSI prevalence rate.

Several limitations should be noted in our study. First, our results cannot be used to generalize throughout Indonesia, nor even in North Jakarta, as 47% of subjects were Chinese while 41,71% of Indonesian children are Javanese. Furthermore, subjects' parents had attained a relatively high educational level (mostly university graduates or above, 70.09%), while most parents in Indonesia attained less education (mostly senior high school or below 97.06%).¹² Well-educated parents may have better perception in reporting and rating their children's performances on the given questionnaires. Also, the small number of kindergartens (only two kindergartens agreed to enroll) and the specific type of kindergartens (only private kindergartens enrolled)

were leading causes of this population skew.

Second, the assessments were a screening method based only on parents' perceptions. Although SSP is a validated screening questionnaire, the precise diagnosis of DSI must be confirmed by experts. Subjects who were deemed to have DSI based on the questionnaires were referred to professionals for follow-up. Further studies involving a larger population and more intensive follow-up are needed to more precisely determine DSI prevalence in children.

Third, the low survey response rate by parents contributed to several problems in data analysis. Of the 264 questionnaire packets distributed, only 117 were returned by parents (44.3%). If all non-subjects were excluded, the DSI prevalence in kindergarten children would have been estimated to be as high as 41.9%. To compensate for this problem, we calculated the prevalence of DSI from all questionnaire packets, a method similar to that of an earlier study⁸ Hence, the DSI prevalence in this study was calculated to be 18.56%.

DSI is one of the most common problems occurring in kindergarten children. DSI may even persist until later in life and affect a child's future. Although the high DSI prevalence found in our study (18.56%) cannot be generalized throughout Indonesia, it indicates that children screened to have DSI may require more attention and intensive follow-up from parents, teachers, and care providers, at least in the two private kindergartens enrolled in this study.

The limitations of our study suggest a need for further, more rigorous, epidemiological studies to establish a more valid DSI prevalence, especially in Indonesian children.

References

1. Ayres J. Sensory integration and the child: Understanding hidden sensory challenges. 25th ed. Los Angeles: Western Psychological Services; 2005. p. 4-38.
2. Kandel ER, Schwartz JH, Jessel TM. Principles of neural science. 4th ed. New York: McGraw-Hill; 2000. p. 318-381.
3. Nass RD. The neurologic examination of the young child. In: David RB, Bodensteiner JB, Mandelbaum DE, Olson BJ, editors. Clinical Pediatric Neurology. 3rd ed. New York: Demos Medical Publishing; 2008. p. 45-55.
4. Miller LJ, Lane SJ. Toward a consensus in terminology in sensory integration theory and practice. Part 1: Taxonomy of neurophysiological processes. Sensory integration special interest section quarterly. 2000;23:1-4.
5. Bundy AC, Murray EA. Sensory integration: A Jean Ayres' theory revisited. In: Bundy AC, Lane SJ, Murray EA, editors. Sensory integration: Theory and practice. 2nd ed. Philadelphia: F.A. Davis; 2002. p. 3-33.
6. Reeves GD. From neuron to behavior: Regulation arousal, and attention as important substrate for the process of sensory intergration. In Roley SS, Blanche EI, Schaaf RC, editors. Understanding the nature of sensory integration with diverse populations. San Antonio, TX: Therapy Skill Builders; 2001. p. 89-108.
7. Lane SJ, Miller LJ, Hanft BE. Toward a consensus in terminology in sensory integration theory and practice: Part 2: Sensory integration patterns of function and dysfunction. Sensory integration special interest section quarterly. 2000;23:1-3.
8. Ahn RR, Miller LJ, Milberger S, Mcintosh DN. Prevalence of parents' perceptions of sensory processing disorders among kindergarten children. Am. J Occup Ther. 2004;58:287-93.
9. McIntosh DN, Miller LJ, Shyu V, Dunn W. Overview of the short sensory profile (SSP). In: Dunn W, editor. The sensory profile: examiner's manual. San Antonio, TX: The Psychological Corporation; 1999. p. 59-73.
10. The Psychological Corporation. Short Sensory Profile. [cited 2013 May 27]. Available from: <http://www.vsb.bc.ca/sites/default/files/schoolfiles/Programs/Short%20Sensory%20Profile.pdf>.
11. University of Kansas Medical Center. Sensory profile (3-10 years): Explanation of scores. [cited 2012 July 16]. Available from: http://classes.kumc.edu/sah/resources/sensory_processing/learning-opportunities/sensory_profile2/sensory_profile2_main.htm.
12. Statistics Indonesia. Hasil Sensus Penduduk 2000. Berita Resmi Statistik. 2002;26:1-11.
13. Ministry of Health Republic of Indonesia. Indonesia country profile 2007. Jakarta: Ministry of Health Republic of Indonesia; 2008. p. 8.
14. Sontosudarmo A, Tukiran. Keragaman etnis dalam pengelolaan wilayah. In: Hartono, Sudibyakto, Susanto A, Sutikno, Woro S, Sukamdi, editor. Menuju pengelolaan sumber daya wilayah berbasis ekosistem untuk mereduksi potensi konflik antar daerah. Yogyakarta: Fakultas Geografi UGM; 2003. p. 119-29.