

CLINICAL RESEARCH ARTICLE



# Positive behavioral effect of sensory integration intervention in young children with autism spectrum disorder

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**BACKGROUND:** Sensory integration occupational therapy (SI-OT) might be useful for autism spectrum disorders (ASD) in younger age, according to Pusponogoro. Previous studies were still limited, especially in younger age. This study evaluated the effect of SI-OT in improving positive behaviors of ASD children aged 2–5 years.

**METHODS:** Non-randomized controlled trial of SI-OT evaluation, assessed with Vineland Adaptive Behavior Scale-II.

**RESULTS:** A total of 72 subjects were studied. Following SI-OT, communication skills (expressive, receptive), socialization (coping skills), and daily living skills (personal, community) were improved significantly.

**CONCLUSIONS:** SI-OT with Ayres theory in 60 min, twice a week for 12 weeks improved positive behaviors.

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## IMPACT:

- To address the effectivity of sensory integration occupational therapy (SI-OT) in improving positive behaviors of autism spectrum disorders (ASD) children aged 2–5 years.
- The first study to evaluate evidence of SI-OT in ASD younger than 3 years.
- Non-randomized controlled trial of SI-OT evaluation of ASD in younger children aged 2–5 years with Vineland Adaptive Behavior Scale-II.
- SI-OT of Ayres theory in 60 min, twice a week for 12 weeks improves communication domain (expressive, receptive, written) aged 2–4 years, and socialization domain (interpersonal relationship, play, and leisure time) aged 2 years of ASD children.

## INTRODUCTION

Autism spectrum disorder (ASD) is a complex developmental disorder that can lead to dysfunction in social communication, interaction, and restrictive, repetitive pattern of behavior. Since 2013, Diagnostic and Statistical Manual 5 (DSM-5) included sensory disorder as a symptom under the latter category. Sensory processing disorder in ASD often yields difficulty in regulating responses to sensation and specific stimuli that limits the ability to participate in normal life routines.<sup>1,2</sup>

Autism is one of the emerging neurodevelopmental disorders in the twentieth century. Studies showed a remarkable increasing prevalence of ASD. Therefore, screening for suspected symptoms is mandatory.<sup>3–6</sup> Sensory integration occupational therapy (SI-OT) based on Ayres theory is a common method to increase the ability to process and integrate sensory information and thereby demonstrate improvement in positive adaptive behaviors. Most studies showed that SI-OT only had low to moderate evidence in older children.<sup>7–9</sup>

Based on clinical experience and observation of pediatric neurologists in Indonesia, SI-OT might be useful as an ASD treatment for younger children especially those under 5 years.<sup>10,11</sup> This is due to the benefits of SI-OT by Ayres theory such as exposure to

multisensory experience, individual-tailoring, active engagement of the child, the establishment of a therapeutic alliance between the child and therapist, targeting the just-right challenge, and providing within the context of play suitable for young children.<sup>12</sup> According to this condition, we conducted a study to evaluate the effect of SI-OT in improving the positive behavior of children aged 2–5 years with ASD.

## METHODS

### Participants

Subjects who fulfilled the diagnostic criteria of ASD from DSM-5 were selected from Check My Child Clinic (CMC), Anaku Clinic, and Harapan Kita Growth Developmental Clinic Jakarta from March 2019 to August 2021. The inclusion criteria for intervention and control group were (1) recently diagnosed ASD with DSM-V criteria in children aged 2–5 years, (2) the subject had never participated in SI-OT or had only participated in SI-OT for less than 1 month in CMC, Anaku Clinic, and Harapan Kita Growth Developmental Clinic, and (3) parents gave informed consent for interviews, whereas additional inclusion criterion for the interventional group was that the subjects completed the SI-OT in twice a week for 12 weeks (24 times), 60 min for each session without any other kind of therapies or medications. The exclusion criteria for intervention and

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**Table 1.** Structural elements of sensory integration occupational therapy of Ayres theory.

Part no., item, and item components
<i>Part 1: therapist qualification</i>
Postprofessional training in sensory integration, certification in SI/SIPT education (minimum of 50 education hours in SI theory and practice, e.g., postprofessional SI or SIPT certification or university course)
Supervision (minimum of 1 h/month by an expert or 5 years of experience providing occupational therapy using SI intervention)
<i>Part 2: components of the occupational therapy assessment report</i>
Historical information (e.g., medical, educational, and therapeutic, as appropriate; developmental history; occupational profile)
Reason for referral
Performance patterns (e.g., activities child currently seeks out and enjoys)
Sensory processing: modulation and discrimination
Postural ocular control
Visual-perceptual and fine motor skills
Motor coordination, gross motor skills, and praxis
Organization skills
Performance (e.g., interpretation of the effects of sensory integration and praxis on referring problems)
<i>Part 3: physical environment</i>
Adequate space for flow of vigorous physical activity
Flexible arrangement of equipment and materials for rapid change of the intervention environment
No less than 3 hooks for hanging suspended equipment, minimal distance between hooks 2.5–3 ft (i.e., enough room to allow for full orbit on suspended equipment)
One or more rotational devices attached to ceiling support to allow 360° of rotation
Quiet space (e.g., tent, adjacent room, or partially enclosed area)
One or more sets of bungee cords for suspended equipment
Mats, cushions, pillows (available to be used to pad floor underneath all suspended equipment during intervention)
Equipment adjustable to the child's size
Therapist monitors accessible equipment for safe use
Unused equipment stored or placed so children cannot fall or trip
Documentation of routine monitoring of equipment safety (e.g., ropes and bungee cords not frayed)
Variety of equipment available (e.g., bouncing equipment such as trampoline; rubber strips or ropes for pulling; therapy balls; swings [platform swing, square platform, glider swing, frog swing, flexion disc, bolster swing, tire swing, net swing]; scooter and ramp; weighted objects such as balls or bean bags in visual targets; ramps; climbing equipment; barrel for rolling; props to support engagement in play, e.g., dress-up clothes, stuffed animals, and dolls, material for practicing daily living skills, e.g., school supplies, clothing, and shoes with laces)
<i>Part 4: communication with parents and teachers</i>
Goal setting
Goals and objectives as defined by a team including a child, family, or significant others
Therapist defines areas to be addressed that will improve engagement
Family or teacher education (e.g., ongoing interchange to direct the course of intervention)
Discuss the potential influence of sensory integration and praxis on the performance of valued and needed activities
Discuss the child's sensory integration and praxis abilities and their influence on the child's and family's participation in the home, school, and community

SI sensory integration, SIPT sensory integration and praxis tests.

control group were that (1) the subjects were accompanied by other comorbidities (such as epilepsy, cerebral palsy) or genetic syndromes that caused sensory processing disorder, (2) abnormal growth status (such as microcephaly, stunting, malnutrition), (3) consumption of any medications, and (4) attending any other therapies.

### Material and designs

Subjects were assessed using the Vineland Adaptive Behavior Scale-II tool by a pediatric psychologist. It consisted of communication domains (including expressive, receptive, written subdomain), socialization domains (including interpersonal relationship, play and leisure time, coping skill subdomain), and daily living skills domains (including personal, domestic, community subdomain). The assessments were conducted pre and post therapy for each intervention and control group with analyzing the difference (delta) score of pre and post therapy between both groups. The effect of SI-OT intervention was evaluated with a non-randomized

controlled trial, because of the ethical reason that the main intention of all subjects attending the clinics was to seek therapy. The study design compared a group of participants receiving SI-OT intervention with a historical control group from the same population.

### Procedures

The subjects from the intervention group received SI-OT in accordance with the clinics' protocol with the frequency of two times per week, for 1 h long each session, for 12 weeks (24 times), 60 min for each session. The SI-OT exposed subjects to multisensory stimulations through play method based on good fidelity of Ayres theory on structural and process elements according to Parham et al. study (Tables 1 and 2).<sup>12</sup> These interventions are individually designed based on their sensory profiles. This therapy aimed to stimulate and involve the subjects in reciprocity interaction, improve subjects' comprehension toward instructions in order to give appropriate responses as well as increase subjects' awareness of surroundings.

**Table 2.** Process elements of sensory integration occupational therapy of Ayres theory.

Item no. and item	Item description
1. Ensures physical safety	The therapist anticipates physical hazards and attempts to ensure that the child is physically safe through the manipulation of protective and therapeutic equipment and the therapist's physical proximity and actions. An existing safe room is important, as is the therapist's attention to the child's abilities and potential dangers
2. Presents sensory opportunities	The therapist presents the child with $\geq 2$ of 3 sensory opportunities—tactile, vestibular, and proprioceptive—to support the development of self-regulation, sensory awareness, or movement in space
3. Helps the child to attain and maintain appropriate levels of alertness	The therapist helps the child to attain and maintain appropriate levels of alertness and an affective state that support engagement in activities
4. Challenges postural, ocular, oral, or bilateral motor control	The therapist supports and challenges postural control, ocular control, or bilateral development. At least one of these types of challenges is intentionally offered: postural challenges, resistive whole-body challenges, ocular-motor challenges, bilateral challenges, oral challenges, and projected action sequences
5. Challenges praxis and organization of behavior	The therapist supports and presents challenges to the child's ability to conceptualize and plan novel motor tasks and to organize his or her own behavior in time and space
6. Collaborates in activity choice	The therapist negotiates activity choices with the child, allowing the child to choose equipment, materials, or specific aspects of an activity. Activity choices and sequences are not determined solely by the therapist
7. Tailors activity to present just-right challenge	The therapist suggests or supports an increase in complexity of challenge when the child responds successfully. These challenges are primarily tailored to the child's postural, ocular, or oral control: sensory modulation and discrimination; or praxis developmental level
8. Ensures that activities are successful	The therapist presents or facilitates challenges that focus on sensory modulation or discrimination; postural, ocular, or oral control; or praxis in which the child can be successful in making an adaptive response to the challenge
9. Supports child's intrinsic motivation to play	The therapist creates a setting that supports play as a way to fully engage the child in the intervention
10. Establishes a therapeutic alliance	The therapist promotes and establishes a connection with the child that conveys a sense of working together toward one or more goals in a mutually enjoyable partnership. Therapist and child relationship goes beyond pleasantries and feedback on performance such as praise or instruction

On the contrary, subjects from the control group did not receive any therapies.

Data were collected two times using the Vineland Adaptive Behavior Scale-II tool by a pediatric psychologist from the caregiver's report before beginning the therapy and after completion of the SI-OT twice a week for 12 weeks (24 times), 60 min for each session in the intervention group. In the control group, data were collected at the first meeting and 12 weeks afterward without therapy. The obtained data from caregivers were confirmed with therapist and neuropsychiatric clinical evaluation. Domain standard scores (from domain items) and *v*-scale scores (from subdomain items) for each group were compared.<sup>13</sup>

### Analysis

The data analysis was performed using the Mann–Whitney test for data that were not normally distributed, and *t*-test independent analysis for normally distributed data. This study used Program Software SPSS vers.25.

### RESULTS

A total of 72 ASD subjects aged between 2 and 5 years were studied. Most subjects were of 3 years in both intervention and control groups (38.9 and 38.9%, respectively), and the boys-to-girls ratio was 2.3-to-1 in the intervention group and 3-to-1 in the control group. Table 3 presents the characteristics of subjects and caregivers.

Data of the communication domain, as well as receptive and expressive subdomains after SI-OT in the intervention group, were improved significantly compared with the control group ( $p = 0.003$ ;  $p = 0.002$ ;  $p = 0.001$ , respectively) (Table 4).

Significant improvements were also achieved in the socialization domain ( $p = 0.002$ ) including the coping skills subdomain ( $p < 0.001$ ), compared with the control group (Table 4).

Daily living skills domain with personal and community subdomain showed significant improvement after SI-OT intervention ( $p = 0.005$ ;  $p = 0.044$ ;  $p < 0.001$ , respectively) compared with the control group.

### DISCUSSIONS

The current study was the first study to address evidence of SI-OT in ASD children younger than 3 years. Our main findings were that subjects with ASD who received SI-OT scored significantly higher in the communication domain and subdomains (expressive, receptive). On the contrary, Pfeiffer et al.<sup>14</sup> and Schaff et al.<sup>15</sup> showed no significant score difference in the communication domain post therapy using Vineland Adaptive Behavior Scale-II. However, their subjects were older in age and received lesser duration and amount of therapy sessions compared to our study. In addition, Iwanaga et al.<sup>16</sup> also stated that verbal communication was not improved significantly, but non-verbal communication significantly improved after SI-OT. The study was applied to older children with a longer duration of therapy and using different tools.

Better communication after SI-OT is not defined solely by its structural elements, such as specific activities during therapy, rather it includes elements of process as well, such as the therapeutic relationship, motivation, and collaborative atmosphere between child and therapist. Thus, sensory modulation improvement post SI-OT will increase attention in ASD children, in order to support a higher level of processing ability that is needed to communicate.<sup>17</sup>

Our study also found significant improvement scores in the socialization domain and coping skills subdomains after SI-OT. On the contrary, Pfeiffer et al.<sup>14</sup> and Schaff et al.<sup>15</sup> showed no significant score difference in the socialization domain post therapy using Vineland Adaptive Behavior Scale-II. Their subjects' age was older and they received lesser duration and amount of therapy session.

Improvement in sensory modulation and praxis skills after OT-SI may underlie the gain that is seen in social skills. It is likely that behavior regulation also improves and subsequently children with ASD are able to participate in social activities.<sup>15</sup> The coping skill

**Table 3.** Demography characteristics.

Demography characteristics	Intervention (n = 36)	Control (n = 36)
Sex, n (%)		
Boy	25 (69.4)	27 (75.0)
Girl	11 (30.6)	9 (25.0)
Subject age, n (%)		
2 years	12 (33.3)	8 (22.2)
3 years	14 (38.9)	14 (38.9)
4 years	6 (16.7)	11 (30.6)
5 years	4 (11.1)	3 (8.3)
Social economy status <sup>a</sup> , n (%)		
Middle up	36 (100.0)	36 (100.0)
Middle low	0 (0.0)	0 (0.0)
Home stimulation <sup>b</sup> , n (%)		
Ideal	21 (58.3)	19 (52.8)
Not ideal	15 (41.7)	17 (47.2)
Caregiver occupation, n (%)		
Working	27 (75.0)	11 (30.6)
Not working	9 (25.0)	25 (69.4)
Caregiver age (years) <sup>c</sup> , n (%)		
<33	19 (52.7)	24 (66.6)
≥33	17 (47.3)	12 (33.4)
Caregiver educational level <sup>d</sup> , n (%)		
High	28 (77.7)	22 (61.2)
Middle	8 (22.3)	14 (38.8)
Low	0 (0)	0 (0)
Subject previous therapy, n (%)		
None	32 (88.9)	30 (83.3)
Speech therapy	1 (2.8)	1 (2.7)
Behavior therapy	0 (0)	0 (0)
Occupational therapy	2 (5.6)	5 (13.8)
Others	1 (2.8)	0 (0)

<sup>a</sup>Social economy status, middle up: income above minimum regional wage in Indonesia; middle low: income below minimum regional wage in Indonesia.

<sup>b</sup>Home program, ideal: indoor and outdoor activities for sensory stimulation every day for at least 30 min; not ideal: did not fulfill activities as mentioned previously.

<sup>c</sup>Mean age of 33 years was based on the Itschack and Zachor<sup>22</sup> study about the influence of mothers' age in early intervention of ASD patient.

<sup>d</sup>Educational level, high: university background; middle: junior or high school background; low: elementary or without a formal education background.

needs complex responsibility and sensitivity to the surrounding. It also requires flexibility and responsiveness to contextual demands as well as cognitive level.<sup>18</sup>

The result in daily living skills domain including personal and community subdomains after SI-OT improved significantly in our study. These findings were different from Pfeiffer et al.<sup>14</sup> and Schaff et al.<sup>15</sup>

A study by Pugliese et al.<sup>19</sup> stated that higher IQ, younger age, fewer problems with initiation, organization of material problems, and working memory difficulties were significant predictors of better daily living skills behavior. In addition, these daily living skills require routine stimulations by caregivers in order to gain better ability.<sup>20,21</sup>

**Table 4.** Delta score (pre-post) comparison of domain and subdomain.

	Intervention (n = 36)	Control (n = 36)	p
Domain standard score			
Communication	17.33 (SD 19.28)	2.28 (SD 22.73)	<b>0.003*</b>
Subdomain v-scale score			
Receptive	3 (1 to 6)	0.5 (2 to 4)	<b>0.002</b>
Expressive	3 (0 to 5)	1 (−3 to 4)	<b>0.001</b>
Written	0 (0 to 2)	3 (0 to 10.6)	0.658
Domain standard score			
Socialization	12.31 (SD 16.48)	−0.69 (SD 17.76)	<b>0.002*</b>
Subdomain v-scale score			
Interpersonal relationship	2 (1 to 4)	2 (−1 to 4)	0.180
Play and leisure	3 (−0.75 to 6)	1 (−1.0 to 2)	0.245
Coping skills	0 (−1 to 2)	4 (2 to 5)	<b>&lt;0.001</b>
Domain standard score			
Daily living skills	5.0 (SD 19.82)	−8.0 (SD 17.94)	<b>0.005*</b>
Subdomain v-scale score			
Personal	1 (−2 to 4)	0 (−4 to 0)	<b>0.044</b>
Domestic	0 (−1 to 0)	2 (−3 to 2)	0.134
Community	0 (−1 to 2)	−3 (−5 to 0)	<b>&lt;0.001</b>

Bold values indicate statistical significance  $p < 0.05$ .

SD standard deviation, IQR interquartile range.

\*t-test independent; Mann–Whitney test.

## CONCLUSIONS

We found that good fidelity of Ayres theory SI-OT in 60 min twice a week for 12 weeks could improve positive behaviors, particularly in the communication domain (including expressive and receptive subdomain), socialization domain (including coping skills subdomain), and daily living skills domain (including personal and community subdomain). These results of SI-OT will be a good reference therapy for ASD children in order to improve and increase communication, interaction, and daily living skills.

## DATA AVAILABILITY

Data and material are available for transparency.

## CODE AVAILABILITY

Program Software SPSS vers.25.

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## AUTHOR CONTRIBUTIONS

All authors contributed to the study's conception and design, commented on previous versions of the manuscript, and read and approved the final manuscript and agreed to publication.

## COMPETING INTERESTS

The authors declare no competing interests.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by The Ethics Committee of the Faculty of Medicine Universitas of Indonesia no. KET-167/UN2.F1/ETIK/PPM.00.02/2019. Informed consent was obtained from all individual participants included in the study.

## CONSENT FOR PUBLICATION

Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

## ADDITIONAL INFORMATION

**Correspondence** and requests for materials should be addressed to Citra Raditha.

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