Sensory integration method in occupational therapy intervention with children with autism spectrum disorder: a scoping review
Scoping review
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Children with autism spectrum disorder (ASD) frequently report sensory integration processing problems and often receive intervention relevant for that problem. In current occupational therapy (OT) practice, therapists are implementing Ayres Sensory Integration (ASI) method in intervention with children with ASD. This scoping review explored what literature shows about implementation of sensory integration assessment and intervention in OT process for children with ASD and what is the occupational performance outcome. Twelve articles were reviewed, which utilized ASI as intervention, assessing sensory integration processing, ASI techniques as part of OT intervention and improvement of performance in children with ASD as outcome. Studies presented ASI as a clinic – based method using special activities directed to improving children's sensory processing and overall functioning.

Keywords: occupational therapy, Ayres sensory integration, ASD
Sensory integration therapy (SIT) is grounded on Ayres theory (ASI) of sensory processing. This intervention method is commonly provided by occupational therapist, who are leading professionals in it (Ayres, 2005; Schaaf et al., 2018). Sensory integration is defined as the process by which receives and organizes sensations from environment, it gives them meaning and supports development of abilities needed for participation in activities of daily living (ADL) (Ayres, 2005; Bodison et al., 2018). Sensory systems include olfactory, vision, gustatory, auditory, tactile, proprioceptive, and vestibular. ‘Literature supports the relation between difficulties with processing and integrating sensations and performance of ADL such as sleeping, dressing, eating, engaging in play, and participating in leisure and school – related activities’ (Schaaf et al., 2018, p. 1).

Available research findings worldwide, according to Bodison et al. (2018) estimate that 40% – 80% of children with difficulties in development also have sensory processing difficulties. SIT includes a number of sensory and motor activities that provide controlled sensory input, activities are play based and planned individually for each child and directed to development of adaptive response and functional abilities (Pfeiffer et al., 2011; Schaaf et al., 2018), also SIT can be applied to various of disabilities (Schaaf & Smith Roley, 2001). Everyday activities, productivity, self – care and leisure that are performed in home and school, can be impaired by sensory motor difficulties, and change child behavior, therefore including SIT in intervention is recommended to act on effecting hyperactivity or hyperreactivity, improving self – regulation and better organized behavior (Schoen et al., 2019; Case – Smith et al., 2014).

Direct contact with the client, environmental modification and therapeutic activity are main principles that occupational therapist providing SIT base their intervention on (Schaaf & Smith Roley, 2001; Case – Smith et al., 2014). Every intervention should be individually planned based on developmental stage and conducted assessment with a set goal (Schaaf & Smith Roley, 2001; Schoen et al., 2019). Thus, the main goal of ASI is improvement in occupational performance (Schaaf & Smith Roley, 2001), valued through outcomes that show improvement on sensorimotor, language and play skill, independence in self – care, improvement in social participation and behavior (Schaaf et al., 2018; Schaff & Smith Roley, 2001). The evidence of implementing ASI method has a positive effect, with upcoming but insufficient evidence (Schaff & Smith Roley, 2001).

Autism spectrum disorder (ASD) is a developmental disability that impacts a person's social skills, communication, relationships, and self – regulation (WHO, 2019). Autism is classified as a pervasive developmental disorder characterized by impairments in social interaction and imagination, communication, restricted, repetitive, and stereotypical behavior, with present difficulties in ADL (Schaaf & Smith Roley, 2001; Mehzabin & Stokes, 2011). It is estimated that 80% of children with ASD also have sensory integration difficulties (Case – Smith et al., 2014) and hyper or hypo reactivity to sensory input is now a diagnostic criterion for ASD in the Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition (DSM – 5).

According to Schoen et al. (2019) OT is often present as a service as part of within education processes, and it is organized in a way that promotes children to achieve their goals (Novak et al., 2019). Occupational therapists using ASI base their intervention both on corrective remedial and compensatory strategies (Ayres, 2005; Smith Roley et al., 2009; Schaaf et al., 2018). According to Schoen et al. (2019) among most required intervention by parents of children with ASD is SIT, which is provided by occupational therapists, including the one that are served in special education placement.

There are emerging evidence supporting SIT as part of OT intervention (Pfeiffer et al., 2011; Schaff et al., 2014). Considering the diversity of each child with ASD and the characteristics that exist, but also the way...
they will respond to stimuli, complicates the research process due to the inability to unify results that would provide better evidence (Pfeiffer et al., 2011; Schaaf et al., 2018). Likewise, available research is based on small sample sizes of children with ASD, similar backgrounds, and also limited outcome measurement tools (Schaaf et al., 2015; Case – Smith et al., 2014; Bucher et al., 2014). This information directs us to the purpose of this review which aims to explore what literature shows us about implementation of sensory integration assessment and intervention in occupational therapy process for children with autism spectrum disorder and what is the occupational performance outcome.

**Method**

The chosen study method was a scoping review. Scoping reviews are reviewing existing literature on certain topic identify key sources, theories, evidence, and gaps in the research (Grimshaw, 2010). Therefore, a scoping review was chosen to identify and map available evidence, as most suitable for being eligible for including studies with different methods and designs, but also makes it possible to focus on range of relevant information, provide reliable and usable results (Sucharew and Macaluso, 2019). This scoping review was completed through recommendations of Joanna Briggs Institute and following Arksey and O’Malley framework, which is composed of 6 stages, first five are required and last one, consultation is optional, and it wasn’t done through this report (Peters et al., 2020). The last stage was not implemented due to the current pandemic situation, and all encounters are limited except necessary to avoid the spread of the virus and endanger the lives of all of us.

**Procedure**

The first stage included identification of the research question (Peters et al., 2020). Research question was formulated through using the PICO (population, intervention, control, outcome) format (Eriksen & Frandsen, 2018). As population (P) was children age 3 – 12 with ASD, intervention (I) was sensory integration intervention in occupational therapy process, control (C) is not applicable as there is none alternative method being considered and outcome (O) considered effect on occupation performance. The second stage was recognition of relevant studies, third stage was study selection, the fourth stage was data extraction process which provided data summary of results presented in data extraction table (Peters et al., 2020). The fifth stage was a discussion on the analysis of extracted data and descriptively mapping the results, as well as reporting, as said last stage of consultation wasn’t conducted as it is optional (Peters et al., 2020).

As said first stage is identification of research question. What does literature show us about implementation of sensory integration assessment and intervention in occupational therapy process for children with autism spectrum disorder and what is the occupational performance outcome?

Conducted database search for literature was based on inclusion and exclusion criteria, which were ground on PICO framework. Inclusion criteria for population element of PICO framework were children age group 3 – 12 years old with diagnosed ASD, while exclusion criteria were children age groups under 3 years as well as children and adults above 12 years old, also ASD with other developmental disorders and other diagnosis. Inclusion criteria for intervention element were sensory integration and OT intervention provided by occupational therapist, on the other side exclusion criteria were no OT or sensory integration intervention and provided by other professionals, also specific environments were not considered as it would additionally limit already low number of articles. Outcome element considered effect or intervention outcome on occupational performance in children.
Furthermore, inclusion criteria required articles that were published English and had free access to the full article, articles not being published in other language weren’t considered and that was exclusion criteria due to researcher not knowing other language. All qualitative and quantitative studies were taken in consideration for this review, though limited to peer-reviewed scientific literature.

The search was conducted in five electronic databases, PubMed, PsycInfo, ERIC, AMED and CINAHL, these databases were chosen due to the significant volume of medical literature, which includes OT. Additional literature was searched by exploring the reference list of selected articles, which included Google Scholar in search to detect full text of literature search articles related to the topic.

Articles were searched through defined search terms, including Boolean operators. The search relating disability was conducted through several terms ‘autism’ or ‘autistic disorder’ or ‘ASD or ‘autism spectrum disorder’, the diversity contributed to the appearance of articles that did not appear under another term, so all of these terms were kept as search terms. Term ‘sensory integration’ and ‘occupational therapy’ were kept as is, as usually in that way are presented in article title or key words and search presented relevant articles. Also, terms ‘effect’ or ‘outcome’ were added additionally to provide more direct approach in this search, terms relating to particular outcome on selected activity or selected context and assessment weren’t added to search terms as small number of results came up.

Information of each article is presented in table 1 - data extraction table. Data extraction table presented article summary about the author(s), aim of the study, origin country, study design, type of the paper, participants, strength, and limitation, in this way article information were presented through narrative and logical summary (Arksey & O’Malley, 2005; Peters et al., 2020). The findings were summarized through a narrative analysis. The content of the chosen articles was read multiple times, and analysis was directed to answering the purpose of this study.

**Ethical consideration**

As this is literature review, there were no live participants included. Thus, ethical considerations were focused on objectivity of the researcher, reflexivity, and transparency, as well as full commitment in the process of writing this report (Zawacki – Richter et al., 2020). Therefore, every stage of this process was described, as well documented in appropriate and careful manner to ensure transparency, as well as acknowledging authors whom study was used (Wager & Wiffen, 2011).

Likewise, ethical issues were considered through paying attention to the research bias. Interpretation and description of chosen studies were subject to research bias, but through objectivity of researcher intention was reducing bias (Pham et al., 2014). Although, potential bias may arise because the researcher is an occupational therapist who applies sensory integration methods in work, but with insufficient experience, and having to finish certificate education in field in ASI (Wager & Wiffen, 2011). Also, bias could occur as only one researcher conducted this scoping review where there could be lack of general consent on inclusion and exclusion criteria and search terms in search, as well as narrative analysis and data extraction process. Also, as English is not the primary language of the researcher, bias may occur through grammatical errors and misinterpretation of information, to reduce bias on this aspect seminar version on thesis was handed out to English certificate professional for checkout.
### Results

As seen in figure 1, the database search resulted in 256 articles identify from data base search, from which seventeen articles were removed as duplicates, eight were marked as ineligible by automation tools and 43 articles were removed for other reason. Furthermore, 188 articles were screened from which forty – five were excluded and 143 reports remained for retrieval. Thirty reports were assessed for eligibility, from which nine were not relevant to the research question, 2 articles had participants not within outside age range and ten full text articles were excluded, with reason. Additionally, forty – three articles were identified via other citation searching, all those articles were sought for retrieval, from which fifteen were assessed for eligibility. Assessing those studies excluded 5 full text articles were exclude, with reason, then 4 articles for not being relevant to research question and 3 for including participants that were not in age range. In the end a total of 12 articles were chosen for further analysis. Process visualized in figure 1, the PRISMA flow diagram (Page et al., 2020).

Total of 12 selected articles, of which seven were qualitative (#1, #3, #5, #9, #10, #11, #12), three quantitative studies (#2, #4, #7) and two mixed methods (#8, #6). Articles were from 2 different countries, as USA (#1, #3 – #12) and Iran (#2). In these twelve articles, from which three were reviews, two (#11, #6) of remaining eight articles were included in one (#1) of the reviews. All information presented in the data extraction table, table 1. Quantitative studies used randomized control trial, cross sectional, case reports, longitudinal, while qualitative studies used case reports, longitudinal, and the remaining articles were three reviews. Three reviews included level I, II, III and IV studies, where evidence – based review (#1) had 49 studies included, 18 were level I (randomized controlled trials, systematic reviews, and meta – analyses), 17 were level 2 (nonrandomized clinical trials such as cohort studies) and 14 were level 3 (before – after, one group designs), in systematic review (#9) 66 articles were included, 48 were level 1 (randomized controlled trials, systematic reviews, and meta – analyses), 6 were level 2 (nonrandomized clinical trials such as cohort studies) and 12 were level 3 (before – after, one group designs) and in systematic review (#12) 23 articles were included, 8 were level I ( 8 randomized controlled trials, 3 systematic reviews), 1 were level II (nonrandomized clinical trials such as cohort studies), 2 were level III (before –after, one group designs) and 12 were level IV. Articles differed in sample size, with as number is not presented (#1, #9) and variations in inclusion of children with ASD::, 5 boys with ASD (#2), 1 child with ASD (#3), intervention group (n = 16) and control group (n = 15), participants were children with ASD 3 – 8 year old (#4), two 3 year old boys with ASD (#5), 5 children with ASD (6), 1 child with ASD (#7), 10 children with ASD, age 4 – 8 (#8), 72 occupational therapists (#10), 4 children with ASD (#11) and 506 participants (#12).

While reading and analyzing chosen articles there was a variety of information presented, about assessment although not in all articles, about intervention and outcomes. Thus, as a clinician theFrom a clinical perspective, the logical way was to present articles was via clinical stages of through stages of intervention process, as it is assessment, intervention, and outcome. The narrative analysis presented the following themes: tests assessing sensory integration processing, techniques in ASI as part of OT intervention in children with ASD, ASI as part of OT intervention to improve performance in everyday activities in children with ASD.

#### Tests assessing sensory integration processing

To implement ASI in OT intervention in children with ASD, the occupational therapist performed assessments (table 2), variety of assessments were used, as four of them address sensory processing, other eight assess developmental stages and abilities, also one outcome measurements and one measurements of fidelity. To
ensure that therapy is based and delivered on ASI principles. Measurements of fidelity are included in process, implying ASI. The ASI Fidelity Measure is a measure that provides evaluation on 10 clinic-based ASI elements, providing sensory stimulation, designing environment to challenge child’s motor abilities and support self-regulation, collaborate with child on choosing and creating activities that provide right challenge and provide success, along with deriving child motivation to play and developing therapist-child connection (#12, #8). Tests assessing sensory processing included in articles were Sensory Integration and Praxis Test (SIPT) (#4, #8) shows reliability factor to be moderate to high (Asher et al., 2008), the Sensory Profile (#8) has acceptable reliability and internal consistency (Ohl et al., 2012), the Sensory Experiences Questionnaire (SEQ) is a measurement used to distinguish sensory experience in children with ASD, it is conducted to detect hypo and hyper responsiveness (#8) and it is an internally consistent and reliable caregiver report (Little et al., 2011), Sensory Processing Measure (SPM), a standardized measurement of sensory processing (#3), which shows that this tool is valid and reliable (Miller-Kuhaneck et al., 2007). Tests assessing sensory processing used to evaluate child sensory processing patterns for diagnostic purpose and planning intervention. Furthermore, assessments addressing developmental stages and abilities, including Short Child Occupational Profile (SCOPE) (#4) demonstrated being valid and reliable among occupational therapist (Bowyer et al., 2007), Bruininks–Oseretsky Test of Motor Proficiency (#10), has presented as reliable and valid test (Gharaei et al., 2019), Developmental Test of Visual–Motor Integration (#10) has internal consistency and convergent validity according to Brown (2016), Early Intervention Developmental Profile (#10) demonstrated rater reliability and construct validity (Van et al., 2011), Hawaii Early Learning Profile (#10) has presented convergent and discriminant validity (Li et al., 2018), Motor–Free Visual–Perceptual Test (#10) demonstrated fair reliability and variety of results in validity (Brown & Peres, 2017), and Test of Visual–Perceptual Skills (#10) which has reported reliable and valid (Brown & Peres, 2018), Functional behavior assessment for children with sensory integrative dysfunction (#5). Likewise, Goal attainment scale (GAS) (#4) which is outcome measurements. Articles #1, #2, #7, #6, #9 and #11 did not include tests assessing sensory integration processing.

**Techniques in ASI as part of OT intervention in children with ASD**

Describing an SI approach in intervention with children with ASD, defined three elements to the sensory integration approach: educating parents about sensory integration and child needs, helping parents and teachers modify the environment so it supports sensory needs, and helping children organize responses to sensory input (#2).

Studies supported the use of planned and controlled sensory input for enhancing the development and sensory processing of children with ASD (#5). Including child in activities that are rich with sensory stimulation provides opportunity for adaptive responses, were reported to promote activity performance (#12). Occupational therapist creates intervention based on previous assessment and in treatment through individualized activities and special equipment challenges child sensory and motor skills (#12).

SI activities provided tactile, proprioceptive, and vestibular input to the child to influence arousal and attention (#10, #2), as well as positive reinforcement (#10).

Some of ASI strategies in occupational therapy intervention with ASD children include: vests, swinging, brushing, joint compressions, alternative seating, sensory diets, and vestibular or proprioceptive interventions (#12), deep pressure and tactile input (#5), sensory input through vestibular and somatosensory activities (#5),
providing tactile, vestibular and proprioceptive stimuli through play and other meaningful activities (#12), likewise to support students self-regulation weighted west can be applied as well as ball chair, swing, yoga, special seat cushion and tactile stimulation through legs and arm brushing (#3).

ASI as part of OT intervention to improve performance in children with ASD

The participation of a child with ASD in ASI was found to have positive changes in many aspects of children ability, improvement in social interaction, purposeful play and decreased sensitivity (#1), self-regulation, fine and gross motor skills, sensory and motor abilities and social participation (#3), meaningful effect on behavior and performance (#12), improvements in social interaction, functional communication during mealtime, involvement in new activities, positive response holding as well as hugging (#5).

Studies showed that improved social interaction can may relate to improved sensory processing as the child has better ability to organize sensation and information related to social interaction and as result participate in them (#2), effectiveness of interventions addressing social skills and communication, play and leisure, as well as repetitive and restricted behaviors (#9). Encouragement on increasing attention and concentration, reducing hyperactivity and impulsivity, and increasing safety during play and daily activities (#8), reducing unwanted behaviors, and increasing participation in purposeful activities (#11), prospering processing and motor skills as well as planning activities, by applying required tools and materials (#4), show positive results towards occupational performance improvement. Occupational therapists use environmental changes to improve occupational skills, primary modification in environments conditions, based on that as described changes in the principles of sensory integration can affect occupational performance (#4).

The results showed that positive improvement in occupational performance of children with ASD was in the most important outcome expected from implementing SI intervention in occupational therapy process (#4).

Discussion

This review was conducted with the purpose of exploring what literature shows us about implementation of sensory integration assessment and intervention in occupational therapy process for children with autism spectrum disorder and what is the occupational performance outcome.

The search resulted in twelve articles that answer addressed the research question. The findings show suggest that occupational therapists working with children with autism spectrum difficulties ASD in interventions report using apply SIT methods. Narrative analysis presented three themes; tests assessing sensory integration processing, techniques in ASI as part of OT intervention in children with ASD and ASI as part of OT intervention to improve performance in everyday activities in children with ASD. Thus, before starting therapy, the child is assessed by a variety of tests which explore sensory integration function in children. After the assessment, treatment is started in which the main techniques are listed as proprioceptive, vestibular, and tactile input, as well as positive reinforcement. The results identified 6 (#1, #2, #3, #4, #5, #7) studies reporting a positive benefit of SIT/ASI for some children with ASD. Most of the articles refer to clinical significance of ASI method as part of occupational therapy intervention (Watling & Hauer, 2015). Findings addressed aim of this scoping review, occupational therapist implement ASI method in the practice as complementary method to OT process but with insufficient evidence and more research to it is needed.
Occupational therapist should be informed about interventions with best evidence of effectiveness as they could provide best service to client (Novak et al., 2019). According to Will et al. (2018) there is variety of intervention for children with ASD. In relation to current literature and practice Case – Smith and Arbesman’s previous (2008) systematic review reported following interventions as one of the most used in intervention with children with ASD, sensory integration and sensory – based interventions, interactive interventions, developmental skill programs, social – cognitive skill training, parent directed or mediated approaches, and behavioral intervention. On the other side Will et al. (2018) have presented and categorized evidence – based interventions for children with ASD as established methods; behavioral package, modeling, naturalistic teaching strategies, cognitive behavioral intervention, etc., furthermore methods that are emerging; exercises, massage, music therapy, structured teaching, etc. and unestablished methods; DIR/Floor time, sensory integrative package, academic interventions, etc. To provide the most effective treatment parents involvement is needed, as they should be educated and included in process (Novak et al., 2019; Allen et al., 2021). This approach is preferably as parents know their child’s abilities and capacity, also spend the most time together and parent provided therapy can be done continuously throughout the day and thus provide the best effect (Novak et al., 2019; Allen et al., 2021).

Schaaf et al (2010) suggested that including SIT in OT intervention through sensory integration frame of references facilitates may impact on motor, sensory, cognitive, social, and psychological skills to improve child's performance in ADL (Schaaf et al., 2010). As previously already stated, a sensory integration frame of reference is applied in a specially equipped room and the process is guided by educated professional, alongside with developmental frame of reference should be considered in working with children. A developmental frame of reference states that development takes place in stages, and to fulfill each subsequent stage, the previous one must be developed and integrated into the daily life of the individual (Creek, 2014). A developmental frame of reference implies six adaptive skills: dyadic and group interaction skill, self and sexual identify, cognitive and sensory integration skill, mastering the above skills allows for optimal functioning in the activities of everyday life (Creek, 2014). Occupational therapist working with children should base their intervention on developmental frame of reference, and support stage by stage to encourage development, but also to avoid the unintended consequences of skipping a certain period. As one of six skills presented by developmental frame of references includes sensory integration, makes is a method that occupational therapist working with children should consider, especially in the treatment of a child with an ASD in whom research has indicated difficulties in sensory integration.

Occupational therapists using SIT method is a frequently used intervention for children with ASD (Hunt et al., 2017). The findings suggest that establishing an assessment of a child's sensory functions, connecting them to child difficulties and clinical reasoning for implementing SIT in OT process with goal of improving performance of ADL (Watling & Hauer, 2015; Schoen et al., 2019). Although there is lack of assessment in large parts of articles, which makes it difficult to see whether there was improvement if children are not assessed before and after. Recognizing these needs in individuals and implementing sensory integration findings in the OT intervention process could lead to better participation in ADL, also increase the level of occupational performance, and overall lead to a better quality of life. Therefore, although some emerging research shows that ASI intervention may have a positive outcome, although evidence of the effects of sensory integration in children with ASD is limited, research shows that the intervention has a positive outcome, which may explain why indicate a question why more occupational therapists do not et train in and apply methods and principles in intervention. Due to that,
through this report it has been explained why sensory integration intervention may form an important part of OT treatment for children with ASD is, but it raises above considered question and requires more research on the topic. Although most articles provide similar information and enable the application of SIT in practice, additional research are needed in the future as more evidence should be obtained on this topic. Perhaps, it would be interesting and useful if studies published in the future followed fully described cases, including participation challenges, assessment of sensory and motor skills with assessment described above, with 45 – minute weekly therapy, intervention method and outcome of child with autism spectrum but as well other disability.

Limitations

The limitation for this study was the limited number of studies that met the set inclusion and exclusion criteria, as it was limited to English language articles due to this article on other language could be missing from this review, also age of the targeted group was limitation. Furthermore, another limitation was using peer – reviewed articles. However, by only using peer – reviewed literature and not including gray literature, the quality of the included studies may be higher. Also, regarding quality of articles, critical appraisal is not required for scoping review, and it wasn’t applied, but including it in this process could evaluate the risk of bias and provide level of evidence of included articles. Thus, defined search criteria provided a more directive approach, as well as better selection of articles that match the purpose of this review. A limitation is participation of the same authors in more than one article. Another limitation was search for articles in specific databases, which makes it possible some articles were left out from this review.

This scoping review followed Arksey and O’Malley framework (Arksey & O’Malley, 2005), from which five of six step were done. Last step, which is optional and includes consultations with experts for further topic progress (Arksey & O’Malley, 2005) as said was not undertaken, but it could provide profitable information about providing SIT in daily practice, but also valuable information could be gain from therapist that don’t implement SIT. Also, limitation was that this review was conducted by one researcher, which may affect selection of articles, data extraction and analysis of articles, but researcher had retained quality through reflexivity and reflexive diary, as the process was documented and presented through figures and tables. Likewise, this was researcher first time conducting scoping review which can be limitation.

Conclusion

Ayres Sensory Integration intervention is frequently requested by parents and is often utilized by occupational therapists for children with ASD, including those served in special education settings (Watling & Hauer, 2015; Schoen et al., 2019). Occupational therapists used a wide range of assessments, creating ASI programs implemented in OT intervention aimed at that leads to improving occupational performance and overall functioning of children with ASD. These improvements were detected and reported as part of this scoping review, but with limited evidence.

Although future research is needed to confirm and widen these findings. There is need for more research to support efficiency of this method as part of OT intervention. To have more relevant findings future research should include larger samples of children. Furthermore, current studies primarily explore effectiveness of the method on the vestibular, tactile, and proprioceptive systems, but information on interventions on the auditory,
auditory, visual, and gustatory systems is lacking. Furthermore, future research should explore measures that are most appropriate for assessing the child and planning an occupational therapy intervention. Likewise, future studies could also include parental involvement in the OT process.

References


1. Background Knowledge Synthesis for Knowledge Translation.


Figure 1. PRISMA flow diagram (Page et al., 2020), process of selection articles on topic sensory integration method in occupational therapy intervention with children with ASD.
<table>
<thead>
<tr>
<th>Author/ Date</th>
<th>Aim of the study/paper</th>
<th>Country</th>
<th>Study design</th>
<th>Type of the paper/information</th>
<th>Participants</th>
<th>Main findings/conclusions</th>
<th>Strengths and limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Case – Smith &amp; Arbesman (2008)</td>
<td>to examine effect of ASI in OT intervention on children with ASD to review interventions used in OT with children with ASD</td>
<td>USA</td>
<td>evidence based review</td>
<td>qualitative study</td>
<td>children with ASD (number not presented) 49 studies were included, 18 were level 1 (randomized controlled trials, systematic reviews, and meta-analyses), 17 were level 2 (nonrandomized clinical trials such as cohort studies) and 14 were level 3 (before–after, one group designs)</td>
<td>findings presented intervention for individuals with ASD fined in literature, which are sensory integration and sensory based, secondly</td>
<td>limitation was variation of scientific rigor among the studies, furthermore, lack of long-term evaluation of effects, lack of randomization, not adequate data analysis, not measuring children’s</td>
</tr>
<tr>
<td>2. Case – Smith &amp; Bryan (1999)</td>
<td>to review interventions used in OT with children with ASD</td>
<td>USA</td>
<td>single-subject</td>
<td>qualitative &amp; quantitative study</td>
<td>5 boys with ASD</td>
<td>findings support literature about behavioral changes which are result of participating in ASI intervention.</td>
<td>limitation was generalization due to single-subject, also timeline was limited, and there was no follow up evaluation which would show changes in performance</td>
</tr>
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<td>3. Clark et al. (2019)</td>
<td>to describe SI on child with ASD as part of OT intervention</td>
<td>USA</td>
<td>case report</td>
<td>qualitative study</td>
<td>1 child with ASD</td>
<td>findings of this study emphasize on conducting comprehensive evaluation, use findings to see why participation challenges occur, identify child need and work with team to support its need and create IEP goals as well as provide occupational therapy service.</td>
<td>not presented</td>
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<tr>
<td>4. Kashefimehr et al. (2018)</td>
<td>to examine the effect of ASI on different aspect on OT with children</td>
<td>Iran</td>
<td>randomized control trial</td>
<td>quantitative study</td>
<td>intervention group (n = 16) and control group (n = 15),</td>
<td>findings show that occupational performance and sensory integration in children with ASD</td>
<td>one limitation is parent report measure, and another limitation is this study</td>
</tr>
<tr>
<td>#</td>
<td>Study Description</td>
<td>Sample Size</td>
<td>Study Design</td>
<td>Study Type</td>
<td>Findings</td>
<td>Limitations</td>
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<td>#5.</td>
<td>Linderman &amp; Stewart (1998) to explore effect of SI on children with ASD as part of OT process</td>
<td>2 (3 year old boys)</td>
<td>Case report</td>
<td>Qualitative</td>
<td>Findings support use of ASI intervention as part of occupational therapy process with children with ASD.</td>
<td>Limitation is inability of generalizing of results due to single – subject design, also because of ethical concerns A – B – A design was chosen and not A – B.</td>
<td></td>
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<tr>
<td>#6.</td>
<td>Park (2011) to examine SI strategies in OT intervention</td>
<td>5</td>
<td>Case report</td>
<td>Qualitative</td>
<td>Findings extended understanding of how narrative theory intersects with SI.</td>
<td>Due to need for knowledge study focus has shifted which is presented as limitation.</td>
<td></td>
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<tr>
<td>#7.</td>
<td>Schaaf et al. (2012a) to describe changes in adaptive behaviors while using intensive ASI on child with ASD</td>
<td>1</td>
<td>Case report</td>
<td>Qualitative</td>
<td>Findings support and build on evidence which show that GAS is useful for measuring individuals’ outcomes.</td>
<td>Limitations include lack of generalizability due to it being case report, also inability to distinguish treatment effects from maturation effects.</td>
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<td>#8.</td>
<td>Schaaf et al. (2012b) to examine feasibility, safety, and acceptability of using ASI in OT intervention on children with ASD</td>
<td>10 (age 4 – 8)</td>
<td>Randomized control trial</td>
<td>Quantitative</td>
<td>Findings show that protocol is safe to use, feasible to attend and administer in intervention on children with ASD.</td>
<td>Limitation of data set.</td>
<td></td>
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<td>#9.</td>
<td>Tanner et al. (2015) to examine effectiveness of interventions to improve social participation, play, leisure and restricted and repetitive behaviors in people with ASD</td>
<td>(number not presented)</td>
<td>Systematic review</td>
<td>Qualitative</td>
<td>Findings suggest several interventions to improve social communication and skills that can be part of occupational therapy process.</td>
<td>Limitation is presented through implementing findings in intervention with children with ASD.</td>
<td></td>
</tr>
</tbody>
</table>
| #10. | Watling et al.  
(1999) | to examine current occupational practice patterns working with children with ASD | USA | cross sectional | quantitative study | 72 occupational therapists | his study clarified the nature of current OT practice patterns for 2–year-old to 12–year-old children with autism. | limitations were inherent to the nature of survey research and problems in finding desired participants |
| #11. | Watling & Dietz  
(2007) | to examine effects of SI intervention on behaviors and task management on young children with ASD | USA | case report | qualitative & quantitative study | 4 children with ASD | findings show that short-term ASI intervention doesn’t have a substantially different effect than a play scenario on undesired behavior or engagement of children with ASD, but data presented that ASI can produce effect that is seen in treatment and in child home. | strengths of this study is that is carried out in systematic manner and by ASI criteria, also it was carried out by the same occupational therapist, furthermore rates were blind to treatment, and this study had high interrater agreement on the dependent variable ratings and high procedural reliability, on the other side limitation were constraints imposed by the operational definition of engagement, secondly small sample size, complications in rating engagement, short duration of the A2 phases, and the potential for bias. |
| #12. | Watling & Hauer  
(2015) | to look for evidence for SI and SBIs within the scope of OT to improve performance in ADL for children with ASD | USA | systematic review | qualitative study | 506 participants  
23 articles were included, 8 were level I (8 randomized controlled trials, 3 systematic reviews), 1 were level II (nonrandomized clinical trials such as cohort studies), 2 were level III (before–after, one group designs) and 12 were level IV | main findings in this study show that there is moderate evidence about using ASI as part of occupational therapy to improve performance of activities of daily living | it was limited to English language articles that were published between January 2006 and April 2013, also it is limited by the quality of the evidence |
<table>
<thead>
<tr>
<th>Test</th>
<th>Number</th>
</tr>
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<tr>
<td>Fidelity measure</td>
<td>#12, #8</td>
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<tr>
<td>Sensory Integration and Praxis Test (SIPT)</td>
<td>#4, #8</td>
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<tr>
<td>Goal attainment scale (GAS)</td>
<td>#8</td>
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<tr>
<td>Short Child Occupational Profile (SCOPE)</td>
<td>#8</td>
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<tr>
<td>Functional behavior assessment</td>
<td>#5</td>
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<tr>
<td>the Sensory Profile</td>
<td>#8</td>
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<tr>
<td>the Sensory Experiences Questionnaire (SEQ)</td>
<td>#8</td>
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<tr>
<td>Test of Visual – Motor Integration</td>
<td>#10</td>
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<tr>
<td>Early Intervention Developmental Profile</td>
<td>#10</td>
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<td>Hawaii Early Learning Profile</td>
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<tr>
<td>Motor - Free Visual - Perceptual Test</td>
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<tr>
<td>Test of Visual – Perceptual Skills</td>
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<td>Bruininks – Oseretsky Test of Motor Proficiency</td>
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<tr>
<td>Sensory Processing Measure (SPM)</td>
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<tr>
<td>no measurements included in study</td>
<td>#1, #2, #7, #6, #9 &amp; #11</td>
</tr>
</tbody>
</table>

Table 2 – summary of tests assessing sensory integration processing approaches in ASI as part of OT intervention in children with ASD