

Review Paper

The Relationship Between Sensory Processing Patterns and Participation in Childhood Leisure and Play Activities: A Systematic Review and Meta-analysis



Navid Mirzakhani Araghi^{1,2}, Zahra Pashazadeh Azari¹, Mehdi Alizadeh Zarei³, Alireza Akbarzadeh Baghban⁴, Shafagh Saei^{5,6*}, Hamid Reza Yousefi Nodeh⁷, Azizeh Farshbafkhalili⁸, Ebrahim Mahmoudi⁹

1. Department of Occupational Therapy, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
2. Physical Medicine & Rehabilitation Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
3. Department of Occupational Therapy, School of Rehabilitation, Iran University of Medical Sciences, Tehran, Iran.
4. Department of Basic Sciences, Proteomics Research Center, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
5. Department of Occupational Therapy, Student Research Committee, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
6. Department of Occupational Therapy, Rehabilitation Research Center, School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran.
7. Pediatric Health Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.
8. Physical Medicine and Rehabilitation Research Center, Aging Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran.
9. Department of Physical and Occupational Therapy, School of Physical and Occupational Therapy, McGill University, Montreal, Quebec, Canada.



Citation Mirzakhani Araghi N, Pashazadeh Azari Z, Alizadeh Zarei M, Akbarzadeh Baghban A, Saei S, Yousefi Nodeh H R, et al. The Relationship Between Sensory Processing Patterns and Participation in Childhood Leisure and Play Activities: A Systematic Review and Meta-analysis. *Iranian Rehabilitation Journal*. 2023; 21(1):17-38. <http://dx.doi.org/10.32598/irj.21.1.1277.2>

doi <http://dx.doi.org/10.32598/irj.21.1.1277.2>

**Article info:**

Received: 10 Aug 2021

Accepted: 20 Sep 2021

Available Online: 01 Mar 2023

Keywords:

Children, Leisure, Participation, Play, Sensory processing

ABSTRACT

Objectives: Sensory processing patterns can be related to children's preferences for various activities. Still, our understanding of how different sensory processing patterns are related to children's participation in leisure activities is fairly limited. Therefore, this study aimed to investigate the association between sensory processing patterns and children's participation in leisure activities.

Methods: In this systematic review, the PRISMA (The Preferred Reporting Items For Systematic Reviews And Meta-Analyses) Guidelines were followed. We searched PubMed, Google Scholar, Springer, ProQuest, Scopus, Cochrane Library, Medline, OT Seeker, SID, and Healio databases using the following keywords: "Participation", "leisure", "play", "sensory processing", "sensory integration", "sensorimotor", "sensory", and "children". A total of 5040 articles were found, of which 5027 were eliminated after the review, and finally, 13 articles were included in the study based on the inclusion criteria; 6 of them entered the meta-analysis process. The meta-analysis was performed using CMA software.

Results: The meta-analysis of 6 studies illustrated a significant correlation between the energy level and desire to participate in leisure activities, the auditory-visual sensitivity and willingness to participate in leisure activities, the sensory processing patterns and the intensity of involvement in leisure activities, the general sensory processing and desire to participate in leisure activities, the sensory processing patterns and desire to participate in informal activities, the olfactory sensitivity and desire to participate in leisure activities, the auditory filtering and desire to participate in leisure activities, the sensory processing patterns and enjoyment of participation in leisure activities, and finally sensory processing patterns and desire to participate in recreational activities.

Discussion: The evidence in articles on sensory processing patterns and participation in play and leisure activities is inadequate. The only conclusion drawn from all patterns of sensory processing is the significant relationship between these patterns and the preference to participate in recreational activities (which is just one of the several leisure activities).

* Corresponding Author:

Shafagh Saei, PhD.

Address: Rehabilitation Research Center, Department of Occupational Therapy, School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran.

Tel: +98 (914) 6735546

E-mail: sh.saei@yahoo.com

Highlights

- There is a significant correlation between sensory processing patterns and childhood participation activity.
- The sensory processing patterns and the frequency of doing leisure activities are significantly correlated.
- There is a significant correlation between general sensory processing and the desire to participate in leisure activities.

Plain Language Summary

This study revealed the little attention paid to leisure activities among various types of actions undertaken by children, even though the growth and development of the child are facilitated as a result of participation in leisure activities. The children's sensory preferences can affect their participation in these activities, and by shedding light on them, we can provide a list of suitable leisure activities for children.

1. Introduction

One of the major occupations of children is play [1]. On the other hand, it is an everyday occupation performed within a setting. It is affected by internal and external personal or environmental items [2]. In addition, these elements are affected by sensory processing in children [3]. Sensory processing is a phrase used due to Ayres' research in 1972-1979. This term refers to the processing and organizing of sensations during activities [3]. Evidence shows that children's participation and choices in various activities of daily living are affected by sensory processing patterns [4, 5]. Therefore, having information about sensory processing science can help healthcare providers to pay attention to the children's participation in different activities and plan an intervention for children with different kinds of impairments [6]. Accordingly, it is necessary to contemplate children's sensory priorities when presenting games, leisure, and academic activities. To achieve this goal, we need to know how children's participation in leisure and play can be increased or decreased by their sensory preferences.

To clarify the systematic search for articles, participation in leisure, play, and sensory processing was defined. In this study, the interpretation of the play was as follows: 1) Having an inner motivation to do the activity, 2) being free from external laws, 3) going beyond reality and also reflecting on being realistic, 3) focusing on the process of doing the activity instead of the result of the activity, 4) to be spontaneous and safe, and 5) to need the active participation of the player [7, 8]. Based on the occupational therapy practice framework (OTPF), leisure time is a non-engaging and self-stimulate activity that is

performed at an optional time when it is not devoted to mandatory occupations like doing self-care tasks or jobs [9]. Approximately 30% of a day devotes to voluntary activities in normal children [10]. Accordingly, the main part of their daily lives in children is devoted to playing and leisure activities.

Dunn developed a sensory processing model that proposes an association between an individual's neural system and self-regulatory techniques [4]. In Dunn's model, the spectrum of neural thresholds is crucial. For example, strong input is not demanded by people with lower thresholds for sensory stimuli. However, they often do not notice the stimulus if they have a high point. Another major concept is self-regulation, in which individuals can respond passively or actively to sensory stimuli. In the intersection of these two spectrums, Dunn presents four patterns of sensory processing: Sensory seeking, sensory avoiding, sensory sensitivity, and low registration.

According to the definition of the World Health Organization (WHO), participation is an essential part of human development, through which proficiencies, qualifications, and the meaning of life are acquired [11]. Therefore, to optimize children's participation in society, it is necessary to find out how their sensory processing ability affects their participation in daily life. This study aims to raise the therapists' awareness of the mentioned cases. Accordingly, a systematic review of articles was carried out to investigate the association between sensory processing patterns and children's participation in leisure and play activities. The main research question is, "What is the association between sensory processing and participation in leisure activities and play in children aged 3 to 14 years?" Hence, this systematic review seeks to explore the following issues: The research undertaken

on this subject so far, the quality of existing evidence, and the pooled measure of the correlation between the patterns of sensory processing and participation in leisure activities.

2. Materials and Methods

The PRISMA (the preferred reporting items for systematic reviews and meta-analyses) guidelines were followed in conducting this systematic review [12]. First, to review the literature on this subject, we searched Persian and equivalent English keywords such as “participation”, “leisure”, “entertainment”, “play”, “sensory processing”, “sensory integration”, “sensory”, “motor sensory”, “occupational therapy” and “children”, in online databases like PubMed, Google Scholar, Springer, ProQuest, Scopus, Cochrane Library, Medline OT seeker, SID, and Healio.

To define texts that can be included in this study, play, and leisure activities were defined broadly. For example, play denotes the sensual and physical discovery of playthings and the settings, manipulation of playthings with or without friends, and spontaneous engagement in children. The play consists of capabilities like imagination, management of playthings, social communication, or fine motor dexterities.

Other inclusion criteria of the papers are as follows:

1. Collection and evaluation of data about play or leisure and sensory processing,
2. Publication in a reliable journal,
3. Description of data collection or evaluation method in the text.
4. The sample consisted of children aged 3-14 years,
5. The research published during 2010-2021, and
6. The availability of the full text (English or Persian).

Studies that did not include a full text did not examine children aged 3-14 years, did not examine both sensory processing and leisure or play participation, and were written in languages other than English or Persian were excluded. In addition, studies that examined involvement in activities other than leisure and play were excluded.

The study selection process was carried out in 2 phases, all titles were evaluated, and those not compatible with the study's objectives were excluded. All articles collect-

ed through the primary search were listed, and their titles, abstracts, and references were included in EndNote software, version 20. Duplicates were removed automatically and then manually. Two reviewers then checked the titles and summaries of the articles on sensory processing and leisure or play participation. The final list of the selected articles was drawn up and, in the event of controversy on the inclusion or exclusion of an article, the agreement was achieved after the discussion between the reviewers. If no consensus was reached, the study went into a second phase in which the full text of the article was studied and examined independently by the two reviewers. Next, they discussed later disputes, and if there was no agreement, the opinion of a third reviewer was sought. In this way, the final list was created Table 1. The process of identifying articles is shown in Figure 1.

Statistical analysis

The meta-analysis of the data, such as the association between sensory processing and participation in leisure activities and play, was conducted using the Mantel-Haenszel method in comprehensive Meta-analysis software (Version. 2.2; Biostat, Englewood, NJ, USA). The degree of heterogeneity between the results of the included studies was evaluated with the I^2 index, which indicates the proportion of variability between studies, and, if statistically significant, a random effect was used as the basis for the meta-analysis. Funnel plots were used to present the results of the complete meta-analysis to investigate a possible publication bias in the studies.

Critical evaluation and evidence grades

The checklist of Joanna Briggs Institute (JBI) was employed to measure the quality of studies. The quality evaluation results are outlined in Table 2. Also, the JBI checklist for case-control, cross-sectional, and systematic review studies is attached in Appendix 1. The included studies were then assigned to different grades of evidence. For this purpose, the grades of evidence were introduced by the National Health and Medical Research Council of Australia [12].

3. Results

According to the JBI checklist, a total score of more than 80% is defined as high quality, a score between 60% and 80% as medium quality, and a score of less than 60% as low quality [13]. None of the articles were removed because they were of accept quality. Of 13 examined articles, 11 had high quality, and 2 had medium quality.

Table 1. Characteristics of the included studies

Studies and Their Stages	Country/Type of Study/ Instruments	Characteristics of Sample	Findings	Study Limitations
Welters-Davis & Mische Lawson 2011 [24] Level 4	The USA Cross-sectional study 1. Sensory Profile (Dunn 1999) 2. Adolescent/Adult Sensory Profile (Dunn 1999) 3. Parent-Child Play Scale	Seventy typical children 3-4 years old	A significant association was observed between the parents' and children's sensory sensitivity. A significant association was also found between the parents' sensory seeking and responsive plays. There was a significant association between the parents' and children's sensory avoiding and sensory registration. However, no association was observed between parental sensory seeking and child sensory seeking. The analysis of the association between sensory and play preferences did not show any correlation between parental sensory sensitivity and pretend play. Parents' favorite play activities were mostly non-exploratory, restricting the children's sensory experiences, though children may prefer such activities.	The use of the snowball sampling method; the parents were primarily white women with academic education.
Engel-Yeger & Ziv-On 2011 [22] Levels 2-3 of The National Health and Medical Research Council (NHMRC)	Israel Case-control study 1. Short Sensory Profile (McIntosh et al. 1999) 2. Preference for Activities of Children (PAC) (King et al. 2004).	Fifty-eight male children aged 6-10 years, including 29 children with ADHD, 15 with predominant symptoms of hyperactivity and impulsivity, and 14 with predominant symptoms of attention-deficit/hyperactivity disorder (ADHD). Twenty-nine typically developing children were in the control group.	Children with ADHD showed slight preferences for participating in activities compared to the control group. Among all children with ADHD, poor preference for participating in social activities was associated with multiple problems in auditory filtering and overall sensory processing. High olfactory sensitivity and a slight preference for participation in social activities were correlated. Problems in the auditory filtering and slight preferences for participation in social, recreational, and informal activities, and the overall preferences to participate in activities were correlated. The lower energy levels were positively associated with a weak desire to participate in social activities. In addition, great auditory/visual sensitivity was positively associated with a slight desire for participation in social, recreational, and informal activities. A greater sensory-seeking tendency was associated with a stronger desire for physical activities. Overall sensory processing difficulties were positively associated with a weak desire to participate in social activities.	All samples were male.
Engel-Yeger et al. 2011 [23] Levels 2-3 of NHMRC	Israel Case-control study 1. Scoring of Atopic Dermatitis (SCORAD) 2. Short Sensory Profile (McIntosh et al. 1999) 3. Preference for activities of children (King et al. 2004)	Thirty-seven children (14 males and 23 females) with atopic dermatitis (AD) aged 6-11 years and 104 typically developing peers.	Sensory modulation disorders were observed in children with AD. A significant difference was found between the groups in their desire for engagement in leisure activities. Children with AD were less likely to engage in physical, skill-based, and formal activities than the control group. In the study group, a positive and significant correlation was found between sensory processing patterns and the priority of participation in recreational activities. A low score in sensory response/sensory seeking, auditory filter, visual/auditory sensitivity, and total Short Sensory Profile test suggested that children with severe sensory processing difficulties are more likely to engage in recreational activities.	The small number of study participants was one of the main limitations. Moreover, there was no random selection.

Studies and Their Stages	Country/Type of Study/ Instruments	Characteristics of Sample	Findings	Study Limitations
Hochhauser & Engel-Yeger 2010 [15] Levels 2-3 of NHMRC	Israel Case-control study 1. Short Sensory Profile (McIntosh et al. 1999) 2. Children's assessment of participation and enjoyment (CAPE) (King et al. 2004) 3. The childhood Asperger syndrome test (CAST) (Scott, Baron-Cohen, Bolton, & Brayne, 2007)	Fifty children aged 6 to 11 years, including 25 children with high- functioning ASD and 25 normal children.	<p>The inter-group differences in participation patterns: Diversity: Children with high-functioning ASD (HFASD) engaged in 50% of the leisure activities, while the control group attended 70% of the activities.</p> <p>The intensity of participation was lower in HFASD children than in the control group.</p> <p>In addition, the clinical group was less likely to participate in social and informal activities than the control group.</p> <p>Children with HFASD were more likely to engage in solo activities than the controls.</p> <p>The clinical group had a higher tendency than the controls to perform recreational and informal activities at home.</p> <p>The clinical group gained less pleasure from participation in activities than the control group. This was particularly evident in this field's overall score, especially in recreational, physical, social, formal, and informal activities.</p> <p>Sensory processing capabilities were also related to the patterns of participation in children with high-functioning ASD.</p> <p>Improved overall sensory processing capabilities were significantly associated with higher overall participation intensity.</p> <p>Higher tactile sensitivity was linked to greater participation in physical activities.</p> <p>Children with higher taste/olfactory sensitivities showed lower levels of participation. They also were more likely to do leisure activities with others and gained less pleasure.</p> <p>Children with greater motor sensitivity preferred to do activities at home, especially recreational and informal activities.</p> <p>Children are especially prone to sensory seeking tended to perform most activities at home, especially self-improvement activities.</p> <p>Children with greater visual/auditory sensitivity tended to engage in self-improvement activities with others.</p> <p>Furthermore, children with lower levels of energy were more likely to participate in activities with others, especially in self-improvement and informal activities</p>	<p>The study sample was small, selected from a region with little economic and socioeconomic diversity.</p>
Cosby et al. 2010 [19] Levels 2-3 of NHMRC	The USA Case-control study 1. Short Sensory Profile (McIntosh et al. 1999) 2. Children's assessment of participation and enjoyment (CAPE) (King et al. 2004)	Twenty-four individuals (12 children with a sensory processing disorder and 12 typically children) aged 6 to 9 years old.	<p>The results showed that the two groups of participants had similar patterns regarding the priority of activities and leisure. However, significant differences were observed in the intensity and enjoyment of participation and social networks.</p> <p>In general, children with sensory processing disorders enjoyed less participation in activities than typical peers did.</p> <p>The two groups had identical characteristics in the subscales of "diversity", "where", and "pleasure" ($p>0.05$). However, they were significantly different in the subscales of "intensity" and "with whom", with reported P values of 0.03 and 0.05, respectively.</p> <p>Typical children had more diverse social networks for their social activities than children with sensory processing disorders did.</p>	<p>Only white boys with restricted socioeconomic diversities were examined.</p>

Studies and Their Stages	Country/Type of Study/ Instruments	Characteristics of Sample	Findings	Study Limitations
Cosbey et al. 2012 [20] Levels 2-3 of NHMRC	The USA Case-control Study 1. Short Sensory Profile (McIntosh et al. 1999) 2. Playground Observation Forms	Twelve individuals with a sensory processing disorder (SPD) and 12 typically developing children were selected. The mean age of the subjects in the study group and the typically-developing peer group was 7 years and 11 months and 8 years and 0 months, respectively.	<p>Both groups preferred to play in small groups and were less likely to interact with adults in both groups of children.</p> <p>Both groups were not aggressive, but subjects in the SPD group were more aggressive than their typical peers.</p> <p>Both groups preferred plays to non-playful behaviors (such as discussion), and their play was mainly regular. Also, both groups of children dedicated most of their time to participatory games.</p> <p>In both groups of participants, the percentage of high-level social behaviors was significantly higher than that of low-level social or antisocial behaviors.</p> <p>In 48 observation sessions, the conflict during participation was only observed in 14 sessions in children with SPD, but for typical peers, conflicts were observed in only five sessions.</p> <p>Incidence of Conflict: During the observations, children with SPD (n=8) were more likely to experience conflict than their typical peers (n=5), and they preferred to engage in more than one observation session. Among children with SPD, 4 reported conflicts in at least half of the observation sessions. Besides, children with SPD (n=11), unlike their peers (n=1), were reluctant to apologize for their mistakes. Access to game opportunities: All children in the study were searched as playmates in at least two of the four sessions, but only three children with SPD were searched as playmates in each of the four observation sessions, as opposed to 9 children in healthy peers. Finally, the two groups were different in terms of response to social cues, including behaviors like failure to respond to verbal and nonverbal communication, which indicate the boredom or annoyance of other children, or the fact that sustained social interaction when other children seem to be uninterested in the interaction (e.g. when a child runs away, they ignore another child with SPD or pays attention to other children). Seven children with SPD did not respond to social symptoms in at least one of the four observation sessions, which was observed in only two developmentally healthy children. Generally, the two groups had identified the play pattern. However, conflict, social play, access to gaming opportunities, and awareness of social cues differed.</p>	<ol style="list-style-type: none"> 1. The study was limited to the playground (lack of environmental diversity) 2. This study includes a small sample and is demographically homogeneous. 3. Most children had sensory-seeking preferences; therefore, the results cannot be generalized to other patterns of SPD.
Loh et al. 2020 [18] Levels 2-3 of NHMRC	Malaysia Case-control study 1. Short Sensory Profile Test (McIntosh et al. 1999) 2. Participation in childhood Occupation (PICO-Q, second edition)	One hundred and eighty-six parents of children with ASD and typical children (93 children and 93 children aged 10-6 years) participated, of which 72 children with autism were boys.	<p>Children with ASD had more (a) sensory processing problems and (b) were less likely to participate in children's activities (except for essential activities such as eating and sleeping) compared to the typical group.</p> <p>In children with ASD, a significant association was observed between sensory processing and participation in childhood occupations. More problems in sensory processing were associated with greater participation problems. The auditory filter was the only component of SSP-M significantly associated with all three components of PICO-2 (participation problem, frequency, and enjoyment).</p>	Using a local sample and relying on parental reporting.

Studies and Their Stages	Country/Type of Study/ Instruments	Characteristics of Sample	Findings	Study Limitations
<p>Reynolds et al. 2011 [16] Levels 2-3 of NHMRC</p>	<p>The USA Case-control study 1. Child Behavior Checklist: Competence Scales 2. Sensory Profile</p>	<p>In this study, 27 children with high-function autism aged 6-12 years were in the study group, and 28 typically developed children aged 6-12 were in the control group</p>	<p>Both groups were different with respect to the sensory response. According to the sensory profile test, low sensory registration, sensory seeking, sensory sensitivity, and sensory avoidance were greater in children with autism than in others. In this study, children with autism were more involved in video games, card games, and reading/book games but less engaged in show activities, playing with dolls or action figures, and handicrafts. In general, children with autism were not as involved in household chores, particularly in the kitchen and food preparation. They also preferred to avoid activities such as babysitting, pet care, and general cleaning. In a checklist of child behaviors, competence is assessed in three areas: participation in activities, social skills, and school competence. Statistical analyses revealed significant differences between children in different areas of competency: Children with high sensory sensitivity were less active than those with low sensory sensitivity. Likewise, children with high sensory avoidance were significantly less likely to be engaged than those with low sensory avoidance. As regards social competence, children with greater sensory sensitivity had significantly lower scores than those with lower sensory sensitivity or similar. This general pattern also applies to school competence. Children with higher sensory sensitivity gained significantly lower scores than those with low or similar sensory sensitivity. Moreover, children with greater sensory avoidance gained a lower score on school competency than those with lower or comparable sensory avoidance. In conclusion, in all of these comparisons, children with greater sensory behaviors displayed lower levels of competence.</p>	<ol style="list-style-type: none"> 1. Small sample size 2. Dominance of male subjects in the typical cases 3. A significant cognitive difference existed between the study group and the healthy group 4. Sensory profile tests can be used for children 3-10 years old. This study was used for 12 years old children. However, according to the authors of this study, as noted in previous articles, the sensory profile test was used in this age range.
<p>Kuhaneck & Britner 2013 [14] Level 4 of NHMRC</p>	<p>The USA Cross-sectional study and use of the Structural Equation Model 1. Sensory Processing Measure (SPM) (Parham, Ecker, Miller-Kuhaneck, Henry, & Glennon, 2006) 2. Sensory Processing Measure-Preschool (Miller-Kuhaneck, Ecker, Parham, Henry, & Glennon, 2010)</p>	<p>One hundred and eight school-age children with autism and 55 children with autism aged 2 to 5 years</p>	<p>The direct and indirect relationships between sensory processing and social play were investigated using structural equation modeling. The two questionnaire subscales used in this study were game performance, vision, touch, proprioception, balance, and praxis. Based on the statistical analysis findings, a significant relationship was found between the functions of the sensory system and played in combination with praxis.</p>	<p>Preliminary evidence of the association between the functions of the sensory system and social play in combination with praxis was presented without using a separate play evaluation tool. In addition, the sensory processing assessment tool in this study did not include sensory processing disorders such as hypersensitivity, sensory avoidance, etc.</p>

Studies and Their Stages	Country/Type of Study/ Instruments	Characteristics of Sample	Findings	Study Limitations
Watts et al. 2014 [3] Level 6 of NHMRC	Australia Systematic Review Use the PRISMA (The Preferred Reporting Items for Systematic reviews and Meta-Analyses) guide	In this study, academic databases were sought by the keywords of game, leisure, sensory processing, and sensory integration from 1990 to 2012. Out of 6230 articles identified, 35 had full-text access, of which eight met the inclusion criteria.	All 8 studies were performed in the United States. Inadequate evidence has been provided for the association between play and sensory processing, mainly in case studies and cohort studies. One of the most important findings of this systematic review was that the play desires of children are affected by their sensory desires (Mische Lawson & Dunn, 2008; Welters-Davis & Mische Lawson, 2011). Children with sensory seeking look for toys that meet their sensory needs, including creative art toys or structural blocks that they can disassemble (Mische Lawson and Dunn, 2008). Parents choose toys and games that are consistent with their play preferences and sensory processing and therefore have a bearing on their child's preferences (Welters-Davis and Mische Lawson, 2011).	1. This study covered papers published in English with full text available. 2. In this research, play was defined as play with toys, as well as active and unforced engagement of children. There is, however, a wide range of game definitions that can change the inclusion criteria for future studies.
Little et al. 2015 [17] Level 4 of NHMRC	The USA Cross-sectional study 1. Home and Community Activities Scale (HCAS; Adapted from Dunst et al. 2000) 2. Sensory Experiences Questionnaire Version 3.0 (SEQ 3.0; Baranek 2009) 3. Social Responsiveness Scale (SRS; Constantino and Gruber 2005a, b) 4. Vineland Adaptive Behavior Scales-II (VABS-2; Sparrow et al. 2005)	This study consists of 674 caregivers of children with autism aged 5-12 years.	Sensory hypersensitivity harms neighborhood-social activities (adapted from the Home and Community Activities Scale). Also, children with higher scores in sensory hyper-responsiveness were less likely to involve in community activities, routine tasks, and neighborhood-social activities than in outdoor activities. On the other hand, children with higher scores in sensory and lower responsiveness were more likely to engage in community and neighborhood-based activities. Finally, children with high sensory interest scores, repetition, and sensory seeking were more likely to participate in parent-child repetitive activities than outdoor ones.	Limiting to a time.
Ismael et al. 2015 [25] Level 4 of NHMRC	The USA Cross-sectional study 1. Children's assessment of participation and enjoyment (CAPE; King et al. 2004) 2. Preference for Activities of Children (PAC) (King et al. 2004) 3. Sensory Profile Test (Dunn 1999) 4. Adolescent/Adult Sensory Profile (AASP; C. Brown & Dunn, 2002)	The sample included 91 typical children, 45 males and 46 females aged 6-14.	Children with diverse sensory processing patterns engaged in similar and distinct activities. For instance, most children with various patterns of sensory processing were interested in coloring or drawing, computer games, and sightseeing. Children with sensory avoidance had a higher tendency to engage in activities such as doing puzzles, visiting public libraries, reading, and performing everyday tasks. Watching TV or movies was the most preferred activity of all children, whereas gardening, fishing, horseback riding, and participation in school activities were the children's least favorite in all four sensory patterns. The results of the correlation analysis were as follows: Low registration had a significant negative association with participation diversity. Sensory sensitivity had a significant negative association with social activities. Sensory sensitivity had a significant negative association with skill-based activities.	1. The wide variety of samples and uneven distribution of feature samples. 2. The questionnaires adopted here looked at the extent of engagement in children's activities during the last four months. 3. Since this study was conducted in the Midwest, children's participation might have been affected by climatic conditions (e.g. ice skating, swimming). 4. Since the questionnaires were lengthy, children grew tired sometimes.

Studies and Their Stages	Country/Type of Study/ Instruments	Characteristics of Sample	Findings	Study Limitations
Chien et al. 2016 [21] Levels 2-3 of NHMRC	Australia Case-control study 1. Short Sensory Profile Test (McIntosh et al. 1999) 2. Participation in Childhood Occupations Questionnaire (PICO-Q) (Bar-Shalita et al. 2009)	Parents of 64 children (mean age: 8 years and one month) participated; 36 children had potential sensory processing disorder (29 males, 7 females) and 28 of them had normal sensory processing (25 males, 3 females), none of whom received a diagnosis of specific disorder. They were.	<p>Children with potential sensory processing disorder had significantly higher levels of participation and pleasure than children with normal sensory processing (in the whole scale and all areas except the daily care domain). Most types of sensory processing disorder had a low-to-moderate correlation with one or more domains of the Childhood Participation Questionnaire, including four types of motor sensitivity, sensory responsiveness / sensory seeking, low energy/weakness, and visual/auditory sensitivity. In this study, they were hypothesized to be positively associated with children's participation. Taste/Olfactory sensitivity scores were unrelated to any Participation in Childhood Occupations Questionnaire (PICO-Q) scores. Hence, this type of sensory processing disorder was not entered into the dimensional multiple regression analysis as an independent variable. Sensory lower responsiveness/sensory seeking was identified as the only significant predictor for daycare.</p> <p>Low energy/weakness was identified as the only significant predictor of the participation pleasure domain, but no predictors were found for routines and habits.</p> <p>Sensory responsiveness/sensory seeking and visual/auditory sensitivity were two predictors for this domain.</p> <p>In all regression models, motor sensitivity was not a significant predictor. In general, multiple regression analysis revealed that only three types of disorders (low sensory response/sensory seeking, low energy/weakness, and visual/auditory sensitivity) were significant predictors for the domains of the Childhood Participation Questionnaire.</p> <p>The results of the correlation analysis were summarized as follows: Movement sensitivity had a significant positive association with the level of play and leisure participation. Auditory filtering is significantly positively associated with the level of play and leisure participation. Low energy had a significant positive association with the level of play and leisure participation. Movement sensitivity had a significant positive association with the enjoyment of play and leisure participation. Auditory filtering had a significant positive association with the enjoyment of play and leisure participation. Low energy had a significant positive association with the enjoyment of play and leisure participation. Visual and auditory sensitivity had a significant positive association with the enjoyment of play and leisure participation. Low energy had a significant positive association with the frequency of play and leisure participation. Visual and auditory sensitivity had a significant positive association with the frequency of play and leisure participation.</p>	<ol style="list-style-type: none"> 1. Only children with sensory processing disorder who had never been referred to medical clinics were examined. 2. An average sample size was used. 3. This study categorizes children into two groups those with a definite or probable diagnosis of sensory processing disorder and those with healthy sensory processing. Also, instead of observing children's performance or reporting, it measures participation through parental reporting.

Table 2. Results of quality scoring based on the Joanna Briggs Institute (JBI) appraisal checklist for the included studies

No.	Authors	Methodology	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Total Score
1	Watts et al. 2014 [3]	Systematic review	Y	Y	N	Y	Y	U	Y	Y	Y	Y	Y	81.1%
2	Engel-Yeger & Ziv-On 2011 [22]	Comparison case-control	Y	Y	N	Y	Y	U	Y	Y	Y	Y		80%
3	Hochhauser & Engel-Yeger et al. 2010 [15]	Comparison case-control	Y	Y	Y	Y	Y	Y	N	Y	Y	Y		90%
4	Engel-Yeger et al. 2011 [23]	Comparison case-control	Y	Y	Y	Y	Y	Y	U	U	Y	Y		80%
5	Cosbey et al. 2010 [19]	Comparison case-control	Y	Y	Y	Y	Y	Y	N	Y	Y	Y		90%
6	Cosbey et al. 2012 [20]	Comparison Case-control	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		100%
7	Reynolds et al. 2011 [16]	Comparison case-control	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		100%
8	Chien et al. 2016 [21]	Comparison case-control	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		100%
9	Loh et al. 2020 [18]	Comparison case-control	Y	Y	Y	Y	Y	N	N	Y	Y	Y		80%
10	Welters-Davis & Mische Lawson 2011 [24]	Cross-sectional	Y	Y	Y	Y	N	N	Y	Y				75%
11	Ismael et al. 2015 [25]	Cross-sectional	Y	Y	Y	N	Y	Y	Y	Y				87.5%
12	Kuhaneck & Britner 2013 [14]	Cross-sectional	Y	Y	Y	Y	N	N	Y	Y				75%
13	Little et al. 2015 [17]	Cross-sectional	Y	Y	Y	Y	Y	Y	Y	Y				100%

The bulk of the research was undertaken in the United States (seven studies) and the rest in Australia (two studies), Malaysia (one study), and Israel (three studies).

Study groups

The studies were performed on children with autism spectrum disorder (ASD) (five articles), sensory processing disorder (two articles), normally developed children with potential sensory processing disorders (one article), children with attention-deficit hyperactivity disorder (ADHD) (one article), atypical dermatitis (one article), and normally developed children (two articles).

Articles on children with autism spectrum disorder

Preliminary research exhibited a significant relationship between the sensory system’s functions and played in children with ASD [14] In three studies, this association was investigated based on the type of disorders in sensory processing patterns. In Hochhauser and Engel-Yeger ‘s study [15], a significant correlation was reported between enhanced sensory processing ability and greater intensity of participation in children. Accordingly, the observed significant correlations between the desire to participate in leisure activities and sensory processing disorders were as follows:

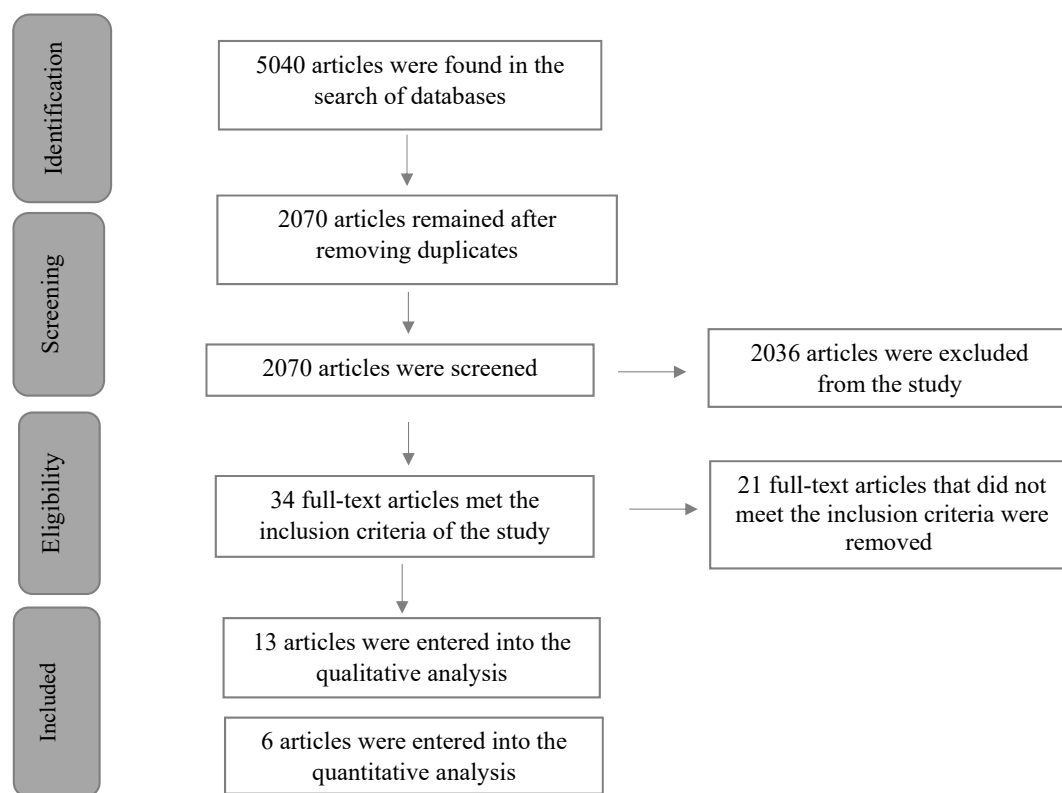


Figure 1. Process of selecting studies for the meta-analysis and systematic review

Iranian Rehabilitation Journal

1. High tactile sensitivity was associated with the increased intensity of participation in physical activity,
2. High taste/smell sensitivity was associated with low participation intensity,
3. Taste/smell sensitivity was associated with the delight of performing recreational activities with others,
4. High motor sensitivity was related to several activities, particularly recreational and informal activities at home
5. A high sensory search was related to the performance of more activities, especially self-improvement activities at home, and Lower energy levels in children were related to the tendency to do activities with others [15].

Reynolds et al. also reported that increased sensory sensitivity and sensory avoidance significantly correlated with lower activity and social competence in children [16]. Then again, Little et al. stated that sensory hyper-responsiveness significantly affects neighborhood-social activities and the routine work (work done at home) in children and encourages outdoor activities. In addition, children with a greater tendency for sensory interests, repetitive movements, and sensory seeking preferred joint activities with other children and parents to alfresco activities [17].

In the study of Loh et al., sensory processing was found to be significantly correlated with participation in children's occupations. Also, more problems in sensory processing were related to increased obstacles to participation. The auditory filtering was the only component of sensory processing significantly associated with participation problems ($r=0.36$, $P=0.01$), participation intensity ($r=0.22$, $P<0.05$), and participation enjoyment ($r=0.27$, $P<0.01$) [18].

Articles on children with sensory processing disorder

As asserted by Cosbey et al., children with sensory processing disorder (SPD) differ from their typical peers in terms of the intensity of participation and the people with whom they are engaged. Moreover, typical children have more diverse social networks in their social activities than children with SPD [19]. In a 2012 study, the researchers looked at children's behaviors on the playground, observing that both typical children and children with SPD were likely to engage in participatory and regular games. In addition, they tend to play in small groups and spend less time with adults. However, there were some differences in terms of conflicts, play chance, and social signal awareness. In children with SPD, significant positive and negative correlations with the above items were found [20].

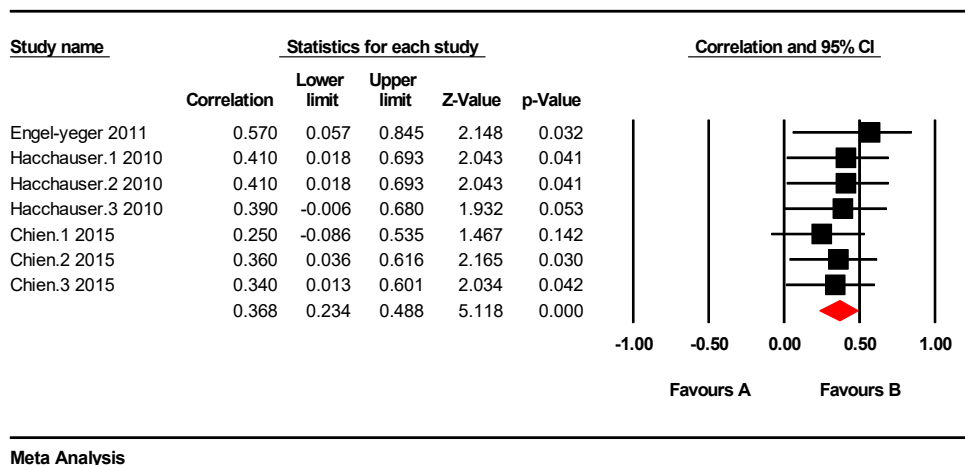


Figure 2. Correlation between the energy level and preference for participation in leisure activities

Heterogeneity: $\chi^2=1.47$, $d_f=6$ ($P=0.961$); $I^2=0\%$. Test for overall effect: $Z=5.12$ ($P<0.001$).

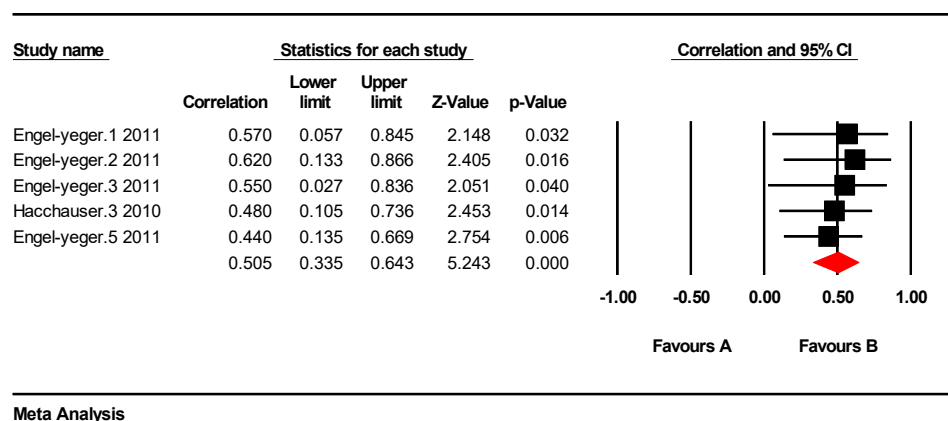


Figure 3. Correlation between the auditory/visual sensitivity and preference for participation in leisure activities

Heterogeneity: $\chi^2=0.71$, $d_f=4$ ($P=0.950$); $I^2=0\%$. Test for overall effect: $Z=5.24$ ($P<0.001$).

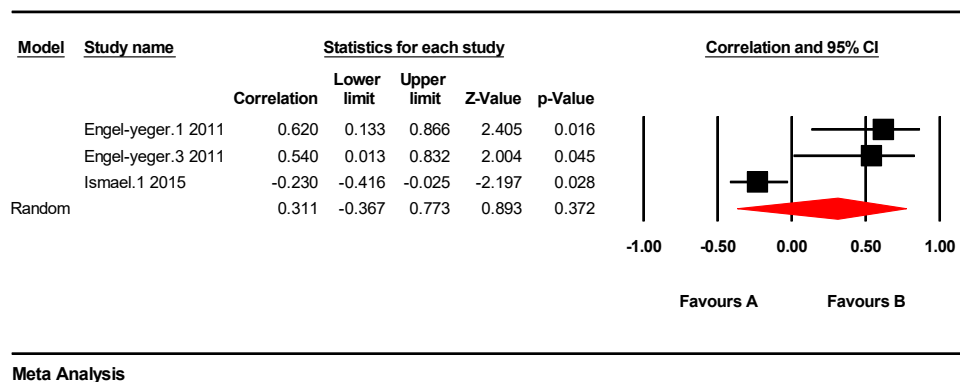


Figure 4. Correlation between the sensory sensitivity and preference for participation in social activities

Heterogeneity: $\chi^2=14.297$, $d_f=2$ ($P<0.001$); $I^2=86\%$. Test for overall effect: $Z=0.893$ ($P=0.372$).

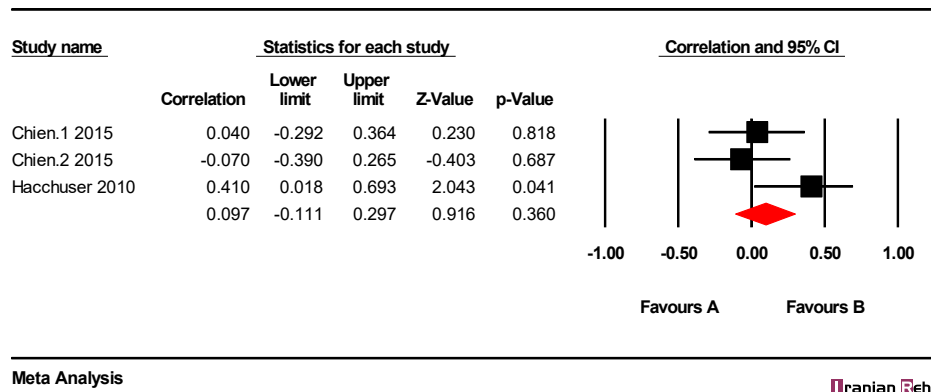


Figure 5. Correlation between the taste/olfactory sensitivity and intensity of participation in leisure activities
 Heterogeneity: $\chi^2=3.55$, $d_f=2$ ($P=0.169$); $I^2=44\%$. Test for overall effect: $Z=0.92$ ($P=0.360$).

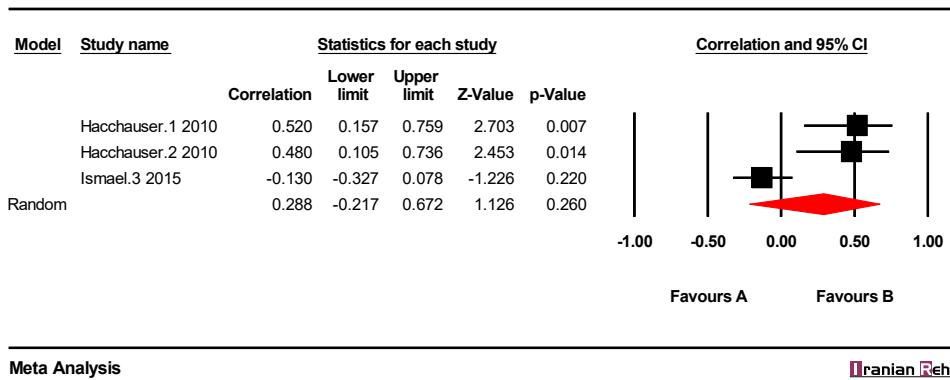


Figure 6. Correlation between the sensory sensitivity and “with whom” dimension of participation in leisure activities
 Heterogeneity: $\chi^2=13.611$, $d_f=2$ ($P=0.001$); $I^2=83\%$. Test for overall effect: $Z=1.126$ ($P=0.260$).

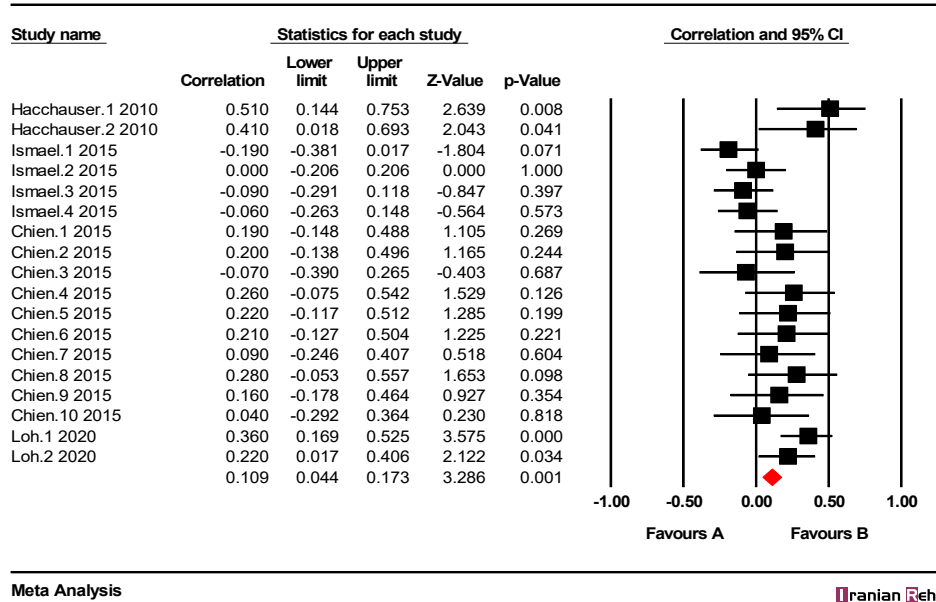
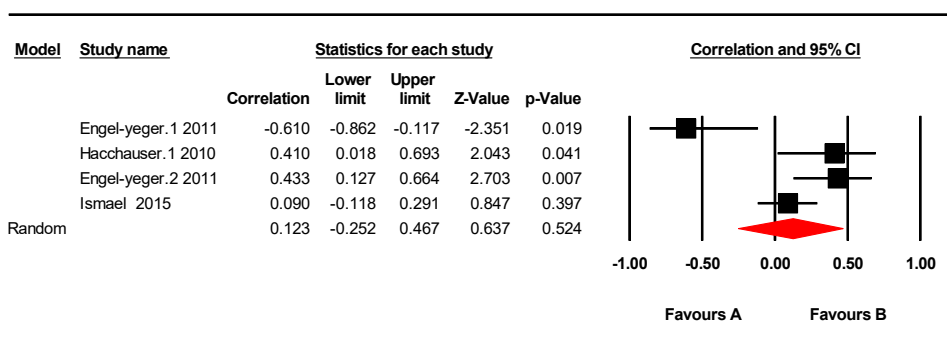
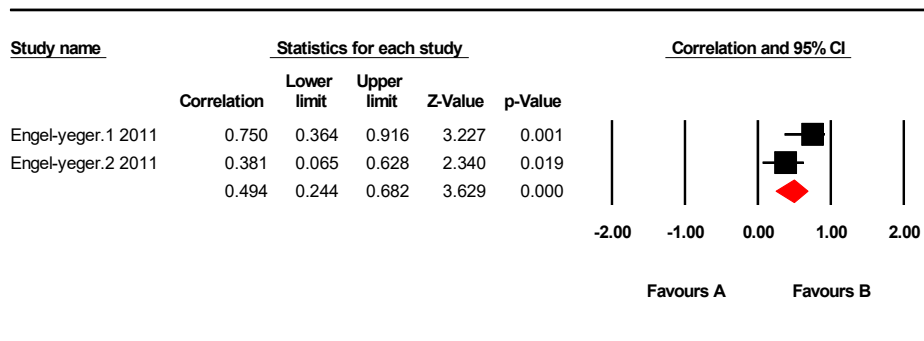


Figure 7. Correlation between the sensory processing patterns and intensity of participation in leisure activities
 Heterogeneity: $\chi^2=34.06$, $d_f=17$ ($P=0.008$); $I^2=50\%$. Test for overall effect: $Z=2.70$ ($P=0.007$).



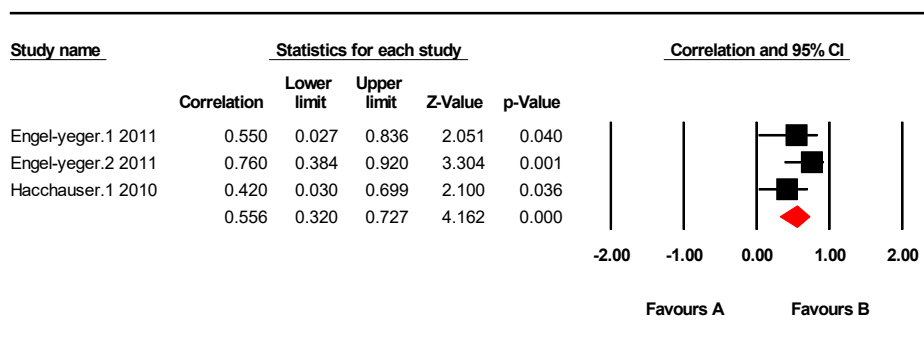
Meta Analysis

Figure 8. Correlation between the sensory seeking and preference for participation in leisure activities
 Heterogeneity: $\chi^2=13.079$, $d_f=3$ ($P=0.004$); $I^2=77\%$. Test for overall effect: $Z=0.55$ ($P=0.582$).



Meta Analysis

Figure 9. Correlation between the general sensory processing and preference for participation in leisure activities
 Heterogeneity: $\chi^2=2.72$, $d_f=1$ ($P=0.099$); $I^2=63\%$. Test for overall effect: $Z=3.63$ ($P<0.001$).



Meta Analysis

Figure 10. Correlation between the sensory processing patterns and preference for participation in informal activities
 Heterogeneity: $\chi^2=2.21$, $d_f=2$ ($P=0.332$); $I^2=9\%$. Test for overall effect: $Z=4.16$ ($P<0.001$).

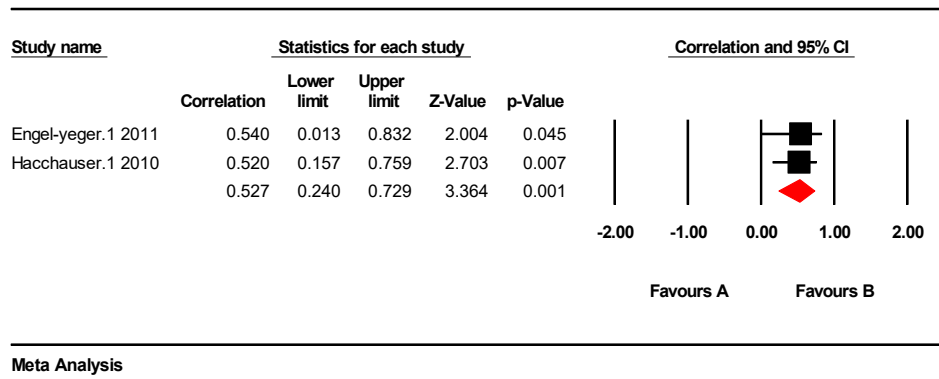


Figure 11. Correlation between the olfactory sensitivity and preference for participation in leisure activities

Heterogeneity: $\chi^2=0.01$, $d_f=1$ ($P=0.940$); $I^2=0\%$. Test for overall effect: $Z=3.36$ ($P=0.001$).

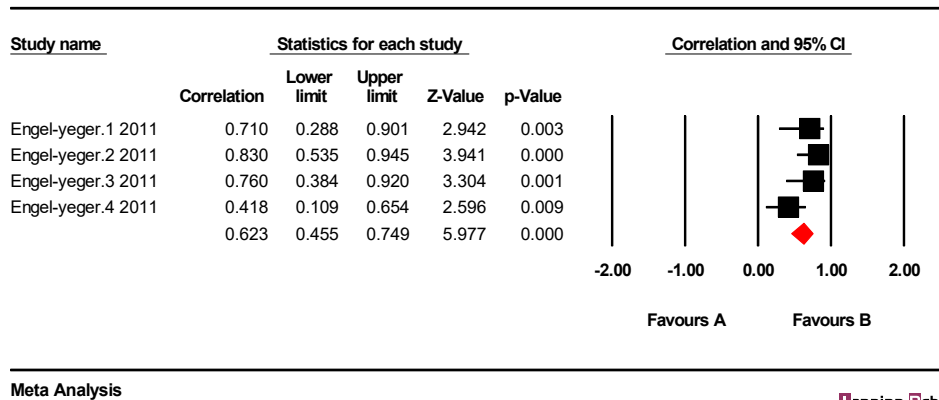


Figure 12. Correlation between the auditory filtering and preference for participation in leisure activities

Heterogeneity: $\chi^2=6.12$, $d_f=3$ ($P=0.106$); $I^2=51\%$. Test for overall effect: $Z=5.98$ ($P<0.001$).

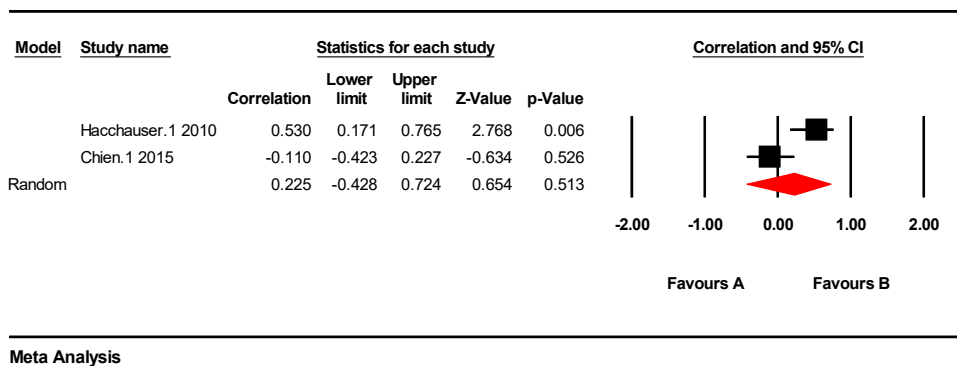
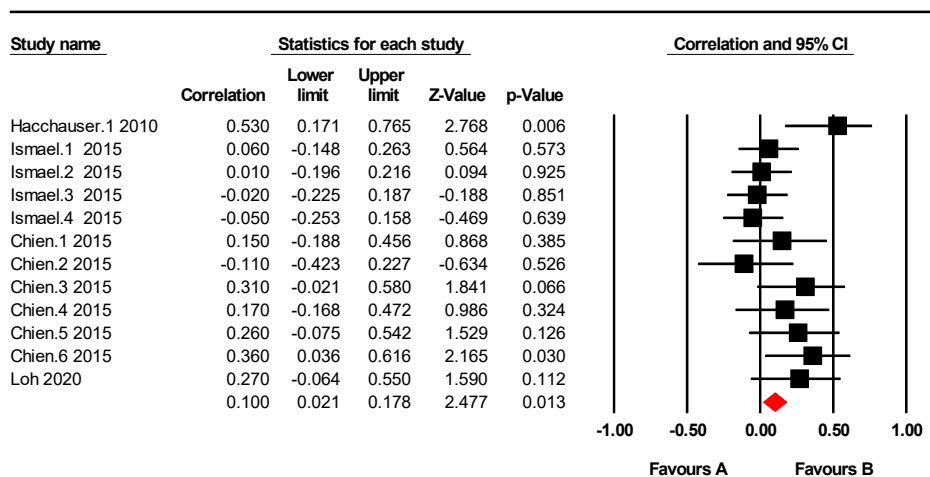


Figure 13. Correlation between the taste/olfactory sensitivity and enjoyment of participation in leisure activities

Heterogeneity: $\chi^2=6.48$, $d_f=1$ ($P=0.011$); $I^2=85\%$. Test for overall effect: $Z=0.65$ ($P=0.513$).

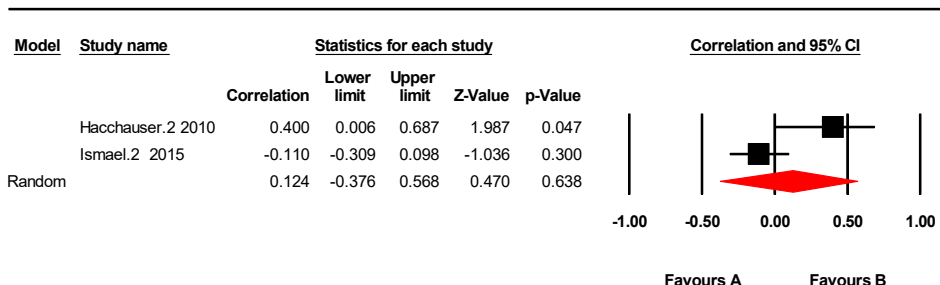


Meta Analysis

Figure 14. Correlation between the sensory processing patterns and enjoyment of participation in leisure activities

Heterogeneity: $\chi^2=17.18$, $d_i=11$ ($P=0.103$); $I^2=36\%$.

Test for overall effect: $Z=2.48$ ($P=0.013$).

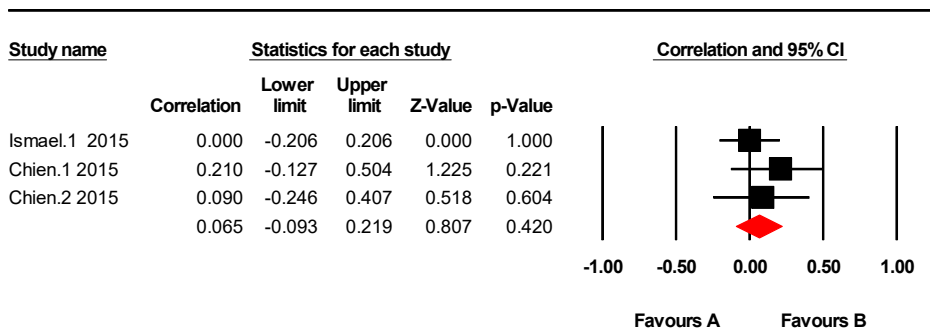


Meta Analysis

Figure 15. Correlation between the sensory sensitivity and “where” dimension of participation in leisure activities

Heterogeneity: $\chi^2=5.021$, $d_i=1$ ($P=0.025$); $I^2=80\%$.

Test for overall effect: $Z=0.470$ ($P=0.638$).



Meta Analysis

Figure 16. Correlation between the sensory seeking and intensity of participation in leisure activities

Heterogeneity: $\chi^2=1.12$, $d_i=2$ ($P=0.572$); $I^2=0\%$.

Test for overall effect: $Z=0.81$ ($P=0.420$).

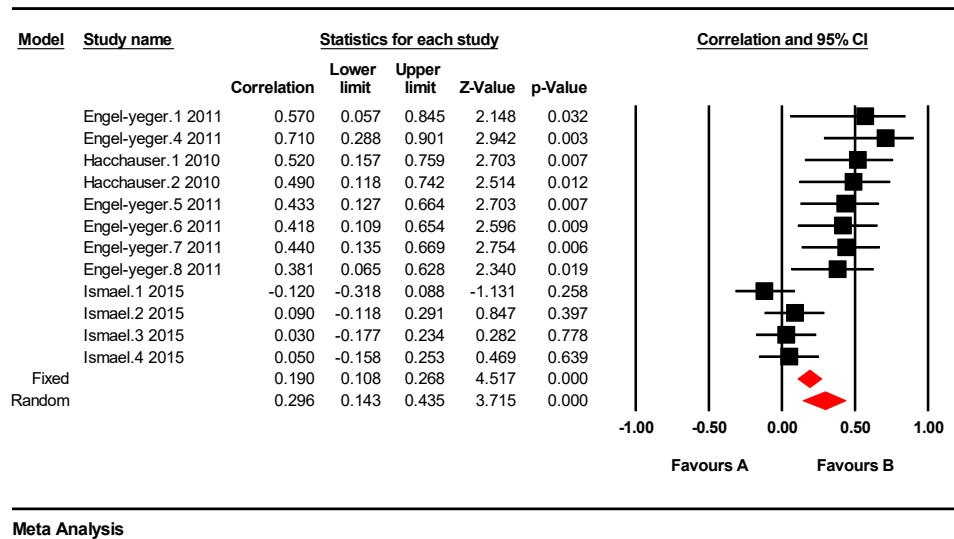


Figure 17. Correlation between sensory processing patterns and preference for participation in recreational activities

Heterogeneity: $\chi^2=35.89$, $d_f=11$ ($P<0.001$); $I^2=69\%$.

Test for overall effect: $Z=3.72$ ($P<0.001$).

Articles on children with potential sensory processing disorder

Chien et al.'s studied children with potential sensory processing disorders, reporting that they had a significantly higher level of participation (in all subscales of the questionnaire and participation in child occupations) and less fun (in all areas except daycare) compared to children with normal sensory processing. The results of this study are as follows:

1. As for the level of participation, low sensory response and sensory seeking were the only predictors of the daycare area.
2. Low energy/weakness was the only significant predictor of participation pleasure.
3. As for the frequency of participation, low sensory response/sensory seeking, as well as the sensitivity of vi-

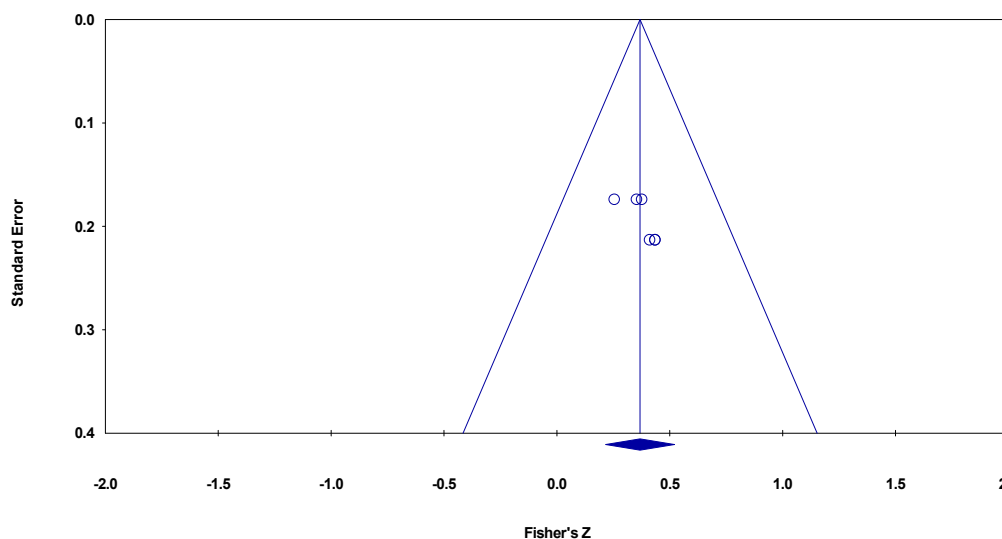


Figure 18. Standard difference in means in the view of a funnel plot

sual or auditory sensations, were two main predictors of participation in school activities.

4. Taste/olfactory sensitivity was not associated with participation in childhood activities.

5. There were no predictors in routine jobs and habits [21].

Articles on children with attention-deficit/hyperactivity disorder

There was only one study on children with attention-deficit/hyperactivity disorder (ADHD), in which Engel-Yeger and Danila Ziv-On demonstrated a positive correlation between intensified hearing filter problems and low preference for social activities, as well as between leisure and informal activities and overall preference for all activities based on the Preference for Activities of Children (PAC) questionnaire. In addition, a significant correlation was observed between general sensory processing problems and a slight preference for participation in social activities [22].

Articles on children with atypical dermatitis

In this group of research, Engel-Yeger et al. observed positive and significant correlations as follows:

1. Low sensory response and sensory seeking correlate with a desire to participate in leisure activities.

2. Sensitivity to visual/auditory sensations correlates with the desire to participate in leisure activities.

3. The total score of sensory processing based on the short sensory profile test correlates with the desire to participate in leisure activities [23].

Their results suggested that children who have a problem with patterns of sensory processing are more likely to engage in recreational activities.

Articles on typically developing children

Walters and Lawson identified a significant positive correlation between parental sensory seeking and responsive play. They also found a correlation between sensory sensitivity and sensory avoiding scores of parents and children [24].

In the study of Ismail et al., a significant association was reported between sensory avoidance and more visits to public libraries/studies, puzzle-making, and daily activities. In their study, watching TV and movies was the

absolute favorite of all children, while fishing, gardening, horse riding, and school activities were their least favorite in all four sensory patterns. In addition, significant negative correlations were reported as follows:

1. Between low sensory registration and overall participation diversity scores of children's assessment of participation and enjoyment (CAPE),

2. Between sensory sensitivity and desires for social and skill-based activities,

3. Between sensory avoidance and desires for social and skill-based activities [25].

Measurement of sensory processing and participation in leisure and play

Ten studies used the sensory profile test (the short or long form), one used the sensory experiences questionnaire (third edition), and one employed the sensory processing measure to assess sensory processing.

The following tools and questionnaires were used to assess participation in games and leisure: Activities

1. Parent-child play scale (one article)

2. Children's assessment of participation and enjoyment-CAPE (three articles)

3. Preference for activities of children- PAC (three articles)

4. Playground observation forms (one article)

5. Child behavior checklist: Competence scales (one article)

6. Home and community activities scale

Meta-analysis

In this study, 6 articles [15, 16, 17, 23, 24, 25] that met the inclusion criteria were subjected to the quantitative synthesis. The results suggested significant correlations between the energy level and preference for participation in leisure activities ($r=0.368$, 95% CI: 0.23-0.49, $P<0.001$, $I^2=0.0$), the auditory/visual sensitivity and preference for participation in leisure activities ($r=0.505$, 95% CI: 0.33-0.64, $P<0.001$, $I^2=0.0$), the sensory processing patterns and the intensity of participation in leisure activities ($r=0.109$, 95% CI: 0.04-0.17, $P=0.001$, $I^2=0.50$), the general sensory processing and preference

for participation in leisure activities ($r=0.494$, 95% CI: 0.24-0.68, $P<0.001$, $I^2=0.63$), the sensory processing patterns and preference for participation in informal activities ($r=0.556$, 95% CI: 0.32-0.73, $P<0.001$, $I^2=0.09$), the olfactory sensitivity and preference for participation in leisure activities ($r=0.527$, 95% CI: 0.24-0.73, $P=0.001$, $I^2=0.0$), the auditory filtering and preference for participation in leisure activities ($r=0.623$, 95% CI: 0.45-0.75, $P<0.001$, $I^2=0.51$), the sensory processing patterns and enjoyment of participation in leisure activities ($r=0.100$, 95% CI: 0.02-0.18, $P=0.013$, $I^2=0.36$), the sensory processing patterns and preference for participation in recreational activities ($r=0.296$, 95% CI: 0.14-0.43, $P<0.001$, $I^2=0.69$). No significant correlations were found between the sensory sensitivity and desire to participate in social activities, the taste/olfactory sensitivity and intensity of engagement in leisure activities, the sensory sensitivity and “with whom” dimension of participation in leisure activities, the sensory seeking and preference for participation in leisure activities, the taste/olfactory sensitivity and delight of the involvement in leisure activities, the sensory sensitivity and “where” dimension of engagement in leisure activities, the sensory seeking and intensity of participation in leisure activities (Figures 2 to 17).

Publication bias

Six studies were summarized in a funnel plot (Figure 18). No publication bias was found in the meta-analysis based on Begg and Mazumdar’s correlation.

4. Discussion

As mentioned, the evidence presented by articles on the patterns of sensory processing and participation in play and leisure activities is inadequate. In the reviewed studies, leisure activities were classified into 7 categories: recreational, social, physical, self-improvement, skill-based, informal, and formal. Moreover, in all reviewed articles, a significant correlation had been reported between the patterns of sensory processing and childhood activity participation, though the direction and type of these correlations were different. However, a significant correlation emerged between general sensory processing problems and lesser involvement in leisure activities in three groups of studies, including children with ASD, potential sensory processing disorder, and ADHD [18, 21, 22]. Also, 9 out of 12 articles directly investigated the correlation between sensory processing patterns and play or leisure activities [3, 14, 24, 25]. Two out of the other three articles investigated the correlation between these patterns and participation in all children’s activities [18, 21], and one looked at their relationships with en-

gagement in home and community activities [17]. Two articles consistently asserted that autistic children with strong sensory seeking are less likely to participate in outdoor activities than other activities [15, 17].

The meta-analysis of six studies [15, 16, 17, 23, 24, 25] illustrated significant correlations between the energy level and preference for participation in leisure activities, the auditory/visual sensitivity and preference for participation in leisure activities, the sensory processing patterns and the intensity of the involvement in leisure activities, the general sensory processing and preference for participation in leisure activities, the sensory processing patterns and preference for participation in informal activities, the olfactory sensitivity and preference for participation in leisure activities, the auditory filtering and preference for participation in leisure activities, the sensory processing patterns and enjoyment of participation in leisure activities, sensory processing patterns and preference for participation in recreational activities.

In one of the studies, sensory avoidance was found to be significantly correlated with preferences for participation and intensity of involvement in leisure activities [25]. Therefore, it was impossible to carry out a meta-analysis, and there was scant evidence demonstrating the relationship between sensory avoidance patterns and leisure participation dimensions.

The relationship between auditory/visual sensitivity and the preference for participation in leisure activities has been investigated in three studies in connection to four activity categories, including recreational, informal, social, and self-improvement activities [15, 22, 23], with the results indicating the significance of this relationship. However, no study has explored the relationship between auditory/visual sensitivity and other leisure activities. In addition, the association between general sensory processing and preference for participation in leisure activities had been examined for social [22] and recreational [23] activities, but other types of leisure activities have not been explored in studies. Although three studies had reported a significant relationship between sensory seeking and preferences for participating in physical [22], self-improvement [15], and recreational activities [23], one study demonstrated a non-significant relationship between sensory seeking and preferences for participating in recreational activities [25]. The meta-analysis of these activities came together because they were part of leisure activities. Finally, the meta-analysis of two studies manifested a significant relationship between sensory processing patterns and preferences for participation in informal activities [15, 22]. These relationships were ob-

tained for auditory filtering, auditory/visual, and motor sensitivity.

As far as the participation dimension is concerned, the relationship between taste/olfactory sensitivity and dimensions of participation in leisure activities was examined only in terms of the intensity and enjoyment of participation [15, 21]. Furthermore, among the sensory processing patterns, the association between sensory sensitivity and sensory seeking was investigated in terms of the dimensions of participation in leisure activities (diversity, intensity, with whom, where, enjoyment, frequency, and level) [15, 21, 25]. The results of the meta-analysis showed no significant relationship between the two activities. Since the relationship of sensory avoiding and sensory registration with the dimensions of leisure participation was only explored in Ismail et al.'s study [25], it could not be subjected to meta-analysis.

This study provided useful information on how different types of sensory processing patterns relate to dimensions of leisure and play participation in children. Knowledge of these relationships can lead to introducing new methods in the intervention process for children with disabilities.

5. Conclusion

The only conclusion that can be drawn from all patterns of sensory processing is the significant relationship between these patterns and the preference for participation in recreational activities (Figure 17). Among the patterns of sensory processing, studies on the relationship between sensory avoidance and the dimensions of leisure participation are fewer than the other patterns, and only one study mentioned it. Therefore, it is recommended that future studies focus more on this area to enable future meta-analyses. The reviewed studies examined the relationships between sensory processing patterns and engagement in some types of leisure activities, and it is recommended that these relationships be examined with other kinds of activities as well. The association between the patterns of sensory processing and engagement in play and leisure activities has been studied in a limited clinical community, and they are very rare in the Middle East; therefore, these studies must be reviewed in children with a variety of disorders and be carried out in the Middle East. Finally, it should be noted that due to the low to moderate level of the available evidence, further research is needed. However, this study provides an understanding of the correlation between different patterns of sensory processing and play, and leisure activity participation based on scientific documents and

demonstrates the significance of this concept in the occupational progress of children.

Limitations

This review only covered articles published in English and Persian whose full text was available. Furthermore, participation in play and leisure activities encompassed playing with toys, unforced and active engagement of the children, and an internally-driven non-committed activity. It is performed voluntarily when not assigned to mandatory occupations such as sleep, work, or self-care. However, various definitions of play and leisure can change the inclusion criteria for future studies.

Ethical Considerations

Compliance with ethical guidelines

The Iran National Committee approved this research for Ethics in Biomedical Research (Code: IR.SBMU.RETECH.REC.1399.1344).

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

We would like to express our gratitude to everyone who contributed to the data collection and writing of this systematic review and meta-analysis.

References

- [1] Moore A, Lynch H. Play and play occupation: A survey of paediatric occupational therapy practice in Ireland. *Irish Journal of Occupational Therapy*. 2018; 46(1):59-72. [DOI:10.1108/IJOT-08-2017-0022]
- [2] Case-Smith J, O'Brien JC. *Occupational therapy for children*-E-Book. Amsterdam: Elsevier Health Sciences; 2013. [Link]
- [3] Watts T, Stagnitti K, Brown T. Relationship between play and sensory processing: A systematic review. *American Journal of Occupational Therapy*. 2014; 68(2):e37-46. [DOI:10.5014/ajot.2014.009787] [PMID]

- [4] Dunn W. Supporting children to participate successfully in everyday life by using sensory processing knowledge. *Infants & Young Children*. 2007; 20(2):84-101. [DOI:10.1097/01.IYC.0000264477.05076.5d]
- [5] Bundy AC, Shia S, Qi L, Miller LJ. How does sensory processing dysfunction affect play? *American Journal of Occupational Therapy*. 2007; 61(2):201-8. [DOI:10.5014/ajot.61.2.201] [PMID]
- [6] Lawson LM, Dunn W. Children's sensory processing patterns and play preferences. *Annual in Therapeutic Recreation*. 2008; 16(1). [Link]
- [7] Stagnitti K. Understanding play: The implications for play assessment. *Australian Occupational Therapy Journal*. 2004; 51(1):3-12. [DOI:10.1046/j.1440-1630.2003.00387.x]
- [8] Reilly M. *Play as exploratory learning: Studies of curiosity behavior*. California: SAGE Publications, Incorporated; 1974.
- [9] American Occupational Therapy Association. Occupational therapy practice framework: Domain and process. *American Journal of Occupational Therapy*. 2017; 68(Supplement_1):S1-48. [DOI:10.5014/ajot.2014.682006]
- [10] Hofferth SL, Sandberg JF. How American children spend their time. *Journal of Marriage and Family*. 2001; 63(2):295-308. [DOI:10.1111/j.1741-3737.2001.00295.x]
- [11] World Health Organization. International classification of functioning, disability, and health: Children & youth version: ICF-CY. Geneva: World Health Organization; 2007. [Link]
- [12] Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*. 2009; 6(7):e1000097. [DOI:10.1371/journal.pmed.1000097] [PMID] [PMCID]
- [13] Mostafaei H, Sadeghi-Bazargani H, Hajebrahami S, Salehi-Pourmehr H, Ghojzadeh M, Onur R, et al. Prevalence of female urinary incontinence in the developing world: A systematic review and meta-analysis-A Report from the Developing World Committee of the International Continence Society and Iranian Research Center for Evidence Based Medicine. *Neurourology and Urodynamics*. 2020; 39(4):1063-86. [DOI:10.1002/nau.24342] [PMID]
- [14] Kuhaneck HM, Britner PA. A preliminary investigation of the relationship between sensory processing and social play in autism spectrum disorder. *OTJR: Occupation, Participation and Health*. 2013; 33(3):159-67. [DOI:10.3928/15394492-20130614-04] [PMID]
- [15] Hochhauser M, Engel-Yeger B. Sensory processing abilities and their relation to participation in leisure activities among children with high-functioning autism spectrum disorder (HFASD). *Research in Autism Spectrum Disorders*. 2010; 4(4):746-54. [DOI:10.1016/j.rasd.2010.01.015]
- [16] Reynolds S, Bendixen RM, Lawrence T, Lane SJ. A pilot study examining activity participation, sensory responsiveness, and competence in children with high functioning autism spectrum disorder. *Journal of Autism and Developmental Disorders*. 2011; 41(11):1496-506. [DOI:10.1007/s10803-010-1173-x] [PMID] [PMCID]
- [17] Little LM, Ausderau K, Sideris J, Baranek GT. Activity participation and sensory features among children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*. 2015; 45(9):2981-90. [DOI:10.1007/s10803-015-2460-3] [PMID] [PMCID]
- [18] Loh SY, Ee SI, Marret MJ, Chinna K. Sensory processing and participation in childhood occupation in Autism and Typically developing children-A cross sectional case control. *bioRxiv*. 2020; 1-16. [Preprint]. [DOI:10.1101/2020.07.22.215574]
- [19] Cosbey J, Johnston SS, Dunn ML. Sensory processing disorders and social participation. *American Journal of Occupational Therapy*. 2010; 64(3):462-73. [DOI:10.5014/ajot.2010.09076] [PMID]
- [20] Cosbey J, Johnston SS, Dunn ML, Bauman M. Playground behaviors of children with and without sensory processing disorders. *OTJR: Occupation, Participation and Health*. 2012; 32(2):39-47. [DOI:10.3928/15394492-20110930-01]
- [21] Chien CW, Rodger S, Copley J, Branjerdporn G, Taggart C. Sensory processing and its relationship with children's daily life participation. *Physical & Occupational Therapy in Pediatrics*. 2016; 36(1):73-87. [DOI:10.3109/01942638.2015.1040573] [PMID]
- [22] Engel-Yeger B, Ziv-On D. The relationship between sensory processing difficulties and leisure activity preference of children with different types of ADHD. *Research in Developmental Disabilities*. 2011; 32(3):1154-62. [DOI:10.1016/j.ridd.2011.01.008] [PMID]
- [23] Engel-Yeger B, Shani-Adir A, Kessel A. Participation in leisure activities and sensory modulation deficiencies of children with atopic dermatitis. *Acta Paediatrica*. 2011; 100(10):e152-e7. [DOI:10.1111/j.1651-2227.2011.02328.x] [PMID]
- [24] Welters-Davis M, Mische Lawson L. The relationship between sensory processing and parent-child play preferences. *Journal of Occupational Therapy, Schools, & Early Intervention*. 2011; 4(2):108-20. [DOI:10.1080/19411243.2011.595300]
- [25] Ismael NT, Lawson LAM, Cox JA. The relationship between children's sensory processing patterns and their leisure preferences and participation patterns. *Canadian Journal of Occupational Therapy*. 2015; 82(5):316-24. [DOI:10.1177/0008417415577421] [PMID]

This Page Intentionally Left Blank