The International Journal of Indian Psychology
ISSN 2348-5396 (Online) | ISSN: 2349-3429 (Print)
Volume 11, Issue 2, April- June, 2023
DIP: 18.01.141.20231102, DOI: 10.25215/1102.141
https://www.ijip.in

**Research Paper**

# Sensory Processing and Social Functioning in Younger and Older Children with Autism Spectrum Disorder

Sonu Darnal[1]*, Prof. Satyananda Panda[2], Dr. Namrata[3]

## ABSTRACT

***Background:*** The association between sensory processing and social functioning has been reported in children with developmental disabilities, especially in children with autism spectrum disorder (ASD). However, the association between the two has received less attention, especially in the older age group. ***Aim:*** The present study aimed to examine the differences in sensory processing in younger and older children with ASD. It further aimed to understand the relationship between sensory processing and social functioning in children with ASD and also to investigate if sensory features are predictive of social deficits in this population. ***Method:*** 123 mothers of younger (4-10 years) and older children (11- 18 years) with ASD participated in the study. The mean age of the participants was between 30-35 years old. The participants completed the socio-demographic profile, along with the Short Sensory Profile (SSP) and social problem dimension of the Child Behavioural Checklist (CBCL). t-test was computed to examine differences in sensory processing and social functioning in younger and older children. Pearson correlation and regression were computed to understand the relationship dynamics of sensory processing and social functioning. ***Results:*** Results from the present study highlighted that the younger and older children with ASD significantly differed in the dimensions of taste and smell, movement sensitivity, low energy and visual and auditory filtering of SSP sig at .01 and .05 levels. Sensory processing significantly correlated with social functioning. Further, it was found that auditory filtering, tactile sensitivity and underresponsive/sensation seeking significantly predicted social functioning in younger and older children with ASD sig. at $p<.01$ and $p<.05$ level. ***Conclusion:*** Understanding the relationship between sensory processing and social functioning will guide the therapists to formulate interventions that target the sensory features affecting social functioning in the ASD population in different age groups.

***Keywords:*** *Sensory Processing, Social Functioning, ASD, Children*

[1]PhD scholar, Sikkim University, Department of psychology, Gangtok, East Sikkim (Sikkim), India
[2]Head, Department of Psychology, School of Human Sciences, Sikkim University (A central university), Gangtok, East Sikkim (Sikkim)- India
[3]Assistant Professor, Department of Humanities and Social Sciences, Maulana Azad National Institute of Technology (MANIT), Bhopal, Madhya Pradesh, India
*Corresponding Author

**Received: December 06, 2022; Revision Received: May 24, 2023; Accepted: May 28, 2023**

Autism Spectrum Disorder (ASD) is a lifelong neurodevelopmental disorder that typically occurs during the first three years of life (Sharma & Sharma, 2016). The symptoms of ASD are present in the areas of social functioning and restricted behaviour, and repetitive interests (APA, 2013). The symptoms may range from avoiding eye contact and difficulty understanding nonverbal cues to dependency on daily routine (Sicile-Kira, 2004). While the number of cases of ASD has increased in recent years (Chiarotti & Venerosi, 2020), one in 160 children in the world falls under the spectrum (WHO, 2019). Almost a decade ago, it was estimated that one in 68 children are diagnosed with ASD in India (CDC, 2010). Still, it is difficult to accurately state the prevalence of ASD in the country, as it is often undiagnosed or unreported (Sharma & Sharma, 2016). Confirming that boys are twice as likely to be diagnosed with ASD compared to girls, one in 42 boys is considered to fall within the spectrum (CDC, 2010).

Unusual sensory response and social impairment are identified as major symptoms of ASD. Lack of social functioning was first observed by Kanner (1943) while working with 11 cases of autism. Social impairment generally refers to difficulties in initiating and maintaining social communication, atypical eye contact, and lack of facial expression and body language (Derakhshanrad et al., 2022). Researchers in the past have theorized ASD as a social disorder (such as the social motivation hypothesis and mindblindness) (Thye et al., 2018). On the other hand, sensory processing difficulties were recently added to the diagnostic criteria of ASD in DSM-5 (APA, 2013). Sensory processing refers to the atypical behaviour responses to sensory stimuli. The behaviour pattern includes under and over-responsivity (hypo and hyperreactivity to sensory stimuli) and eccentric sensation seeking (Derakhshanrad et al., 2022; Ben-Sasson et al., 2019). Over 95% of children with ASD are diagnosed with atypical sensory functioning (e.g., seeking or avoiding certain sounds or producing unusual sounds, seeking bright light and movement, and being indifferent to pain) (Ausderau et al., 2014). Both atypical sensory and social function hinders typical daily functioning in home, school, and community activities (Hilton et al., 2007; Thye et al., 2018; Kojovic et al., 2019).

***Sensory processing, social functioning in ASD***

Sensory processing atypicalities are frequently reported in children with ASD (Hilton, 2010; Kojovic et al., 2019). It usually manifests as hypersensitivity, hyporesponsive, avoidance, and sensation seeking which affects multisensory systems including visual, tactile, auditory, gustatory and olfactory (Sinclair et al., 2017). Research has documented the interrelationship between sensory processing and functional impairments in social, emotional, and behavioural areas in ASDs (Matsushima & Kato, 2013), including attention and language impairment in younger children with ASD (Baranek et al., 2013; Sabastos-Devito et al., 2016). Ashburner and colleagues (2008) aimed to understand the association between sensory processing and classroom emotion, behaviour and academic performance in ASD. The findings from the study highlighted that auditory filtering, underresponsiveness/ sensation seeking were negatively associated with academic achievement in this population. Other studies have reported the association between sensory atypicalities and socio-emotional impairment (Ben-Sasson et al., 2009), and communicational skills (Hilton et al., 2007).

Studies have frequently highlighted the relationship between atypical sensory profiles and social functioning in children with ASD (Hilton et al., 2007; Derakhshanrad et al., 2022; Kojovic et al., 2019). Studies have reported that sensory processing difficulties may hinder

their attention to social stimuli, social reciprocity and adherence to social norms in this population (Hilton et al., 2007; Ronconi et al., 2016; Thye et al., 2018). Matsushima and Kato (2013) conducted an initial study in Japan that aimed to examine the relationship between sensory deficits and social functioning deficits. Eighty-four children (42= ASD, 42= typical population) children aged between 4-6 years old participated in the study. It was found that atypical sensory processing and social deficits were higher in children with ASD compared to the typical population. Further, it was reported that the total raw score of Japanese Sensory Intervention-Revised (JSI-R) significantly predicted the severity of the social interaction deficit in this population. Recently, Derakhshanrad et al. (2022) aimed to validate the relationship between sensory processing and social functioning in children with ASD. The online survey of 142 mothers found a significant association between higher sensory issues, specifically auditory and tactile sensitivity, and lesser social functioning. In similar studies on younger children with ASD, the authors have reported a significant relationship between sensory processing and social, emotional, and behavioural responses (Barker et al., 2008; Hilton et al., 2010). Studies have recently highlighted that sensory processing may even precede and predict social difficulties in children with ASD (Baranek et al., 2018; Damiano-Goodwin et al., 2018). Damiano- Goodwin et al. (2018) highlighted that sensory-seeking features are identified at an early age of 18 months in children with a higher risk of ASD diagnosis. The authors further reported that sensory seeking is predictive of future reduced social orientation issues in these children. Similarly, Baranek et al. (2018) concluded that sensory features, particularly sensory seeking manifested at two years of age, may affect social functioning in their preschool years.

Though studies have found a significant association between sensory processing and social deficits, little is explored in the area, especially in older children with ASD. Studies have reported that adolescence with ASD significantly differed from the control groups in sensory experience, especially in sensation seeking and sensory avoidance (Crane et al., 2009; Marche et al., 2012). Howe and Stagg (2016) conducted a study of 18 children with ASD aged between 12-16 years attending mainstream school. The results from the study highlighted that 86 % of the children reported difficulties in at least two or more quadrants of the sensory profile. The participants reported the highest difficulty in the dimension of auditory, followed by tactile, olfactory and visual. Chen et al. (2009) further explored the relationship between sensory processing and restricted and repetitive behaviour in 8-16 years old with ASD. The authors reported a significant correlation between atypical sensory processing, specifically tactile, visual and auditory hyperresponsiveness, and restricted and repetitive behaviour patterns. In the studies conducted by Hilton et al. (2007; 2010) on high-functioning autism, the results have shown that deficits in social functioning are found in adolescence and adulthood, reducing their ability to productively participate in occupational activities. The findings further identified olfactory and tactile as strong predictors of social impairments in these children.

***Purpose***

It can be argued that the findings in this area are inconclusive and lacks generalizability. Rogers and colleagues (2005) found no significant relationship between sensory processing and social functioning in children with ASD. Studies are conducted on high-functioning autism (Hilton et al., 2007; 2010) and focused on younger children with ASD (Kojovic et al., 2019; Matsushima & Kato, 2013). The need for research in sensory and social features in children, as well as adults, has been recently highlighted by Hilton and Pelphrey (2018).

Though the research reporting the relationship between sensory processing and social problems in children with ASD is increasing recently, however, it is scarcely researched in a developing country like India. Studies so far have focused on clinical profiles of ASD, risk factors, epidemiology and intervention plans in the country (Patra and Kar, 2021; Padmanabha et al., 2019). However, very little has been done on sensory processing and social deficits have been documented so far in the Indian context. Therefore, the present study aimed to understand the difference in sensory processing and social functioning in younger and older children with ASD. The study further aimed to examine the relationship between sensory processing and social functioning and to investigate if sensory features are predictive of social deficits in this population.

## METHOD

### *Participants*

The participants consisted of mothers of children with ASD. The children belonged to two age groups, younger (4-11 years old) and older (12-18 years old). A total of 123 mothers (mothers of younger children= 73; mothers of older children= 50) of children with ASD participated in the study. The mean age of the participants was between 30- 35 years age. The participants were residents of West Bengal, India. More than 50% of the participants belonged to the upper middle class, lower upper class (24.4%) and upper class (14.6%) as measured by the updated version of the Kuppuswamy Socioeconomic Scale (Bairwa et al., 2013). 41.5% of the participants were graduates, 35% were postgraduates, and the remaining had completed secondary education. Out of 123, 82 mothers (65%) were housewives, while 12 per cent run their own businesses and 22% of the mothers worked in private and government sectors.

### *Measures*

*Short Sensory Profile (SSP)* (Dunn, 199)*:* The SSP is the 38 items scale used to measure the sensory difficulties in dimensions of tactile, taste and smell, movement sensitivity, underresponsive or sensation seeking, auditory filtering, low energy, auditory and visual sensitivity. It is a five-point Likert scale ranging from 1 (always) to 5 (never). The scale's total score ranged from 1-190, where a lower score indicated higher sensory issues and atypical responses. *Child Behavioural Checklist (CBCL)* (Achenbach, 1991): CBCL consists of 113 items. The scale is widely used to measure the behavioural, emotional and social problems in the atypical and typical populations aged between 4-18 years. CBCL has eight dimensions (withdrawn/depression, anxious/depression, somatic complaints, delinquent behaviour, aggressive behaviour, social problem, thought problem and attitude problem) and two broad dimensions of internalizing and externalizing. The dimension of social problem was used to measure social functioning in children with ASD. The dimension consisted of 11 items and focused on the social functioning of the child, e.g., dependent on elders, feeling lonely, does not get along with others, not being liked by others, having speech problems and so on. The participants mark 0 for never and 2 for always. The total score of the dimension ranged from 0-22. The higher score indicates greater social difficulties, whereas the low score refers to better social functioning.

### *Procedure*

The data was collected from five therapy centres in the state of West Bengal, India. With the approval of the head of the institutions, the aim and objectives of the study were explained to the mothers of children with ASD. Children who were diagnosed by professionals alone were included in the study. One hundred twenty-three mothers provided their consent to

participate in the study. The participants filled out their demographic data, along with the SPP and social problem dimension of the CBCL Scale. There was no missing value found in the collected data. No monetary aid was provided to the participants for participating in the study. The Ethical Committee of Sikkim University, Gangtok, India approved the study.

***Statistical analysis***

The statistical analysis was run on the statistical package for social studies (SPSS) version 23. t-test was computed to explore the difference in sensory processing and social functioning in younger and older children with ASD. Pearson correlation was computed to understand the relationship between sensory processing and social functioning. Further, regression was computed to examine if sensory features predicted social function in this population.

## RESULTS

To fulfil the objectives of the study t-test was computed to examine the differences in sensory processing and social functioning in younger and older children with ASD.

***Table 1 Difference between younger and older children in sensory issues and social functioning***

| Variables | Mean | | SD | | T | Sig. |
|---|---|---|---|---|---|---|
| | Younger | Older | Younger | Older | | |
| **Tactile** | 29.55 | 28.26 | 3.18 | 4.58 | 1.84 | .07 |
| **Taste and smell** | 15.01 | 13.40 | 3.57 | 3.91 | 2.33 | .02* |
| **Movement sensitivity** | 12.22 | 11.00 | 3.17 | 3.25 | 2.06 | .04* |
| **Underresponsiveness/ sensation seeking** | 22.30 | 22.18 | 4.69 | 5.88 | .122 | .90 |
| **Auditory filtering** | 21.25 | 21.12 | 3.32 | 3.80 | .191 | .85 |
| **Low energy** | 23.68 | 20.78 | 5.12 | 5.12 | 3.09 | .00** |
| **visual and auditory sensitivity** | 19.45 | 17.54 | 3.76 | 3.47 | 2.90 | .01* |
| **CBCLSocialProblem** | 17.85 | 17.96 | 1.45 | 1.73 | -.37 | .71 |

*Sig. at *p< .05; **p<.01*

The table above shows that younger and older children significantly differed in taste and smell (t=2.33, p<.05), movement sensitivity (t=2.06, p<.05), low energy (t=3.09, p<.01) and visual and auditory filtering (t=2.90, p<.05) dimensions of sensory processing. In all four dimensions, taste and smell, movement sensitivity, low energy and visual and auditory filtering, older children with ASD (M=13.40, SD=3.91; M= 11.00, SD= 3.25; M= 20.78, SD= 5.12 and M= 17.54, SD= 3.47, respectively) were found to have higher sensory issues compared to younger children with ASD. However, the two age groups did not differ in their experience of social problems.

***Table 2 Relationship between Sensory Processing and Social Problems***

| | | Tactile sensitivity | taste and smell | Movement sensitivity | Underresesponsive /sensation seeking | Auditory filtering | Low energy | visual and auditory sensitivity |
|---|---|---|---|---|---|---|---|---|
| Taste and smell | Pearson Correlation | .23* | 1 | | | | | |
| | Sig. (2-tailed) | .010 | | | | | | |
| Movement sensitivity | Pearson Correlation | .23** | .28** | 1 | | | | |
| | Sig. (2-tailed) | .009 | .002 | | | | | |
| Underresesponsive /sensation seeking | Pearson Correlation | .40** | .25** | .27** | 1 | | | |
| | Sig. (2-tailed) | .00 | .01 | .00 | | | | |
| Auditory filtering | Pearson Correlation | .45** | .20* | .19* | .40** | 1 | | |
| | Sig. (2-tailed) | .00 | .03 | .03 | .00 | | | |
| Low energy | Pearson Correlation | .30** | .11 | .27** | .29** | .23** | 1 | |
| | Sig. (2-tailed) | .00 | .25 | .00 | .00 | .01 | | |
| visual and auditory sensitivity | Pearson Correlation | .17 | .25** | .13 | .21* | .368** | .141 | 1 |
| | Sig. (2-tailed) | .07 | .005 | .16 | .02 | .000 | .119 | |
| CBCL Social Problem | Pearson Correlation | -.31** | -.05 | .03 | -.26** | -.35** | -.09 | -.07 |
| | Sig. (2-tailed) | .00 | .60 | .72 | .00 | .00 | .36 | .53 |

**Correlation is significant at the 0.05 level (2-tailed).*
***Correlation is significant at the 0.01 level (2-tailed).*

The results highlighted that the sensory features significantly correlated with the social problem dimension of CBCL sig at .01 level. Tactile sensitivity (-.31**), underresponsiveness (-.26**) and auditory filtering (-.35**) significantly correlated with social problems in ASD. Greater problems in the three dimensions of SSP indicated greater problems in social issues in children with ASD. However, no significant correlation was found between taste and smell, movement sensitivity, low energy and visual, and auditory filtering and social functioning.

***Table 3 Linear regression on younger children with ASD on different dimensions of Short Sensory Profile (tactile sensitivity, taste and smell sensitivity, movement sensitivity, underresponsive/ sensation seeking, auditory filtering, low energy, visual and auditory sensitivity) on the Social Problem dimension of CBCL (N=123)***

| | R Square | B | SE |
|---|---|---|---|
| | | Social problem | |
| Tactile sensitivity | .06 | -.11* | .05 |
| Taste and smell | .02 | .05 | .05 |
| Movement sensitivity | .02 | .06 | .05 |
| UnderRes/sensation seeking | .03 | -.05 | .04 |
| Auditory filtering | .12 | -.15** | .05 |
| Low energy | .01 | -.03 | .03 |
| Visual and auditory sensitivity | .00 | .00 | .05 |

Sig. at *p< .05; **p<.01; ***p<.001

Table 3 showed a significant regression equation (F= 4.62 and 9.70) with an $R^2$ value of .06 and .12, which indicates tactile sensitivity and auditory filtering as predictors of social problems in younger children with ASD. The analysis showed that there is a significant

relationship between tactile sensitivity, auditory filtering and the social problem dimension of the CBCL scale. Further, tactile sensitivity and auditory filtering (p=.04 and p=.003, respectively) contributed as a significant predictor of social problems in younger children with ASD.

***Table 4 Linear regression on older children with ASD on different dimensions of Short Sensory Profile (tactile sensitivity, taste and smell sensitivity, movement sensitivity, underresponsive/sensation seeking, auditory filtering, low energy, visual and auditory sensitivity) on the Social Problem dimension of CBCL (N=123)***

| | R Square | B | SE |
|---|---|---|---|
| | | Social problem | |
| Tactile sensitivity | .13 | -.14** | .05 |
| Taste and smell | .06 | -.11 | .06 |
| Movement sensitivity | .01 | -.04 | .08 |
| UnderRes/sensation seeking | .12 | -.10* | .04 |
| Auditory filtering | .13 | -.16* | .06 |
| Low energy | .00 | -.01 | .05 |
| Visual and auditory sensitivity | .01 | -.06 | .07 |

*Sig. at *p< .05; **p<.01; ***p<.001*

Table 3 showed a significant regression equation (F=7.29, F= 6.58, F= 6.86) with an $R^2$ value of -.14, -.10 AND -.16 which indicates tactile sensitivity, underreponsive/sensation seeking and auditory filtering as the predictors of social problems in older children with ASD. The analysis showed that there is a significant relationship between tactile sensitivity, underreponsive/sensation seeking, auditory filtering and the social problem dimension of the CBCL scale. Further, tactile sensitivity, underreponsive/sensation seeking, and auditory filtering (p=.01, p=.014, p=.012) contributed as significant predictors of social problems in older children with ASD.

## DISCUSSION

The findings of the present study highlighted that children in the younger and older age groups significantly differed in the dimensions of taste and smell, movement sensitivity, low energy and visual and auditory filtering of SSP (sig at .01 and .05 levels). On the other hand, no significant difference in social functioning was found across age groups. Interestingly, older children with ASD reported greater difficulties in all four domains. Tabasi et al. (2016) reported that children in the older group reported fewer sensory difficulties compared to the younger children. Similar findings were reported by Little et al. (2018). On the other hand, no significant difference was found in sensory features across age groups in the study conducted by Green et al. (2012) and Ausderau et al. (2014). However, in a recent meta-analysis, it is reported that sensory processing in children with ASD may increase, decrease or remain stable over a period of time (Ben-Sasson et al., 2019). The symptoms of sensory processing deficits may vary depending on the age of diagnosis, the beginning of the intervention, the availability of resources and also the degree of the disorder. Therefore, the inconclusive findings extend the need for methodically grounded longitudinal study designs.

SSP significantly correlated with social functioning in the dimensions of under-responsiveness, tactile sensitivity, and auditory filtering. The findings are in line with earlier studies (Hilton et al., 2010; Kojovic et al., 2019). Kojovic et al. (2019) further confirmed the association between sensory issues and social functioning at an early age, i.e., before 6 years. Studies have further reported a significant association between sensory seeking and

social deficits (Baranek et al., 2018; Watson et al., 2011), confirming the present findings. Higher levels of sensory seeking behaviour may lead to missing social opportunities, significantly contributing to social difficulties (Tomchek et al., 2015; Derakhshanrad et al., 2022). Studies in the past have shown that sensory seeking behaviour in early years correlated with reduced social orienting later in their lives (Baranek et al., 2018; Damiano-Goodwin et al., 2018).

Atypical auditory processing has been repetitively reported in children with ASD, which includes sensitivity to loud noise, indulgence in high-pitch sounds, and lack of auditory orientation (Khalfa et al., 2004; Thye et al., 2018). Studies have documented the interrelationship between auditory orientation and social communication, like a delayed response to social calling (Kallstrand et al., 2010; Vouloumanos & Curtin, 2014). Both hypo and hyperresponsivity to tactile are related to the social deficit and social orientation in children with ASD (Thye et al., 2018). Hilton et al. (2010) found that severe sensory issues were associated with higher social deficits in children with high-functioning ASD. The authors also reported that the atypical sensory issues were found to be possible predictors of social difficulties in this population. This association hampers a child's ability to socialize in school (Howe & Stagg, 2016), further affecting their academic achievement (Ashburner et al., 2008).

Linear regression analysis showed that tactile sensitivity and auditory filtering significantly predicted social problems in younger children sig. at $p < .01$ and $p < .05$ level. The findings fall in place with the previous studies. The study by Hilton et al. (2010) identified atypical oral, olfactory and tactile sensitivity as strong predictors of social difficulties in children with ASD aged between 6-10 years old. Similarly, Derakhshanrad et al. (2022) found tactile and auditory predictive of social difficulties in 4-10 years children with ASD. Recent findings have suggested that tactile sensitivity has connections to brain areas related to social functioning, supporting the hypothesis that skin is a 'social organ' (Adolphs, 2009; Brauer et al., 2016). Social touch plays a critical role in the development of the child, influencing well-being, self-esteem, health status and overall life satisfaction (Thye et al., 2018). Future studies may explore the relationship between tactile perception and social orientation in children with ASD. This would provide needed intervention at a younger age to facilitate better social functioning later in life.

Further, auditory filtering, underresponsive/sensation seeking and tactile sensitivity, significantly predicted social functioning in older children with ASD sig at $p < .01$ and $p < .05$ levels. This finding adds to the little knowledge of sensory processing and social functioning in older children with ASD. As discussed earlier, sensory seeking has associations that affect social function later in life (Damiano- Goodwin et al. 2018; Marche et al., 2012). Studies have reported that sensation seeking behaviour and low social skill directly affects their relationship with peers, and academic performance (Mc Clelland et al., 2003). Abnormality in the domain of tactile has been frequently reported in children with ASD (Balasco et al., 2020). Also, the association between tactile sensitivity and core symptoms of ASD, like social functioning deficits have been established in earlier studies (Derakhshanrad et al., 2022; He et al., 2021). The study conducted by Foss-Feig et al (2012) found that hyporesponsive tactile response significantly correlated with poor social function. The atypicalities in tactile sensitivity that are identified at an early age may continue to exist later in life, significantly influencing their social relations later in life.

Atypical auditory processing has been frequently reported in children with ASD. Studies have documented the interrelationship between auditory orientation and social communication, like a delayed response to social calling (Kallstrand et al., 2010; Vouloumanos & Curtin, 2014). After controlling for hearing ability and IQ, individuals with ASD were found to have difficulty filtering the auditory information from the other incoming information from the environment leading to difficulty in integrating the auditory inputs (Teder-Salejarvi et al., 2005). Lack of attention and hypersensitivity to auditory input directly affects social engagement in this population (Thye et al., 2018). Therefore, due to complex auditory processing, children with ASD are at a higher risk of experiencing socialisation difficulties as they age than their typically developing peers (O'Connor, 2012). It is important that extensive studies are conducted to explore sensory processing and social functioning in this area, as abnormal processing in tactile and auditory could affect the ability of the child to socialize, as the social expectation and demands increase with age.

***Limitation***

The main contribution of this study is the inclusion of older children with ASD and an attempt to understand the relationship between sensory processing and social functioning across age groups. However, the study has its limitations. The present study does not explore the causal relationship between sensory processing and social difficulties. Researchers proposed the relationship between sensory and social functioning as bidirectional (Thye et al., 2018). Therefore, future studies may be designed to explore the bidirectional relationship. The study lacks first-hand prospects the children with ASD. The caregiver's understanding of child behaviour alone limits the findings of the study. The results of social functioning in children with ASD cannot be concluded based on the social problem dimension of CBCL. Therefore, it can be argued that the use of a more appropriate tool to measure social problems in ASD would provide more reliable results.

Sensory processing abnormalities in children with ASD can interfere with progress in therapy and treatment outcomes. Therefore, our findings suggest the assessment and monitoring of sensory processing and social functioning at an early age. Better intervention plans from early would help in delimiting social functioning later in life. Considering the limitations of the present study, future studies may be conducted using tools measuring social responsivity, social communication and social orientation in this population. Future studies may look into the role of gender and severity of the disorder in the experience of sensory processing and social functioning.

## CONCLUSION

Studies have found that sensory atypicalities could be a significant contributor to social difficulties revealing a significant association between the two in children with ASD. Owing to its relationship abnormal sensory processing could predict deficits in social functioning at an early age and also later in life. Therefore, the present study aimed to understand sensory processing and social functioning in younger and older children with ASD. The study further aimed to explore the relationship between the two in ASD. The findings of the study highlighted that sensory processing features significantly differed in the two groups across taste and smell, movement sensitivity, low energy and visual and auditory filtering dimensions of SSP. A significant relationship was found between tactile sensitivity, auditory filtering, visual sensitivity and under responsiveness and social problems. Further, it was found that auditory filtering significantly predicted social problems in younger children and tactile sensitivity significantly predicted social functioning in older children with ASD.

The study falls in line with the earlier studies that the relationship between sensory processing and social functioning is identified at an early age and continues to exist later in life. Therefore, understanding the relationship between the two variables will guide the therapists to formulate interventions that target the sensory features affecting social functioning in these children. The limited studies in this area and the inconclusive findings indicate an urgent need for future studies for generalizability and gaining confidence in scientific conclusions.

## REFERENCES

Achenbech, T.M. (1991). *Manual for the Child Behavior Checklist/4-18 and 1991 profile*. Burlington, VT: University of Vermont Department of Psychiatry.

Adolphs, R. (2009). The social brain: neural basis of social knowledge. *Annual Review Psychology. 60,* 693.

American Psychiatric Association (2013). *American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*. Arlington, VA: American Psychiatric Association.

Ashburner, J., Ziviani, J., & Rodger, S. (2008). Sensory processing and classroom emotional, behavioral, and educational outcomes in children with autism spectrum disorder. *American Journal of Occupational Therapy, 62*(5), 564-573.

Ausderau, K. K, Sideris, J., Little, L. M., Furlong, M., Bulluck, J. C., & Baranek, G. T. (2016). Sensory subtypes and associated outcomes in children with autism spectrum disorders. *Autism Research. 9*(12), 1316-1327.

Bairwa, M., Rajput, M., Sachdeva, S. (2013). Modified Kuppuswamy's Socioeconomic Scale: Social Researcher Should Include Updated Income Criteria, 2012. Indian *Journal of Community Medicine, 38*(3), 185-86.

Balasco, L., Provenzano, G., & Bozzi, Y. (2020). Sensory Abnormalities in Autism Spectrum Disorders: A Focus on the Tactile Domain, From Genetic Mouse Models to the Clinic. *Frontiers in Psychology, 10*. doi: 10.3389/fpsyt.2019.01016

Baranek, G., Watson, L. R., Boyd, B. A., Poe, M. D., David, F. J., & McGuire, L. (2013). Hyporesponsiveness to social and nonsocial sensory stimuli in children with autism: children with developmental delays, and typically developing children. *Development and Psychopathology. 25* (2), 307-320.

Baker, A. E. Z., Lane, A., Angley, M. T., & Young, R. L. (2008). The relationship between sensory processing patterns and behavioural responsiveness in autistic disorder: a pilot study. *Journal of Autism and Developmental Disorders, 38*(5), 867-875

Baranek, G.T., Woynaroski, T.G., Nowell, S., Brown, L.T., Dubay, M., Crais, E.R., & Watson, L.R. (2018). Cascading effects of attention disengagement and sensory seeking on social symptoms in a community sample of infants at-risk for a future diagnosis of autism spectrum disorder. *Developmental Cognitive Neurosciences. 29,* 30-40.

Ben-Sasson, A., Gal, E., Fluss, R., Katz-Zetler, N. & Cermak, S. A. (2019). Update of a meta-analysis of sensory symptoms in ASD: A new decade of research. *Journal of Autism and Developmental Disorders, 49,* 4974-4996.

Ben-Sasson, A., Hen, L., Fluss, R., Cermak, S. A. C., & Engel-Yeger, B., Gal, E. (2009). A meta-analysis of sensory modulation symptoms in individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders. 39* (1). DOI 10.1007/s10 803-008-0593-3

Brauer, J., Xiao, Y., Poulain, T., Friederici, A., & Schirmer, A. (2016). Frequency of maternal touch predicts resting activity and connectivity of the developing social brain. *Cerebral Cortex, 26* (8), 3544-3552. https://doi.org/10.1093/cercor/bhw137.

Centers for Disease Control and Prevention. (2010). Autism spectrum disorders. Retrieved from: www.cdc.gov/ncbddd/autismiindex.htmi

Chen, Y., Rodgers, J., & McConachie, H. (2009). Restricted and Repetitive Behaviours, Sensory Processing and Cognitive Style in Children with Autism Spectrum Disorders. *Journal of Autism and Developmental Disorder. 39*, 635-642. DOI 10.100 7/s10803-008-0663-6

Chiarotti, F & Venerosi, A. (2020). Epidemiology of Autism Spectrum Disorders: A Review of Worldwide Prevalence Estimates Since 2014. *Brain Science, 10*, (274). doi:10.3390/brainsci10050274

Crane, L., Goddard, L., & Pring, L. (2009). Sensory processing in adults with autism spectrum disorders. *Autism. 13*(3) 215-228.

Damiano-Goodwin, C.R., Woynaroski, T.G., Simon, D.M., Ibanez, L.V., Murias, M., Kirby, A., Newsom, C.R., Wallace, M.T., Stone, W.L., & Cascio, C.J. (2018). Developmental sequelae and neurophysiologic substrates of sensory seeking in infant siblings of children with autism spectrum disorder. *Developmental Cognitive Neurosciences. 29*, 41-53.

Derakhshanrad, S. A., Piven, E., & Ghoochani, B. Z. (2022). The relationship between sensory experiences and social functioning in children with autism spectrum disorder. *International Journal of Developmental Disabilities.* Doi: 10.1080/2047386 9.2022.2128553.

Dunn, W., (1999). *Sensory profile: User's manual*. San Antonio, TX: The Psychological Corporation.

Foss-Feig, J. H., Heacock, J. L., & Cascio, C. J. (2012). Tactile responsiveness patterns and their association with core features in autism spectrum disorders. Research in Autism Spectrum Disorder, 6, 337-44. doi: 10.1016/j.rasd.2011.06.007

Green, S.A., Ben-Sasson, A., Soto, T.W., Carter, A.S. (2012). Anxiety and sensory over-responsivity in toddlers with autism spectrum disorders: Bidirectional effects across time. *Journal of Autism and Developmental Disorder*. *42*, 1112-19.

Hamiltaon, A., & Pelphrey, K. (2018). Sensory and social features of autism – can they be integrated? *Developmental Cognitive Neuroscience. 29.* Doi: https://doi.org/10.1016/ j.dcn.2018.02.009

He, J. L., Wodka, E., Tommerdahl, M., Edden, R. A. E., Mikkelsen, M., Mostofsky, S. H., & Puts, N. A. J. (2021). Disorder-specific alterations of tactile sensitivity in neurodevelopmental disorders. *Communications Biology, 4*,(97). Doi:https://doi.org/ 10.1038/s42003-020-01592-y

Hilton, C., Graver, K., & LaVesser, P. (2007). Relationship between social competence and sensory processing in children with high functioning autism spectrum disorders. *Research in Autism Spectrum Disorders.* 164-173. doi:10.1016/j.rasd.2006.10.002

Hilton, C.L., Harper, J.D., Kueker, R.H., Lang, A.R., Abbacchi, A.M., Todorov, A., & Lavesser, P.D. (2010). Sensory responsiveness as a predictor of social severity in children with high functioning autism spectrum disorders. *Journal of Autism Developmental Disorder. 40* (8), 937-945. https://doi.org/10.1007/s10803-010-0944-8.

Howe, F. E. J & Stagg, S. D. (2016). How Sensory Experiences Affect Adolescents with an Autistic Spectrum Condition within the Classroom. *Journal of Autism and Developmental Disorders. 46,* 1656-1668.

Kallstrand, J., Olsson, O., Nehlstedt, S.F., Sköld, M.L., Nielzén, S. (2010). Abnormal auditory forward masking pattern in the brainstem response of individuals with Asperger syndrome. *Neuropsychiatric Disease and Treatment. 6,* 289-296

Kanner, L. (1943). Autistic disturbances of affective contact. *The Nervous Child 2,* 217-250.

Khalfa, S., Bruneau, N., Rogé, B., Georgieff, N., Veuillet, E., Adrien, J.-L., & Collet, L. (2004). Increased perception of loudness in autism. *Hearing Research, 198,* 87-92.

Kojovic, N., Hadid, L. B., Martina Franchini, M., & Schaer, M. (2019). Sensory Processing Issues and Their Association with Social Difficulties in Children with Autism Spectrum Disorders. *Journal of Clinical Medicine, 8*. doi:10.3390/jcm8101508

Little, L.M., Dean, E., Tomchek, S., Dunn, W. (2018). Sensory processing patterns in autism, attention deficit hyperactivity disorder, and typical development. *Physical & Occupational Therapy in Paediatrics, 38,* 243-54.

McClelland, M. M., & Morrison, F. J. (2003). Learning-related social skills in preschool children. *Early Childhood Research Quarterly, 18,* 206-224

Marche, W. D, L., Steyaert, J., & Noens, I. (2012). Atypical sensory processing in adolescents with an autism spectrum disorder and their non-affected siblings. *Research in Autism Spectrum Disorders, 6,* 639-45.

Matsushima, K., & Kato, T. (2013). Social Interaction and Atypical Sensory Processing in Children with Autism Spectrum Disorders. *Hong Kong Journal of Occupational Therapy. 23,* 89-96

O'Connor, K. (2012). Auditory processing in autism spectrum disorder: a review. *Neuroscience & Biobehavioral Review, 36*(2), 836-854. https://doi.org/10.1016/j. neubiorev.2011.11.008.

Padmanabha, H., Singhi, P., Sahu, J.K., Malhi, P. (2019). Home-based sensory interventions in children with autism spectrum disorder: a randomized controlled trial. *Indian Journal of Paediatrics.* 86, 18-25.

Patra, S., Kar, & S.K. (2021). Autism spectrum disorder in India: a scoping review. *International Review Psychiatry, 33,* 81-112.

Rogers, S.J., & Ozonoff, S. (2005). Annotation: what do we know about sensory dysfunction in autism? A critical review of the empirical evidence. *Journal of Child Psychology and Psychiatry, 46*(12), 1255-1268.

Ronconi, L., Molteni, M., & Casartelli, L. (2016). Building blocks of others' understanding: a perspective shift in investigating social-Communicative deficit in autism. *Frontiers in Human Neuroscience, 10,* 144. https://doi.org/10.3389/fnhum.2016.00144.

Sabatos-Devito, M., Schipul, S. E., Bulluck, J. C., Belger, A., & Baranek, G. T. (2016). Eye tracking reveals impaired attentional disengagement associated with sensory response patterns in children with autism. *Journal of Autism and Developmental Neuroscience, 46*(4), 1319-1333.

Sharma, D., & Sharma, A. J. (2016). Autism Spectrum Disorder-Impact on Parenting and Coping Strategies. *The International Journal of Indian Psychology, 3,* 16-31.

Sicile-Kira, C. (2004). Autism Spectrum Disorder. New York: Penguin.

Sinclair, D., Oranje, B., Razake, K. A., Siegel, S. J., & Schmid, S. (2017). Sensory processing in autism spectrum disorders and Fragile X syndrome—From the clinic to animal models. *Neuroscience and Biobehavioral Reviews, 76,* 235-253.

Tabasi, F.M., Aliabadi, F., Zarei, M.A., Qorbani, M., & Rostami, R. (2016). Survey of behavioral problems and sensory processing in children with attention deficit/ hyperactivity disorder. *Iranian Rehabilitation Journal. 14,* 63-8.

Teder-Salejarvi, W.A., Pierce, K.L., Courchesne, E., & Hillyard, S.A. (2005). Auditory spatial localization and attention deficits in autistic adults. *Cognitive Brain Research, 23* (2-3), 221-234.

Tomchek, S. D., Little, L. M. & Dunn, W. (2015). Sensory pattern contributions to developmental performance in children with autism spectrum disorder. *American Journal of Occupational Therapy, 69*, (5). doi: 10.5014/ajot.2015.018044.

Thye, M. D., Bednarz, H. M., Herringshaw, A. J., Sartin, E. B. & Kana, R. K. (2018). The impact of atypical sensory processing on social impairments in autism spectrum disorder. *Developmental Cognitive Neuroscience, 29*, 151-167.

Vouloumanos, A., & Curtin, S. (2014). Foundational tuning: how infants' attention to speech predicts language development. *Cognitive Science*, *38*(8), 1675-1686. https:// doi.org/10. 1111/cogs.12128.

Watson, L. R., Patten, E., Baranek, G. T., Poe, M., Boyd, B. A., Freuler, A. & Lorenzi, J. (2011). Differential associations between sensory response patterns and language, social, and communication measures in children with autism or other developmental disabilities. *Journal of Speech, Language, and Hearing Research, 54*, 1562-1576.

World Health Organization. (2019). *The WHO special initiative for mental health (2019-2023): universal health coverage for mental health* (No. WHO/MSD/19.1). World Health Organization.

Centers for Disease Control and Prevention (CDC). (2012). *Autism Spectrum Disorders*.

***Acknowledgement***

The authors thank the families who participated in the study.

***Conflict of Interest***

No conflict of interest was reported by the author(s).

***Author contributions***

All authors made contributions to the study conception and design. Data collection and analysis were done by SD. SD prepared the initial draft of the manuscript. All authors have reviewed, approved, and consented to the submission. All the authors are accountable for all aspects of its accuracy and integrity.

***How to cite this article:*** Darnal, S., Panda, S. & Namrata (2023). Sensory Processing and Social Functioning in Younger and Older Children with Autism Spectrum Disorder. *International Journal of Indian Psychology, 11(2),* 1309-1321. DIP:18.01.141.20231102, DOI:10.25215/1102.141