Psychological Correlates of Sensory Processing among Children in West Bengal with Special Reference to Autism Spectrum Disorder and Attention Deficit Hyperactive Disorder

A Thesis Submitted

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Sikkim University

In Partial Fulfilment of the Requirement for the

Degree of Doctor of Philosophy

By

Sonu Darnal

Department of Psychology

School of Human Sciences

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सामदुर, तादोंग - 737102
सिक्किम, भारत
92-251212, 251415, 251656
- 251067
- www.cus.ac.in

6th Mile, Samdur, Tadong-737102
Gangtok, Sikkim, India
Ph. 03592-251212, 251415, 251656
Telefax : 251067
Website : www.cus.ac.in

सिक्किम विश्वविद्यालय
SIKKIM UNIVERSITY

(भारत के संसद के अधिनियम द्वारा वर्ष 2007 में स्थापित और नैक (एनएएसी) द्वारा वर्ष 2015 में प्रत्यायित केंद्रीय विश्वविद्यालय)
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DECLARATION

I Sonu Darnal, hereby declare that the thesis titled, **"Psychological Correlates of Sensory Processing among Children in West Bengal with Special Reference to Autism Spectrum Disorder and Attention Deficit Hyperactive Disorder"** submitted to Sikkim University for the degree of Doctor of Philosophy in Psychology is my original research work carried out from 2018-2023 under the supervision of Dr Satyananda Panda, Professor and Head, Department of Psychology, Sikkim University and co-supervision of Dr Namrata, Assistant Professor, Maulana Azad National Institute of Technology (MANIT), School of Social Studies.

Any part or content of this research work has not been submitted to this or any other institute or university for the award of any degree or diploma.

Sonu Darnal

Sonu Darnal
Roll no.18PDPS02
PhD registration no. 18/Ph.D/PSY/01

We recommend that this thesis be placed before the examiners for evaluation.

Supervisor
Dr Satyananda Panda
Professor and Head
Department of Psychology
Sikkim University

Namrata

Co-Supervisor
Dr Namrata
Assistant Professor
(MANIT)
School of Social Studies

सामदुर, तादोंग - 737102
सिक्किम, भारत
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(A central university established by an Act of Parliament of India in 2007 and accredited by NAAC in 2015)

CERTIFICATE

This is to certify that the thesis entitled **"Psychological Correlates of Sensory Processing among Children in West Bengal with Special Reference to Autism Spectrum Disorder and Attention Deficit Hyperactive Disorder"** submitted by Sonu Darnal (Roll no. 18PDPS02 and registration no. 18/Ph.D/PSY/01) in partial fulfilment of the requirement for the award of **PhD Degree in Psychology** of Sikkim University has not been previously submitted for the award of any degree or diploma in this or any other University. This thesis is her original work and she has been working under our supervision.

Supervisor
Dr Satyananda Panda
Professor and Head
Department of Psychology
Sikkim University

Co-Supervisor
Dr Namrata
Assistant Professor
(MANIT)
School of Social Studies

मदुर, तादोंग -737102
क्किम, भारत
-251212, 251415, 251656
251067
www.cus.ac.in

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SIKKIM UNIVERSITY
6th Mile, Samdur, Tadong -737102
Gangtok, Sikkim, India
Ph. 03592-251212, 251415, 251656
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"Psychological Correlates of Sensory Processing among Children in West Bengal with Special Reference to Autism Spectrum Disorder and Attention Deficit Hyperactive Disorder"

Submitted by Ms Sonu Darnal under the supervision of Dr Satyananda Panda and Dr Namrata. Department of Psychology. School of Human Sciences, Sikkim University, Gangtok.

Sonu Darnal

Signature of the Candidate
(Sonu Darnal)

Countersigned by Supervisor
(Prof. Satyananda Panda)

Nmrata

Countersigned by Co-Supervisor
(Dr Namrata)

7/7/2023

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Sikkim University

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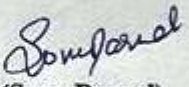

(Sonu Darnal)

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Abbreviations

ASD = Autism Spectrum Disorder

ADHD = Attention Deficit Hyperactive Disorder

SSP = Short Sensory Profile

CBCL= Child Behaviour Checklist

ISAA= Indian Scale for Assessment of Autism

APA = American Psychological Association

NDD= Neuro-Developmental Disorders

DSM 5= Diagnostic and Statistical Manual of Mental Disorder, fifth edition

Abstract

Emerging studies have investigated sensory processing dysfunction in children with developmental disorders, especially in children with autism spectrum disorder and attention deficit disorder (ADHD). However, the prevalence of sensory processing in different age groups and its association with psychological correlates such as social, behavioural and emotional problems and anxiety and depression, are less explored.

The present study aimed to understand the association of sensory processing and psychological correlates in children with ASD, ADHD, and the typical population. The study further aimed to understand sensory processing and psychological correlates in children with ASD and ADHD in different age groups. the children with ASD, ADHD and the typical population were divided into two groups younger (6-11 years) and older (12-18 years). The mothers of these children participated in the study with a mean age range of 30-35 years. A total of 362 mothers comprised the sample for the present study: ASD= 123 mothers (younger= 73 mothers, older= 50 mothers), ADHD= 100 mothers (younger= 50 mothers, older= 50 mothers) and typical population= 139 mothers (younger= 65 mothers, older= 74 mothers). The Short Sensory Profile (SSP) and Child Behaviour Checklist (CBCL) were used to access sensory processing and the clinical (social, emotional, and behavioural) and clinical (depression and anxiety) variables in children with ASD, ADHD and the typical population.

The mean distribution of sensory processing was calculated to understand sensory processing patterns in children with ASD, ADHD, and the typical population. Pearson correlation and linear regression were computed to understand the association

between sensory processing and psychological correlates (clinical and non-clinical) in the three populations. Further, ANOVA was computed to understand the group differences in sensory processing and psychological correlates. Finally, MANOVA and t test were computed to examine the differences in sensory processing and psychological correlates across age groups and gender. The findings from the present study highlighted that children with ASD and ADHD showed higher difficulties in sensory processing features in the domains of taste and smell sensitivity, movement sensitivity, auditory filtering and visual and auditory sensitivity.

Results from the Pearson correlation highlighted a significant association between tactile sensitivity, underresponsiveness/sensation seeking, auditory filtering and social and behavioural problems in children with ASD. In children with ADHD, auditory filtering, movement sensitivity, tactile sensitivity, taste and smell sensitivity, low energy and visual and auditory sensitivity significantly correlated with and predicted social and emotional problems. Further, auditory filtering, underresponsive/ sensation seeking, and low energy significantly correlated with and predicted behavioural problems. The results from the t test highlighted that females had higher problems in the dimensions of sensation seeking, auditory filtering and low energy compared to the males with ASD. A significant gender difference was found in the domains of movement sensitivity and low energy in the ADHD group. Females with ADHD showed more inertia and were highly sensitive to movement compared to males. The results from MANOVA highlighted that older children with ASD and ADHD reported higher problems in movement sensitivity, and sensory seeking/underresponsive compared to the children in the other groups. Children with younger and older children with ASD and ADHD significantly differed in the dimension of emotional problems, depression, and anxiety. Clinicians and therapists

can use the study's findings to develop an inclusive intervention paradigm that addresses the child's sensory processing needs in addition to the treatment of the disorder. Planning age-appropriate interventions that are practical and efficient for these populations is possible. Planning treatment programmes that concentrate on the psychopathologies (anxiety and depression) that were significantly present in older children with ASD and ADHD requires special consideration.

Key Words: *Sensory Processing, Autism, ADHD, Behavioural and Emotional*

CHAPTER I

INTRODUCTION

1.1 Background

Neurodevelopmental disorders (NDD) are a multifaceted subject with a wide range of the clinical spectrum. NDD may have a genetic and hereditary origin. While some disorders can be identified through a medical test (e.g., X syndrome), others such as autism spectrum disorder (ASD) and attention deficit hyperactive disorder (ADHD) can be diagnosed solely with behavioural observations. Many a time these disorders may show overlapping symptomologies like social impairment, sensory and motor dysfunction, attachment issues, sleeping problems, and attention deficits. As a result, the early diagnosis is delayed and may only be diagnosed in adolescents and adulthood (Heady et al., 2022). The delayed diagnosis results in delayed intervention while the child is left with no required support.

Sensory processing disorder is a neurological function, a condition where an individual lacks the ability to organize sensory information into adaptive responses for everyday functioning (Ptak et al., 2022). Sensory processing deficit is widely found in children with a developmental disability, specifically, ASD and ADHD (Cheung & Siu, 2009). The prevalence of sensory processing disorder ranges from 5% to 10% for typically developing children (Ayres, 1989). Whereas, for children with various developmental disabilities, sensory processing disorder ranges from 40-90% (Ahn et al., 2004; Ornitzet al., 1977; Talay-Ongan & Wood, 2000). Assessment of sensory processing, especially in children with developmental disabilities, helps identify dysfunction and proves beneficial for formulating clinical interventions (Cheung & Siu, 2009).

The number of cases of ASD has increased in the last 20 years (Chiarotti & Venerosi, 2020). One in 68 children in the world is diagnosed with ASD by eight years of age (Little et al., 2018). Based on research, the prevalence of ASD in the US is estimated as one in every 68 children (Elsabbagh et al., 2012). In the UK, the prevalence rate of ASD is one in every 102 children (Brugha et al., 2011). 1 in 125 children aged between 3-6 years and 1 in 85 children aged between 6-9 years are diagnosed with ASD in India (Chauhan et al., 2019; Juneja & Sairam, 2018). ADHD is a common psychiatric disorder diagnosed at an early age with an estimated prevalence of 3 to 7% in school-aged children (Huang et al., 2018; Shimizu et al., 2014). 2% to 17% of children are diagnosed with ADHD in India (Joshi & Angolkar, 2021).

Owing to the high prevalence of sensory processing in ASD, sensory processing abnormalities have been included in the recent DSM 5 (American Psychological Association, 2013). Higher sensory abnormalities are found in the areas of taste/ smell sensitivity, under-responsiveness/ sensation seeking, olfactory, auditory filtering and tactile (Baker et al., 2008). Along the same line, differences in sensory processing patterns among children with ADHD and typically developing peer groups (Ghanizadeh, 2011) with greater impairment in the domains of visual, auditory, taste, smell and tactile in ADHD (Panagiotidi et al., 2020) are frequently reported. Further, the prevalence of psychological correlates, such as anxiety, depression, and social, behavioural and emotional problems have been frequently reported in children with ASD and ADHD (Ben-Sasson et al., 2009; Kojovic et al., 2019; McMahon et al., 2019). The present study focuses to understand the prevalence and relationship of sensory processing and psychological correlates in children with ASD and ADHD.

1.2 Sensory Processing: Definition

According to the World Health Organization (WHO, 2007), sensory processing is described as an interface between a person's neurological function and the environment. It broadly refers to the interpretation of the sensory information (auditory, olfactory, tactile, gustatory, visual, vestibular, and proprioceptive) by the neural system (peripheral and central nervous system) to organize an adaptive response to the environment and participate in meaningful daily life activities (Barker et al., 2008; Jorquera-Cabrera et al., 2017).

Sensory information is received from visual (vision), tactile (touch), olfactory (smell), gustatory (taste), auditory (hearing), vestibular and proprioceptive:

Visual: It includes information received through vision. Children with sensory impairment in the visual domain usually show sensitivity to light.

Tactile: Tactile is defined as an individual's sense of touch. Touch is one of the predominant senses and provides the major source of information from the environment. The information from this sensory system includes the sense of touch, pain, texture, and pressure.

Olfactory: Olfactory helps receive information through smell and helps in organizing the adaptive response (Ayres, 1972; Emmons & Anderson, 2005).

Gustation: Gustation is the sense of taste. Children with taste sensitivity are commonly picky eaters. They are often particular about the food they want to take, avoid certain kinds of food, and become anxious when trying new foods.

Auditory: Auditory system deals with hearing. Children having problems in the auditory domain are sensitive to sound. They put their hands to their ears and show irritability and tantrum when encountered with different sound frequencies (Ayres, 1972).

Proprioception: Proprioceptive sensory system includes information arising from muscle, joints, ligaments, and receptors associated with bones and provides information about body position. It plays an important role in the motor functioning of the body by which reflexes, automatic responses and planned actions occur.

Vestibular: The role of the vestibular system often goes unnoticed as most of its functioning takes place without our awareness. The vestibular system primarily coordinates the movement of the eyes, head, and body through space and body movement and the vestibular function helps keep the body balanced and coordinated (Ayres, 1972; Emmons & Anderson, 2005).

1.2.1 Sensory Processing Abnormalities: Signs and Symptoms

Sensory information integration helps us respond and adapt to the environment. However, when these sensory signals are neither detected nor executed into appropriate responses, it may lead to Sensory Processing Dysfunctions (SPD) (Hilton et al., 2010; Miller et al., 2007). Sensory processing impairment can occur in some or all sensory systems such as tactile, auditory, visual, gustatory, olfactory, proprioceptive, and vestibular systems (Ahn et al., 2004; Bundy & Murray, 2002; Reeves, 2001). The symptoms of SPD can range from mild to severe and may affect an individual's behavioural, social, and motor domains, including mild disturbance in self-regulation to severe behavioural impairments (Ahn et al., 2004).

Children with sensory processing difficulties can have difficulty in daily life functioning like a typical response to social stimuli, difficulty regulating attention and mood, and impaired learning and social skills. The symptoms of sensory processing may develop, alter, or fluctuate within the day, from day to day or over a period (Critz et al., 2015). Individuals with sensory processing difficulties may respond to the stimulus with sensory seeking where the individual seeks out the sensory stimuli with

increased intensity and frequency, underresponsivity, such as failing to respond to an alarming situation, overresponsivity, abnormal degree of responsiveness to the physical and emotional stimulus. Individuals with sensory processing difficulties may also have to face functional impairment in the areas of social skills, adaptive responses, self-confidence, self-esteem, or both (Ahn et al., 2004; Critz et al., 2015).

Symptoms of sensory processing have been acknowledged in the Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood, Revised (Zenah et al., 2016). Sensory processing symptoms are now included in the most recent diagnostic criteria for ASD with 'hyper- or hypo' reactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement) as one of the diagnostic features (APA, 2013).

1.2.2 Theories of Sensory Processing

During the 1960s, Jean Ayres identified and described "dysfunction in sensory integrative processes" and further termed it as *sensory integrative dysfunction* (Ayres, 1963). Sensory integration (SI) refers to an ability to organize sensory information from the environment to frame adaptive responses (Ayres, 1989). The information received from the environment is interpreted, organized, discriminated against, and coordinated by the brain for productive functioning. She explained that the dysfunction in interpreting the information received from senses and environment may lead to difficulties in performing adaptive skills (e.g., learning, reading, mathematics, visual, auditory, and motor skills) (Jorquera-Cabrera et al., 2017; Smith et al., 2007). Ayres (1963,1966) also explored the possibility of improvement in

adaptive skills by identifying the patterns of sensory integrative dysfunction, which was further expanded by other researchers.

Recently, Dunn (2014) expanded Ayres's theory to Dunn's Sensory Processing Framework (DSPF), which states that sensory processing is a dual response process to environmental stimuli. Individuals respond differently to sensory information based on how soon the stimuli are detected (threshold- high and low) and how the information is integrated, processed, organized, and synthesized by the brain, framing an appropriate response (self-regulation- active and passive). Based on Ayre's theory, Dunn (2014) proposed four patterns of sensory processing dysfunction based on the individual's response to the stimuli and neurological threshold. The model has four specific sensory patterns: (1) low registration (high threshold and passive self-regulation), (2) sensation seeking (high threshold and active self-regulation), (3) sensory sensitivity (low threshold and passive self-regulation), and (4) sensation avoiding (low threshold and active self-regulation) (Jorquera-Cabrera et al., 2017). Sensation seeking and low registration represent hyposensitivity whereas, sensory sensitivity and sensation avoidance represent hypersensitivity (Fernandez-Prieto et al., 2021). Individuals with sensory overresponsivity respond to sensory stimuli faster, long, and with greater intensity than expected or required. Individuals with sensory underresponsivity are mostly unaware of stimuli around them. They are slow to respond to the given stimuli. In the sensory seeking type, the individuals show interest and seek more sensory stimuli (Ghanizadeh, 2011).

From the perspective of personality, sensory processing is found to have a relationship with emotion and self-regulation (Gouze et al., 2012). In addition, some psychological studies have considered sensory processing sensitivity as a temperament, or personality trait (Aron et al., 2012). For example, responses from

more sensitive people are related to strong emotional reactions, with sensitivity to subtle stimuli. They observe and make cognitive apprehension of the given situation, plan adaptive responses, and learn from the situation. On the other hand, the developmental perspective considers sensory processing in relation to innate biological traits. From this viewpoint, specific aspects of sensory processing have evolutionary benefits (Wolf et al., 2008). The theory further elaborates that society needs people who notice and respond to subtle changes in the environment as well as other people who do not notice subtle changes and can help calm the group.

According to behavioural theorists, sensory processing is related to being over and underresponsive to the stimuli and their association with challenging behaviours, including internalizing and externalizing behaviour. Internalizing behaviours such as anxiety and depression, have been associated with sensory processing across the lifespan (Ben-Sasson et al., 2009). Lane and colleagues (2012) found a positive relationship between sensory sensitivity and anxiety autism, attention deficit hyperactivity disorder (ADHD), and typical development. Underresponsive, overresponsive, or sensory seeking is related to negative emotions like depression, and anxiety.

1.3 Autism Spectrum Disorder (ASD): Signs and Symptoms

The term ‘autism’ is derived from the Greek word *autos,* meaning self (Sharma & Sharma, 2016). According to DSM-5 (2013), ASD is defined as describing a group of neurodevelopmental disorders including Autism, Asperger’s Disorder, Pervasive Developmental Disorder Not Otherwise Specified (PDDNOS) and Child Disintegrative Disorder. ASD is characterized by social, communicational, and behavioural impairments (APA, 2013). Autism is a lifelong neurodevelopmental condition, a developmental disorder that typically occurs during the first three years

of life. Autism is known for its spectrum of disorders because it ranges from mild learning and social impairment to severe multiple disabilities (Sharma & Sharma, 2016). Though children with ASD share characteristics with a wide range of social, communicational, and behavioural impairments, still their uniqueness lies in the degree it is present in each ASD individual. The most common and noticed symptoms of ASD include avoiding eye contact, difficulty reading non-verbal cues, and dependency on routines. They have major difficulties with the quality of their social and communication skills and relationships, as well as the ritualistic practice of restricted, repetitive, and stereotyped patterns of behaviour, interests, and activities. The symptoms may also include difficulty in interactive play, displaying behaviours not typical of their peers and responding to sensory stimuli by screaming or reacting strongly to light, sound, or motion (Harman, 2014; Sicile-Kira, 2004).

With the cases of ASD increasing each year, 1 in 125 children aged between 3-6 years and 1 in 85 children aged between 6-9 years are diagnosed with ASD in India (Chauhan et al., 2019; Juneja &Sairam, 2018). Confirming the earlier records, boys continue to be diagnosed with autism at a greater rate as compared to girls (Augar, 2013). One in every 42 boys is considered to fall under the spectrum of autism (Loomes et al., 2017). Still, it is difficult to accurately assess the true prevalence of the disorder as it is often underdiagnosed and under-reported. Evidence suggests that the reason for the increase in the prevalence of ASD among children in the last 30 years is because of its specific diagnosis under DSM-5 (APA, 2013). Another possible reason for its increasing recognition could be the wide diagnostic criteria, well-established and standardized diagnostic instruments, and increased level of awareness about ASD in the general population (Sharma & Sharma, 2016; Wing, 2015).

1.3.1 Attention Deficit Hyperactive Disorder (ADHD): Signs and Symptoms

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common psychiatric disorders diagnosed in childhood with an estimated prevalence of 3 to 7% in school-aged children (Huang et al., 2018; Shimizu et al., 2014). 1 in 11 children aged between 4-17 years (or 3.4% to 5.3%) worldwide is diagnosed with ADHD (CDC, 2017; Tengsujaritkul et al., 2020). ADHD is conceptualized as involving deficits in sustained attention, impulse control, and activity regulation (APA, 2013). The symptoms of ADHD may cause significant impairment of occupational performance at school, home, and social settings (Wilens & Spencer, 2010). The prevalence rate of ADHD is 13.6 % and 6.5 % in boys and girls, respectively (Ghanizadeh, 2011; Huang et al., 2018). ADHD may occur individually or as comorbid to other disorders. Ghanizadeh (2011) found that two-thirds ADHD population have at least one comorbid psychiatric disorder, commonly oppositional defiant and anxiety disorder.

In addition to the impairment caused by the core symptoms, researchers and clinicians have suggested that children with ADHD are frequently affected by deficiencies in sensory processing in general, and sensory modulation dysfunction in particular (Cheung & Siu, 2009; Lane et al., 2012; Puts et al., 2017). The ability to control and organise the intensity and form of the reaction to sensory input in an appropriate way is referred to as sensory modulation (Lane et al., 2010). Individuals with sensory modulation difficulties may exhibit behaviour patterns that are underresponsive, overresponsive or sensory seeking. They may respond to the environmental stimuli passively, or apathetically (underresponsive), over/exaggerated response (overresponsive) or constantly seek sensory stimuli (sensory seeking) (Shimizu et al., 2014). These responses interfere with the individual's attention,

emotion, and learning (May-Benson & Koomar, 2010). Further, it may adversely affect the person's ability to manage daily activities, including social and school participation (Engel-Yeger & Ziv-On, 2011).

1.4 Social Dysfunction in Children with ASD and ADHD

Social behaviour includes all the sets of behaviours required for basic communication and interaction with other individuals. It includes social skills which is the set of acceptable social behavioural responses to certain social requests. These skills can include the small gestures of looking at a person and smiling to a deep emotional relationship. Whereas, social impairment generally refers to the lack or failure to involve in social interaction, verbally and/or non-verbally (Schreiber, 2011).

Social impairments are mostly diagnosed in individuals with pervasive developmental disorders (PDDs). The symptoms of social impairment mostly consist of avoiding eye contact, and lack of facial expression and gestures that usually facilitate social interaction. Individuals with social impairment generally lack age-appropriate social relationships. They are mostly unaware of the needs of others and lack empathy (Roeling, 2010). One of the major characteristics of ASD is social and communicational deficits. The impaired social skills in children with ASD are usually characterized by poor eye contact, difficulty in initiating and maintaining conversation, and lack of joint attention (Schreiber, 2011).

Researchers have suggested that the lack of social-perceptual abilities required for the processing of facial and bodily gestures may be responsible for social deficits in ASD (Koch, 2012). This population show difficulty in understanding what is communicated to them and in expressing themselves. Failure to which they often exhibit aggressive behaviour, throw tantrums, or themselves. Often, they keep to themselves in group play or activities, which affects their social development during

childhood. Their degree of social deficit largely depends on their degree of disorder, intellectual ability, and degree of social development (Yeo & Teng, 2015). A strong association has been established between social impairment and ADHD (Friedman et al., 2003).

Years back, Cantwell (1996) described social difficulty in ADHD as a 'lack of savoire faire' meaning, the lack of ability to respond appropriately (act or speak) in social situations. It was further mentioned that approximately 20% of children and adolescents with ADHD lacked social naivety. The symptoms of social impairment in this population are observed in their interaction with their peer groups. Children with ADHD are reported to be bossy, bullying, disruptive, inattentive in organized games/sports, have difficulty in accepting failure, are aggressive and usually disobey the rules of games. Resulting to this, 50-60% of children with ADHD experience peer rejection (Carpenter Rich et al., 2009).

Sensory processing is strongly related to social problems in children with ASD and ADHD. Social impairment is commonly found in relation to sensory underresponsiveness, sensation seeking, and auditory and tactile sensitivity. The children either fail to detect their surroundings, take pleasure in sensation, generate additional sensation, are sensitive to auditory sensations or fail to respond to auditory stimuli, prefer to be alone and show diminished motivation in human interactions (Kojovic et al., 2019). Also, both hypo and hyperresponsiveness have been related to impaired social functioning, communication difficulties, and less social competence (Fernandez-Prieto et al., 2021; Hilton et al., 2010). Also, varying degrees of hypo and hyperresponsivity may be present in the same individual (Baranek et al., 2007; Green & Ben-Sasson, 2010; Serafini et al., 2017; Wigham et al., 2015). It is also proposed that the relationship between sensory processing and social functioning may be

bidirectional and interdependent. Sensory processing may precede and predict socially atypical behaviours (Baranek et al., 2018; Gliga et al., 2014; Thye et al., 2018). Children with sensitivity to sound (auditory sensitivity) may avoid social environments that are over-stimulating and thus, leading to less social interaction and involvement. This further affects their social relations (Thye et al., 2018).

1.4.1 Behavioural and Emotional Problems in Children with ASD and ADHD

Behavioural impairments are commonly identified as disruptive, persistent, and repetitive behaviours that are atypical among same-aged children. The behaviours interrupt the activities involved and hinder their continuity (Efron et al., 2020). It is true that children who exhibit behavioural and emotional problems in early childhood continue to show problems in the later years of their life, even throughout their adolescents and adulthood. Behavioural and emotional problems are usually categorized as externalizing and internalizing problems. The externalizing behaviours are outward-directed and involve defiant or noncompliant behaviour. On the other hand, internalizing problems are inward-directed and involve symptoms of withdrawal, anxiety, and depression (Holland et al., 2017).

Apparently, several factors contribute to the prevalence and persistence of externalizing behavioural problems. The coercive parenting cycle model is quoted as a predictor of a child's externalizing problems. According to this model, the parents make repeated requests to the child who does not comply with it. The parents then back off to stop the aversive behaviour of the child. This negatively reinforces the child (by withdrawing the command) and the parent (by discontinuing the negative behaviour of the child). This pattern accelerates and the parent resorts to a severe method of discipline. Now, the child stops the aversive behaviour only when severe methods are used. Eventually, both the parent and the child end up escalating the

aggressive and negative behaviour (Patterson, 1982). Another factor that is found in both the onset and persistence of child behavioural problems are parental stress and family dysfunction, which directly affects the parent-child relationship (Holland et al., 2017). However, the factors that contribute to the prevalence of internalizing problems in younger children and their persistence later in life are less explored. Negative emotionality of the child such as disorganized attachment and higher exposure to parental conflict is found to contribute to internalizing problems in younger children (Keen et al., 2010). Exposure to these life situations at a very early age (below 2- 3 years old) predicts internalizing problems at the age of 5 years. These children are at a higher risk of developing anxiety later in their lives. Theorists have described that emotional dysregulation may result in anxiety and depression (Aldao et al., 2010).

Restricted and repeated behaviour is one of the diagnostic criteria for ASD. The child may be involved in repetitive and stereotyped interests and activities for a longer duration of time (APA, 2013). Apart from these behavioural issues, children with ASD may show significant behavioural and emotional problems which may be of clinical concern. Children with ASD have reported significant internalizing and externalizing behaviour problems including rule-breaking behaviour, aggression, self-harming behaviour, anxiety, depression, attention problems and thought problems. These behavioural issues may contribute to long-term mental health issues and failure in academic achievements (Lindor et al., 2019). However, the degree of these problems varies from individual to individual in the spectrum. The two factors that have been found to contribute to the externalizing and internalizing problems in ASD are sleep patterns (Cohen et al., 2018) and the degree of ASD symptoms (Andersen et al., 2017). Children with severe ASD symptoms and with disturbed sleep patterns are

reported to have higher behavioural and emotional problems. Additionally, emotional dysregulation can cause additional psychopathologies in children with ASD (Lindor et al., 2019).

The higher rates of comorbidity of internalizing and externalizing behaviour frequently occur in children with ADHD. Internalizing problems such as anxiety and mood disorders cooccur with the inattentive type of ADHD, whereas hyperactivity and aggressive behaviour are linked with the hyperactive type of ADHD (Sevincok et al., 2020). The parents of children with ADHD often complain about the child being difficult (demanding, overreacting, noncompliance), having sleep disturbances and with eating problems Holland et al., 2017). The behavioural and emotional problems that are identified at an early age, continue to exist later in life. For children with behavioural problems in their preschool, 50% of these problems are carried to adolescents and adulthood (Campbell, 1995). These children are at higher risk of developing mood and conduct disorder, depression, anxiety, and higher chances of substance abuse (Perera et al., 2014).

There is a relationship between sensory processing and behavioural problems in children with ASD and ADHD. Sensory seeking and repetitive behaviour are found to have a strong relationship (Fernandez-Prieto et al., 2021; Lane et al., 2010). Individuals may need more stimulation to register and modulate the information received from the environment, which may lead to repetitive behaviour. It is found that both hyper and hypo responsiveness are associated with behaviour difficulties, including restricted, repetitive, and stereotyped patterns of behaviour and interests (Fernandez-Prieto et al., 2021). These behavioural patterns have been linked with behavioural disorders like isolation, self-aggression, irritability, an atypical response to change, disinterest and indifference (Gonthier et al., 2016). Many times,

overresposivity has been linked with internalizing and externalizing behaviour in children with ASD and ADHD. For example, children with overresponsivity to tactile may react negatively to grooming (hair brushing). Children with overresponsiveness to smell or sound, may be particular to certain fragrances or put their hands to ears to different sounds (Critz et al., 2015). In addition, children's inability to regulate their emotional and behavioural responses may burden their educational progress and social relations in these populations (Eaves & Ho, 1997; Erfanian et al., 2018). Children with ADHD tend to be bossy, bully, explosive, controlling, and aggressive. These behavioural problems often affect their social and academic achievements (Carpenter Rich et al., 2009).

1.4.2 Depression Symptoms in Children with ASD and ADHD

The word 'depression' comes from the Latin word 'depressio' which means sinking. The person with depression experiences a sinking feeling, burdened by one's own existence. The individual may experience painful feelings, difficulty enjoying, hopelessness, and aloofness, and may also experience panic attacks (Bernard, 2018). Over 300 million people all over the globe are affected by depression. It is also the major cause of suicide between the age group of 15-29 years, which is the second most common cause of death (WHO, 2017). The classification of the disorder in DSM-5 (APA, 2013) and ICD-10 (WHO, 1992) has different categorizations. However, one of the major criticisms is the lack of distinction between childhood and adult depression. Depression has been mainly explained by biological and psychological prospects. Biological theories have identified factors that significantly contribute to depression as noradrenalin deficit, sleep disorder, an endocrine disorder, alterations in the brain and genetics. Similarly, psychological theories have attempted to explain depression in terms of attachment theories, interpersonal theories, cognitive

models, behavioural models, sociocultural models, self-control models and stressful life events (Bernaras et al., 2019).

Only in the past decade, the awareness of depression in the ASD population has gained importance. Along with the typical depressive symptoms that are typically found in children with ASD (decreased pleasure in activities, suicidal ideation, sadness). They may also show other symptoms such as a change in the patterns of repetitive interests, low adaptive behavioural skills, and decreased self-care (Pezzimenti et al., 2019). According to parent reports, 1-10 % of children with ASD also have significant symptoms of depression. Additionally, children with ASD are at a higher risk of depression compared to children with other developmental disabilities (intellectual disability) and typically developing children (Mayes et al., 2011). In fact, children with ASD are four times more likely to be diagnosed with depression compared to the typical population, which may persist through their adolescence and adulthood. However, the reports on the prevalence of depression fluctuate depending on certain factors such as the intelligence quotient (IQ) of the child and the mode of assessment. 52.8 % of children with average IQ report higher depression compared to children with above-average IQ (12.2%). The prevalence of depression is found to be higher when assessed through interview schedules versus when assessed with other tools. Many a time, the self-reports on depression have higher scores compared to the parent and caregiver reports on the child's depression (Pezzimenti et al., 2019).

Unfortunately, little is known about the course of depression in childhood and adolescents. However, it is shown that older children with ASD (40.2% in adults) report higher symptoms of depression compared to the younger population (7.7 % in children below 18 years), with girls showing higher symptoms of depression as they age. On the other hand, boys have reported signs of depression at a young age

(compared to the typical population and compared to girls with ASD) and the symptoms persist in their adolescence and adulthood (Gotham et al., 2015). The symptoms of depression in children with ASD have unfavourable emotional, social, and behavioural consequences.

ADHD has an association with depressive symptoms (Riglin et al., 2021). 9-38 % of children with ADHD are reported to experience depressive symptoms (Turgay & Ansari, 2006). The depressive symptoms of ADHD are usually found later in an individual's life (Gundel et al., 2018). Explaining the co-occurrence of ADHD and depressive symptoms, some researchers suggest that ADHD causes depression (Riglin et al., 2021). Failure in forming positives, poor academic achievement and lack of self-control may lead to the risk of developing depressive symptoms in individuals with ADHD (Schoeler et al., 2018; Thapar et al., 2012). However, on the other hand, Faraone and Larsson (2019) suggest that ADHD and depression share genetic factors. The same genetic type leads to the manifestation of ADHD early in life and depression symptoms later in life (Rutter et al., 2006).

McMahon and colleagues (2019) recently reported that individuals with more significant sensory dysregulation have greater chances of being diagnosed with anxiety and depression disorder. Researchers have reported that both hyposensitivity/ hypo-responsiveness and hypersensitivity to sensory stimuli are significantly connected to depression (Ben-Sasson et al., 2009; Bitsika et al., 2016; Engel-Yeger et al., 2011). The inability to identify and respond to immediate sensory stimuli may develop and elevate depressive symptoms (Serafini et al., 2016). It is further reported that hyposensitivity is frequently associated with depression, whereas hypersensitivity is linked with anxiety (Engel-Yeger et al., 2011; Kinnealey & Fuiek, 1999; Pfeiffer et al., 2005). A longitudinal study has found that sensory processing atypicality may

continue to exist in adolescents and adulthood which largely contributes to the development of anxiety later in life (Pfeiffer et al., 2005).

1.4.3 Anxiety Symptoms in Children with ASD and ADHD

Brown and Barlow (2002) described an anxious response as a "future-oriented emotion" that is uncomfortable with fears of uncontrollability and unpredictability of an aversive event. There is an anticipation of some dreaded event. With the feeling of a lack of control and predictability, the worry tends to accelerate. In such situations, the avoidance of the event or situation that causes an anxious response is the most likely response. However, the avoidance response may get adverse, affecting normal development. Anxiety or anxiety disorder is one of the common disorders evidently found in childhood and adolescents (Wilmshurst, 2009).

Two models were proposed to understand the factors contributing to anxiety in children: cumulative risk pathway and precipitating risk pathway. In the cumulative risk pathway, the child is exposed to several risk factors that increase the chance of developing anxiety or anxiety disorder in children such as an unstable environment, overprotective and anxious parenting, unstable growing environment, anxious attachment, and genetic inclination of developing anxiety or anxiety disorder. In the case of precipitating risk pathway, the development of an anxious response takes place as a result of a learnt response. If the child is exposed to a repeated aversive situation and its aversive consequences, it is likely that the child may give an anxious response to the perceived threat (Brown & Barlow, 2002).

Though anxiety is not the primary symptom of ASD, it is quite frequently reported in children with ASD. The prevalence of anxiety in ASD is high compared to children with other neurodevelopmental disabilities and typically developing children. 50-56% of children with high-functioning autism or Asperger syndrome have

symptoms of anxiety whereas, the presence of anxiety in the typical population is only between 3-12% (Bruggink et al., 2016; Mayes et al., 2011). However, in a recent review, the authors suggested that the prevalence of anxiety in ASD range between 42% to 79% (Kent & Simonoff, 2017).

One of the factors that contribute to the prevalence of anxiety in the ASD population is cognitive function. It is reported that individuals with ASD with higher cognitive ability and verbal IQ experience higher anxiety. The reason is that higher cognitive functioning enables the individual with awareness of their social and adaptive impairment, leading to increased anxiety. Emotional dysregulation is another factor contributing to anxiety in children and adolescents with ASD. The lack of ability to evaluate, express, adjust, and even control one's emotions may significantly contribute to anxiety. The genetic factor is also found to significantly contribute to anxiety in these populations. It has been established that parents with anxiety disorders are more inclined to have anxious children (Vasa & Mazurek, 2015). Studies focusing on anxiety in younger children with ASD highlighted that low quality of life is a significant factor contributing to anxiety (South et al., 2017). However, there is a paucity of research on anxiety in adolescents and adults with ASD.

ADHD and anxiety have been frequently associated with one another. Along with the typical symptoms of ADHD, the children may also exhibit moodiness, inflexibility, and excessive worry (Reynolds & Lane, 2009). Further, it is reported that social factors like disharmony in the family, abuse and neglect may lead to hyperactive and anxious behaviour in children with ADHD (Boat & Wu, 2015). Some researchers suggest anxiety is innately connected to ADHD, whereas others propose anxiety as a comorbidity and suggest that there is a difference in symptoms of ADHD

alone and ADHD with symptoms of anxiety. The comorbidity of anxiety disorder is found in almost fifty per cent of the population diagnosed with ADHD. More specifically, 27% of children with ADHD were found to have more than one form of anxiety disorder, compared to the typical population where only 5% were found to have one form of anxiety disorder (Reynolds & Lane, 2009).

Ayres (1972) explained that impairment in sensory modulation may lead to anxiety and stress-related behaviours. Johnson (1975) proposed that faulty processing of sensory information, particularly sensory hypersensitivity/ overresponsivity, may lead to the manifestation of anxiety. The sensory processing deficits are related to the range of anxiety disorders. In the typical population, both sensory over and under-responsivity are related to anxiety. Research on the clinical population highlighted that sensory processing impairment was related to social anxiety, generalized anxiety, and obsessive-compulsive disorder, including post-traumatic stress disorder. Children who are fearful or anxious may have tactile and auditory sensitivity. Further, when faced with challenging situations, children with overresponsive to sensory stimuli may have difficulty falling asleep at night (McMahon et al., 2019).

1.5 Summary

The background, ideas, and definitions of sensory processing and psychological correlates (social, emotional, and behavioural issues, anxiety, and depression) have been thoroughly covered in this chapter. The remaining chapters of the thesis are organized under the following headings: The review of related literature, Chapter II, has covered research studies related to children with ASD, ADHD, and the general population and psychological correlates of sensory processing. Next chapter III, the present study, outlines the justification for the current investigation, objectives, and hypotheses. The methodology used in the present study has been

discussed in Chapter IV. The interpretation of results and discussion are discussed in Chapter V and Chapter VI. The final chapter VII deals with the summary, implications, strengths, limitations, future recommendations, and conclusion of the study.

CHAPTER II

REVIEW OF RELATED LITERATURE

The first step in conducting research begins with a sound review of the literature. The review also provides an opportunity to compile the studies, old and new with benchmark findings. The process of reviewing the existing literature helps in finding the research gap, on which future research can be conducted. In this chapter, the literature related to sensory processing and psychological correlates in children with autism spectrum disorder (ASD) and Attention-Deficit Hyperactivity Disorder (ADHD) is covered in detail:

Section 2.1 covers the studies conducted in sensory processing related to ASD and ADHD.

Section 2.1.1 contains the studies that have investigated sensory processing and social dysfunction in children with ASD and ADHD.

Section 2.1.2 discusses in detail the studies related to sensory processing and its relation to emotional and behavioural problems in children with ASD and ADHD are discussed in.

Section 2.1.3 covers the studies related to sensory processing and its relationship to anxiety and depression in children with ASD and ADHD.

Section 2.1.4 covers the studies that have investigated the sensory challenges in different age groups and gender in children with ASD and ADHD.

Section 2.2 concludes and summarizes the review chapter.

2.1 Studies on Sensory Processing in Children with ASD and ADHD

Neuro-Developmental Disorders (NDD) are an emerging challenge to health professionals globally. They adversely affect the developmental abilities of

individuals by impairing their social, emotional, academic, and behavioural functioning. NDDs such as ASD and ADHD manifest during childhood and persist for a long time. Autism is characterized by severe dysfunction in social and communication skills and the presence of stereotypical and restricted behaviours, whereas ADHD is characterized as inattention and disorganization, with or without hyperactivity-impulsivity, causing impairment of functioning. Studies suggest that children with ASD and ADHD are more affected by sensory processing deficits compared to children with other developmental disabilities and typically developing children (Leekam et al., 2007; Mathison, 2012). Research suggests that deficits in sensory processing may exist independently or as a comorbid condition to other developmental disabilities (Critz et al., 2015).

Studies have shown that there is an atypical pattern of sensory processing in children with ASD (Matsushima & Kato, 2013; Tseng et al., 2011), where sensory processing atypicalities affect over 90 % of this population (Baker et al., 2008; Dawson & Watling, 2000; Hilton et al., 2010; Leekam et al., 2007). The fifth edition of the Diagnostic and Statistical Manual of Mental Disorder (DSM-5) has made changes in the diagnostic criteria of ASD with the addition of sensory reactivity symptoms in the restricted and repetitive behaviour domain. It has included "hyper- or hyporeactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement)" as one of the diagnostic features (American Psychiatric Association, 2013). Children with ASD seem to experience difficulty in processing sensory input and responding efficiently to environmental demands (Hilton, 2010; Miller et al., 2007). Studies conducted in the field of psychology,

neurosciences and occupational therapy have added to the evidence that children with autism have sensory difficulties compared to the typical population (Cheung & Siu, 2009; Leekam et al., 2007).

A comparative study was conducted with ASD, X syndrome, developmental delay, and the typical population. The sample was matched on their mental age and belonged to the age group of 2-3 years. The study used the short sensory profile which includes seven domains such as tactile, olfactory, visual, auditory functioning and others. The results of the study showed that children with ASD and Fragile X syndrome had greater sensory symptoms compared to children with developmental delays and typically growing. Significant differences were found in the areas of olfactory sensitivity, auditory filtering and tactile (Rogers et al., 2003).

ADHD is conceptualized as involving deficits in sustained attention, impulse control, and activity regulation (APA, 2013). Researchers and clinicians have suggested that sensory processing abilities, particularly sensory modulation, are affected in this population (Shimizu et al., 2014). Sensory modulation refers to "the capacity to regulate and organize the degree, intensity, and nature of responses to sensory input in a graded and adaptive manner" (Lane et al., 2000). Children with ADHD have greater sensory difficulties compared to children without ADHD (Cheung & Siu, 2009; Ghanizadeh, 2011; Shimizu et al., 2014; Yochman et al., 2004). Compared to children without disabilities, children with ADHD are found to have greater difficulties in sensory processing, particularly in visual, auditory, taste and tactile processing (Dunn & Bennett, 2002; Shimizu et al., 2014; Yochman et al., 2004). The impairment in sensory processing patterns may lead to atypical responses to sensory stimuli at school, at home or in the community (Dunn & Bennett, 2004; Ghanizadeh, 2011). Sensory processing dysfunction being a physiological condition

may exacerbate symptoms of hyperactivity and impulsivity. Thus, though not necessarily associated with ADHD, sensory processing may contribute to maladaptive behaviours in this population (Cheung & Siu, 2009; Dunn & Bennett, 2002; Yochman et al., 2004).

Significant sensory processing dysfunction has been repeatedly reported in children with ADHD. Distinguishing between sensory processing disorder, and ADHD can be difficult given their similar behavioural manifestations (Mathison, 2012). However, studies have found that when compared to the typical population, children with ADHD showed greater abnormalities in their sensory modulation on both parent reports and physiological measures (Mangeot et al., 2001; Ghanizadeh, 2011). A study was conducted by Yochman and colleagues (2004) that aimed to compare parents' perceptions of sensory responses of their children, with and without ADHD symptoms. The relationship between the levels of hyperactivity and sensory deficits was examined. The Sensory Profile Questionnaire was completed by forty-eight mothers of children with ADHD and forty-six mothers of children without disabilities, aged between 4 to 6 years old. A group comparison design was used to identify possible differences in sensory processing in these populations. Results indicated that children with ADHD have significantly lower scores on most of the sections and factors in the Sensory Profile Questionnaire compared to children without ADHD. Thus, the results suggested that children with ADHD have higher difficulties in sensory processing and modulation compared to typical children or children without ADHD. A recent study conducted by Panagiotidi et al. (2018) investigated the relationship between ADHD traits and sensory processing in the general population. The results from the study showed that there is a positive correlation between the traits of ADHD and sensory abnormalities. It was found that

difficulties in sensory modulation have been linked with impulsivity, arousal, and impaired attention.

Children with autism are frequently reported to have more severe symptoms in the domain of olfactory. They are likely to be oversensitive to smell, taste, and olfactory hypersensitivity. It is often reported that children with ASD are excessively particular with the taste, smell, and texture of food (Leekam et al., 2007; Rogers et al., 2003). Studies have further found that one of the commonly impaired sensory functioning in the ASD population is their auditory processing. Though studies have found that both hypo and hyper responses to sensory stimuli are found in children with autism (Green et al., 2015; Tomchek & Dunn, 2007), however, hypo responsiveness, especially in the domain of auditory processing is predominantly found in children with autism, compared to the children with developmental delay and typical population (Woodard et al., 2012).

2.1.1 Studies on Sensory Processing and Social Problems in Children with ASD and ADHD

Studies have reported a strong correlation between sensory processing and social functioning in children with ASD and ADHD (Chen et al., 2020; Cosbey et al., 2012; Huang et al., 2018; Kojovic et al., 2019; Matsushima & Kato, 2013; Thye et al., 2018). The impairment in social functioning in children with ASD can be noticed from an early age in the form of atypical eye contact, delayed verbal and non-verbal communication and decreased interest in social interaction (Barker et al., 2008; Kojovic et al., 2019). They may be unable to play creatively, become focused on subtle details, or insist on following specific routines (Rapin, 1991). Further, the atypical sensory processing may hinder their primary social interaction (Caminha & Lampreia, 2012; Matsushima & Kato, 2013).

A comparative study was conducted by Matsushima and Kato (2013) with 42 children with ASD and 42 typically growing children. The study aimed to understand the relationship between sensory patterns and social functioning in children with ASD without intellectual disabilities. The children in both the groups (ASD and the control group) aged between 4-6 years old. A total of 84 children participated in the study, including 42 children with ASD (36 male and 6 female) and 42 typically developing children (32 male and 10 female). The results found that children with ASD significantly differed from the control group, showing higher impairment in sensory processing patterns and social functioning. Further, sensory processing impairment is significantly correlated with social deficits in children with ASD. Auditory filtering and tactile sensitivity significantly correlated and predicted social deficits in this population. Hilton et al. (2010) conducted a similar study on 36 high-functioning children with ASD and 26 children age-matched (6-10 years old) typically developing children. Results highlighted that the atypical responses in multisensory, tactile, and olfactory greatly predicted social and communication impairment.

In a recent review, Thye and colleagues (2018) discussed in detail the influence of altered sensory processing on social impairment in the ASD population. They concluded that sensory atypicality in early childhood may burden and negatively affect their social functioning across development. Their sensitivity to tactile inputs may elevate the child's anxiety, abnormal focus and behaviour problems which may affect their social functioning to a great extent (Cheung & Siu, 2009). Further, children with hyperresponsive auditory input are more inclined to avoid social settings which might lead to further social impairment in children with ASD (Thye et al., 2018).

The core features of ADHD like hyperactivity and impulsiveness, do affect their social life. Often, the child's inattentiveness is misinterpreted as indifference and uncaring by peers and family members, affecting their interpersonal relationships. It has been reported that children with ADHD have to face difficulties in the social realm later in their lives, in the form of distractibility and lack of goal-directed behaviour. Self-reports from adults with ADHD indicated that they view themselves as less socially skilled in regulating their social behaviour. The core symptoms of ADHD are found to influence their social and emotional domains (Friedman et al., 2003; Ponagiotidi et al., 2018). Social impairment was related to low performance and poor social interactions at school because of which youths with ADHD are found to have fewer friends (Hoza et al., 2005). These symptoms of ADHD are persistent into adolescents and adulthood, resulting in emotional and behavioural problems (Du et al., 2018; Mordre et al., 2012).

Aduen and colleagues (2018) aimed to explore the social skill acquisition deficit, performance deficit and strength in children with and without ADHD. The study was conducted on 47 children with ADHD and 23 children typically developing peers aged between 8-12 years. The parent and teacher reports were used to understand the construct. The results highlighted that children with ADHD showed higher impairment in social strength than social acquisition deficit. The children with ADHD acquired age-appropriate social skills, however, they lacked consistency in performing those skills. In the review of literature on social competence, it was reported that children with ADHD have significant interpersonal difficulties. Children with ADHD often engage in excessive movements, positive and negative verbalization, and unexpected and inappropriate behaviours which directly affect their interaction with their peer groups. They were further reported to have difficulty in

shifting the pattern of social communication according to the change in social cues (Nixon, 2001).

2.1.2 Studies on Sensory Processing and Emotional and Behavioural Problems in Children with ASD and ADHD

Autism spectrum disorder widely affects children's emotional and behavioural functioning along with their area of interest that is often abnormal in focus and interest (APA, 2013). They often indulge in repetitive, stereotypical, and restricted activities, such as hand flapping, twirling, humming, rocking, and head banging (Huebner, 1992; Rapin, 1991). The underlying reason for their repetitive stereotypical behaviours or strong aversive responses to commonly occurring sensory inputs has been many a time attributed to their attempt to manage sensory stimulation, or achieve homeostasis, or modulate the sensory system (Baker et al., 2008; Hilton et al., 2010).

Atypical behavioural and emotional problems are often associated with sensory sensitivity, sensory underesponsiveness/ sensory seeking. Individuals with atypical sensory patterns usually respond to loud noise by covering their ears, shutting their eyes to bright light, avoiding certain food textures, failing to respond when called by name, and/ or engaging in repetitive behaviours like hand flipping (Lane et al., 2010). Greater overresponsiveness to sensory stimuli is found to have a relationship with higher emotional reactivity (Schaaf et al., 2003). Studies further indicate that the atypical behaviour responses to sensory stimuli may be in response to hypersensitivity and unwillingness to change or in response to unpredictable sensory input. Children with ASD may react aggressively to unpredictable touch yet enjoy touching certain things that are predictable. Similarly, they may respond atypically to unpredictable loud noise, however, enjoy making repetitive noise (Ashburner et al., 2008).

Many times, overrespositivity has been linked with internalizing and externalizing behaviour in children with ASD and ADHD. For example, children with overresponsivity to tactile may react negatively to grooming (hair brushing). Children with overresponsiveness to smell or sound may be particular to certain fragrances or put their hands to ears to different sounds (Critz et al., 2015). In addition, children's inability to regulate their emotional and behavioural responses may burden their educational progress and social relations in these populations (Eaves & Ho, 1997; Erfanian et al., 2018). Children with ADHD tend to be bossy, bully, explosive, controlling, and aggressive. These behavioural problems often affect their social and academic achievements (Carpenter Rich et al., 2009).

A study conducted by Kargas et al. (2015) identified a significant relationship between auditory processing of the sensory profile and restricted and repetitive behaviour in children with autism. Researchers have noted that hyperresponsive to sensory stimuli has an association with repetitive behaviour in children with autism, especially when the MA (mental age) of these children are controlled (Baranek et al., 2007; Bishop et al., 2006). Studies have reported that high scores in hyperresponsiveness result in higher participation in repetitive behaviour in children with ASD (Bodfish et al., 2000; Dziobek et al., 2006).

Similar results have been found in the study, titled *'Sensory Features and Repetitive Behaviors in Children with Autism and Developmental Delays'*. It included parents and observational measures to examine the association between sensory features and restricted, repetitive behaviours in children with autism (567) and those with developmental delays (542). Confirmatory factor analysis was used for data analysis. Though both the clinical groups showed high sensory processing dysfunction, children with autism scored higher, indicating higher problems compared

to children with developmental delays. The results further highlighted that hyperresponsive behaviours significantly predicted repetitive behaviours, whereas sensory seeking was associated with ritualistic/sameness behaviours (Boyd et al., 2010).

Another study was conducted by Tseng et al. (2011) on preschool children with autism. The study aimed to investigate the rate of co-occurring sensory processing dysfunction in children with autism manifesting emotional and behavioural problems. The study further examined the relationship between sensory processing dysfunction and emotional and behavioural problems. Results from the study confirmed that children with autism displayed a higher rate of sensory processing dysfunction than typically developing children. The study found an increased risk for emotional and behavioural problems in children with autism (73.1%). A significant relationship was found between sensory processing and emotional and behavioural problems, where avoiding significantly predicted internalizing problems and sensory seeking predicted externalizing problems in children with ASD.

A strong relationship between sensory seeking and repetitive behaviour has been established in earlier studies (Fernandez-Prieto et al., 2021; Lane et al., 2010). Individuals may need more stimulation to register and modulate the information received from the environment, which may lead to repetitive behaviour. It is found that both hyper and hypo responsiveness are associated with behaviour difficulties, including restricted, repetitive, and stereotyped patterns of behaviour and interests (Fernandez-Prieto et al., 2021). These behavioural patterns have been linked with behavioural disorders like isolation, self-aggression, irritability, an atypical response to change, disinterest and indifference (Gonthier et al., 2016). Lane et al. (2010) have

found a strong association between taste, smell sensitivity, auditory filtering, movement sensitivity, and maladaptive behaviour. Further, Barker and colleagues (2008) have found an association between maladaptive behaviour, emotional problems, underresponsiveness/ sensation seeking, auditory filtering, and low energy. The findings are in line with other studies (Boyd et al., 2009; Chen et al., 2009; Fernandez-Prieto et al., 2021).

Altered emotional experience is a common co-occurring feature in ADHD (Hirsch et al., 2019). Wender (1995) recognized the patterns of emotion dysregulation in the ADHD population. 70 % of individuals with ADHD report difficulty in emotion regulation. These emotions are experienced by them in greater intensity and exist across the lifespan. Studies have quoted those symptoms of emotion dysregulation, such as irritability, being prone to negative thinking and emotion, and low tolerance, are highly prevalent in children, adolescents, and adults with ADHD (Beheshti et al., 2020). Emotional impairment may independently contribute to functional impairments in individuals with ADHD (Barkley et al., 2010). The symptoms of emotional impairments are higher in children with ADHD compared to the typical population (Skirrow & Asherson, 2013). It is found that dysregulated sensory patterns and the inability to control and manage behaviour in children with ADHD may lead to emotional symptoms such as low tolerance to disappointments, impatience, irritability, anger, and severe emotional reactions (Shimizu et al., 2014). In a recent review, Beheshti and colleagues (2020) found that there is a strong correlation between emotional dysregulation and the severity of ADHD symptoms. Further, ADHD symptoms are significantly correlated with externalizing behaviour, such as aggression and irritation.

2.1.3 Sensory Processing and Anxiety and Depression in ASD and ADHD

Along with the impairments in social, emotional, and behavioural domains, children with ASD often experience comorbid psychiatric symptoms (Salazar et al., 2015). The way in which children with ASD process sensory inputs from their environment is found to have psychological distress (Bitsika et al., 2016). The presence of depressive symptoms occurs significantly more often in children with ASD than in typically growing children (Bitsika & Sharpley, 2015; Kim et al., 2000; Matson & Nebel-Schwalm, 2007) and has been reported to be as high as 54 % as reported by the parents (Mayes et al., 2011). Researchers have found that hyposensitivity/ hyporesponsiveness to sensory stimuli is significantly connected to depression (Bitsika et al., 2016; Engel-Yeger et al., 2011; Pfeiffer et al., 2005; Serafini et al., 2016). Serafini and colleagues (2016) suggested that the inability to identify and respond to immediate sensory stimuli may develop and elevate depressive symptoms. On the other hand, Ben-Sasson and colleagues (2009) added that hypersensitivity too may contribute to depressive symptoms in individuals with ASD.

Studies from the past have shown a relationship between sensory processing dysfunctions and depression (Ben-Sasson et al., 2009; Feldman et al., 2020). In a recent study conducted by McMahon and colleagues (2019), it was found that individuals with greater sensory dysregulation have greater chances of being diagnosed with anxiety disorder. Both hypo and hyperreactivity have been linked with depression in children (Ben-Sasson et al., 2009) and adolescents with ASD (Pfeifer et al., 2005). In the recent study conducted by Rossow et al. (2022) hyperreactivity and sensory seeking were found to be associated with depressive symptoms in preschool children with ASD. The study was conducted on 54 (male= 41, females=

13) preschool children aged between 3-5 years old. The study aimed to explore the relationship between sensory hyperactivity and mental health in preschoolers with ASD. The findings highlighted the relationship between sensory features, particularly with visual, auditory, and tactile reactivity with mental health. The parent reports specifically highlighted that hyperreactivity was related to internalizing problems, whereas sensory seeking was related to externalizing problems in preschool children of this study. Along the same line, studies have reported that hyposensitivity is frequently associated with depression, whereas hypersensitivity is linked with anxiety (Engel-Yeger et al., 2011; Kinnealey & Fuiek, 1999; Pfeiffer et al., 2005).

The researchers explored the longitudinal relationship between sensory reactivity and depressive symptoms in young children with ASD using few or no words. The first phase of the study was conducted on 33 young children, aged between 3-6 years old (male= 25, female= 8). 19 participants were retested in a follow-up after 12 months (male= 15, female= 4). Results highlighted a positive correlation between hyperreactivity and sensation seeking and depressive symptoms in two different time periods. Further, sensory seeking significantly predicted depressive symptoms in children with ASD using few or no words (Rossaw et al., 2022). The association between sensory processing features and depressive symptoms was investigated in 150 young males (6-18 years) with ASD. The results from the study highlighted that there is a significant correlation between sensory processing and total depressive symptom scores. Further, it was found that different aspects of sensory functioning significantly predicted depressive symptoms, with low registration (or sensory hyposensitivity) being the most powerful predictor of depressive symptoms (Bitsika et al., 2016).

Recently, children with ADHD are found to have an association with depression (Riglin et al., 2021). Studies have reported that 9-38 % of children with ADHD experience depressive symptoms (Turgay & Ansari, 2006). The depressive symptoms of ADHD are usually found later in life (Gundel et al., 2018). Explaining the co-occurrence of ADHD and depressive symptoms, some researchers suggest that ADHD causes depression (Riglin et al., 2021). Failure in forming positive relationships, poor academic achievement and lack of self-control may lead to the risk of developing depressive symptoms in individuals with ADHD (Schoeler et al., 2018; Thapar et al., 2012). However, on the other hand, Faraone and Larsson (2019) suggested that ADHD and depression share genetic factors. The same genetic type leads to the manifestation of ADHD early in life and depression symptoms later in life (Rutter et al., 2006).

Sensory processing abnormalities and significant symptoms of anxiety both occur frequently in ASD (Kerns & Kendall, 2014). Further, a relationship between ASD and anxiety disorders among young children and youths with ASD has been found (White et al., 2009). It has been reported that children with ASD report higher symptoms of anxiety compared to the typically developing peer group (Sukhodolsky et al., 2008). Although anxiety is not considered a core feature of autism, its co-morbidity is reported in 18- 87% of children with autism, whereas the prevalence of anxiety in typically developing children is between is around 3-24% (Green & Ben-Sasson, 2010; Simonoff et al., 2008; Van Steensel et al., 2011). Sensory processing abnormalities and significant symptoms of anxiety both occur frequently in ASD. Recent studies have investigated the relationship between these two constructs and have found that overresponsiveness to sensory stimuli (sensory hypersensitivity) may

play a key role in the development of anxiety in children with autism (Green & Ben-Sasson, 2010; Green et al., 2012; Lidstone et al., 2003).

In the studies conducted on healthy populations, both under and overresponsivity to sensory stimuli was found to have a strong connection to self-reported anxiety. Further, sensory overresponsivity is found to have a connection to different aspects of anxiety disorder, for example, generalized anxiety disorder, and social anxiety disorder (McMahon et al., 2019; Xiao et al., 2010). However, studies have found that overresponsiveness to sensory stimulation (sensory hypersensitivity) may play a key role in the development of anxiety in children with autism (Green & Ben-Sasson, 2010; Green et al., 2012; Green et al., 2015; Lane et al., 2012; Lidstone et al., 2003; Pfeiffer et al., 2005). In a recent study, Khaledi et al. (2022) reported a significant relationship between the short sensory profile (SSP) and different dimensions of the anxiety scale (Spence Children's Anxiety Scale). The results highlighted that children with ASD with higher levels of anxiety showed higher sensory responsive abnormalities.

Green and Ben-Sasson (2010) did an extensive discussion on the causal relationship between sensory overresponsiveness and anxiety in children with ASD. The authors proposed and discussed in length that a) anxiety is caused by sensory overresponsiveness, b) sensory overresponsiveness causes anxiety, and c) anxiety and overresponsiveness is unrelated to each other, however, are associated with common risk factor or may have diagnostic overlap. According to the first model, children may become hypervigilant to sensory stimuli in the environment, contributing to the atypical reaction to the aversive sensory stimuli. In the second model, the overreaction to the environmental stimuli is generalized through context conditioning. The unpleasant sensory stimuli (such as loud noise) are associated with certain objects in

the environment, such as a toy or vehicle. Consequently, these objects become capable of producing conditioned responses such as fear and anxiety. So, the child gives a conditioned anxious response to the sight of the vehicle or to the type of toy without the unpleasant sound. Further, with no direct causal relationship between the two, the other risk factors, such as abnormalities in the amygdala may contribute to anxiety and sensory overresponsiveness independently.

Studies have highlighted that children with ADHD are more prone to developing symptoms of anxiety. 25 % of the ADHD population suffers from anxiety disorder (Eberhart & Hammen, 2006; Lane et al., 2012; Reimherr et al., 2017; Reynolds & Lane, 2009). Along with the symptoms of ADHD, the children may also exhibit moodiness, inflexibility, and excessive worry (Reynolds & Lane, 2009). Further, it is reported that social factors like disharmony in the family, abuse and neglect may lead to hyperactive and anxious behaviour in children with ADHD (Boat & Wu, 2015). Lane et al. (2012) found a positive relationship between sensory sensitivity and anxiety in children with ASD, ADHD and the typically developing. Further, it was found that toddlers with ASD who demonstrate a higher frequency of sensory-related behaviours (i.e., underresponsivity, overresponsivity, or sensory seeking) also exhibit more negative emotions like depression and anxiety.

Ayres (1972) explained that impairment in sensory modulation may lead to anxiety and stress-related behaviours. Johnson (1975) proposed that faulty processing of sensory information, particularly sensory hypersensitivity/ overresponsivity, may lead to the manifestation of anxiety. Studies have found an association between sensory overresponsivity and anxiety (Neal et al., 2002; Pfeiffer, 2003). They explained that when faced with challenging situations children with ADHD and overresponsiveness to sensory stimuli may have difficulty falling asleep at night or

often complain sick in their stomachs. In the study conducted by Reynolds and Lane (2009), it was found that children with ADHD and comorbid sensory overresponsiveness are more likely to demonstrate higher levels of anxiety.

2.1.4 Sensory Processing and Psychological Correlates across Age Groups and Gender in ASD, ADHD, and the Typical Population

The previous sections covered the studies conducted on sensory processing and psychological correlates in children with ASD and ADHD. However, the research on sensory processing in children with ASD and ADHD in different age groups and gender were found to be scant.

Leekam et al. (2007) conducted a two-phased study with four sample groups, autism, learning disability, language impairment and typically growing children. These samples were matched on age and IQ. The first study was conducted on children ranging from 2- 11 years old. It primarily focused on the group difference in sensory processing and also examined the sensory patterns in children with ASD. In the second phase, 200 children and adults were included with a wide age range of 32 months old children to 38 years old adults. It primarily aimed to understand in detail the patterns of sensory abnormalities in children with ASD. Results from both studies showed that children with ASD were affected in multiple sensory domains, especially in smell/taste, touch, and vision, and differed from the comparison group in sensory processing patterns and in its frequency. In both studies, children with autism scored low in the domains of touch and smell across age and IQ compared to the other groups. The study had mixed results indicating that for some children with ASD, the sensory abnormalities persisted in their adolescence and adulthood, however, for others, the sensory symptoms changed with age and IQ. Further, the study conducted by Marche et al. (2012) on adolescents with ASD found that they scored low on

sensation seeking and high on sensation avoidance compared to the typical population. The study explained the high sensation avoidance in ASDs to have a connection with their low sensory threshold which is in accord with Dunn's theory of sensory processing. However, the study recommended further investigation to explicitly explain sensory patterns in adults with ASD.

On a similar line, Cheung and Siu (2009) mentioned that the age of the children is a determinant factor in the evaluation of sensory processing. The study was conducted on three comparative groups (autism, ADHD, and the typical population). The study's primary aim was to understand the sensory patterns in children with and without disabilities. Compared to the children with ADHD and the control group, the children with ASD scored low, indicating higher problems in all 8 subscales of sensory processing. The authors further added that children with ASD and typically developing children showed increased sensory processing issues over the span of their childhood. Additionally, children with ADHD were likely to experience sensory processing issues, especially in auditory filtering over a period of time. The results are in line with the previous findings (Kern et al., 2007; Leekam et al., 2007).

In the convenient sampling of 1272, 20.2 % of parents reported clinically significant depression in children with ASD between the age group of 13-17 years old (Greenlee et al., 2016). Studies have further found that oversensitivity to sensory stimuli and its relation to emotional dysregulation may affect a child's anxiety across ages. Children with emotional problems associated with sensory processing have a high chance of future anxiety problems (Hofmann et al., 2012; McMahon et al., 2019). Similarly, Green et al. (2012) conducted a study with 149 toddlers diagnosed with ASD. The study was administered in two phases. The results of the study found a unidirectional relationship where sensory overresponsiveness was predictive of

anxiety, but the anxiety did not predict sensory overresponsiveness. Sensory overresponsiveness was stable across time and based on the results the researchers proposed that sensory overresponsiveness could be an early neurological indicator, which later manifests as anxiety. Along the same line, a longitudinal study found that sensory processing atypicality may continue to exist in adolescents and adulthood which largely contributes to the development of anxiety later in life (Pfeiffer et al., 2005).

Studies have found that children with ADHD are more prone to develop depressive symptoms later in their life and about 25 % of this population have an anxiety disorder (Eberhart & Hammen, 2006; Lane et al., 2012). In the study conducted by Nelson and Liebal (2018), it was found that college-going students with ADHD have greater symptoms of anxiety and depression compared to non-ADHD college students. Further, the females with ADHD showed higher symptoms of anxiety and depression than males. Abikoff and colleagues (2002) have found that boys show more externalizing behaviour problems compared to girls with ADHD. Studies have identified various factors that lead to negative emotions like depression later in their life such as academic failure (Kent et al., 2011), social impairment and interpersonal impairment (Herman et al., 2007; Hoza et al., 2005) and parent-child conflict (Humphreys et al., 2013). Further, Campbell et al. (1995; 1997; 2000) conducted a number of studies on the prevalence of behavioural problems across age groups. Almost 50 % of children who showed behavioural problems at 3 years of age showed similar results at the age of 6. When followed up at the age of 9, two-thirds of these children showed symptoms of externalizing behavioural problems. At the age of 13, these children were most likely to be diagnosed with ADHD compared to children

who did not show any externalizing problems in the preschool years (Holland et al., 2017).

During the process of review of related literature, comparative studies of males and females in children with ASD related to sensory processing or psychological correlates were found to be scarce. However, females (beginning at the age of 10 years old) with ASD are found to have higher depressive symptoms and are prone to commit suicide compared to the general population and to males (boys or men) with ASD (Kolves et al., 2021; Bitsika et al., 2021). Studies have further highlighted that females with ASD have higher symptoms of major depressive disorder compared to the age-matched non-ASD peer group (Hossain et al., 2020; Wigham et al., 2017).

2.2 Conclusion

It was found that children with ASD have higher deficits in sensory processing compared to children with other developmental disabilities (Baranek et al., 1997; Kientz & Dunn,1997; Leekam et al., 2007; Orntiz, 1988). Further, studies have confirmed that their deficit in sensory processing has a strong relation to their social, emotional, and adaptive behaviour (Baranek et al., 2007; Boyd et al., 2010; Green et al., 2012; Hilton et al., 2010; Lane et al., 2012; Tseng et al., 2011). On a similar line, ADHD has also been found to be linked with sensory processing. It must be noted that in a number of instances distinguishing between sensory processing dysfunction and ADHD is a challenge in itself. However, studies have found that children with ADHD are reported to have greater sensory dysfunctions compared to the typical population (Cheung & Siu, 2009; Mangeot et al., 2001; Mathison, 2012).

Though children with ASD and ADHD differ little in their sensory patterns, however, the most affected sensory processing areas in children with ASD are

olfactory, auditory and tactile (Green et al., 2015; Leekam et al., 2007; Rogers et al., 2003; Tomchek & Dunn, 2007), whereas the commonly affected sensory domains in children with ADHD are auditory and tactile (Cheung & Siu, 2009). Further, the symptoms of sensory processing in children with ADHD are found to have a greater effect later in their social life (Friedman et al., 2003; Ponagiotidi et al., 2018). Some findings indicated that sensory processing abnormalities undergo changes with the child's age (Cheung & Siu 2009; Leekamet al., 2007). However, for children with ADHD, the symptom of auditory processing was found to show a significant increase over a period of time (Cheung &Siu, 2009). Further, in the study conducted by Leekam et al. (2007), the results showed that sensory abnormalities continue to affect most individuals with autism even into their adolescence and adulthood.

Studies have found that there exists a relationship between sensory processing and social impairment in children with ASD (Ben- Sasson et al., 2009; Matsushima & Kato, 2013). Auditory hyperresponsiveness was found to have a positive relationship with social impairment in ASD (Thye et al., 2018). Because of the sensitivity to auditory stimuli, there are higher chances that children with ASD would avoid social settings (Cheung & Siu, 2009). Studies have also found that sensory processing impairment is negatively related to emotional and behavioural functions in children with ASD (Tseng et al., 2011). Further, it was found that hyperresponsiveness to sensory stimuli is further related to restricted and repetitive behaviour (Kargas et al., 2015). On the other hand, sensory seeking was found to have an association with ritualistic behaviour in children with ASD (Boyd et al., 2010). Sensory processing impairment in children with ASD and ADHD is found to have a relationship with anxiety and depression (Bitsika et al., 2016; Lane et al., 2012). Studies have found that overresponsive to sensory stimuli, especially tactile sensitivity has a positive

relation to anxiety in children with ASD and ADHD (Cheung & Siu, 2009; Eberhart & Hammen, 2006; Lane et al., 2012).

Though the core symptoms of ADHD are found to have an association with social, and behavioural functioning (Friedman et al., 2003; Ponagiotidi et al., 2018), however, none of the studies have investigated the relationship between sensory processing and psychological correlates (social, and emotional, behavioural). The age of the participants ranged widely, often neglecting the age-specific difficulties and differences in sensory processing and its association with psychological correlates. The gender of the participants was reported with the majority of participants being male, which reflected the uneven gender distribution of ASD and ADHD. Therefore, based on the studies included in the review firm conclusion cannot be drawn.

The findings on sensory processing in different age groups are inconclusive in nature. Studies indicated that sensory processing dysfunction became less intense with age, however, older children with ADHD showed increased sensory processing difficulties, particularly in the auditory domain, compared to the children in the younger age group (Cheung & Siu, 2009; Kern et al., 2006; Little et al., 2018). On the other hand, longitudinal studies further found no significant difference in sensory processing across developmental ages (Green et al., 2012; Ausderau et al., 2014). However, the recent meta-analysis conducted by Ben-Sasson et al. (2019) reported that sensory processing atypicalities may increase, decrease, or remain stable over a period of time. Additionally, the studies conducted on sensory processing and psychological correlates across gender is extremely scarce, based on which a firm conclusion on gender cannot be established.

CHAPTER III

The PRESENT STUDY

3.1 Statement of the Problem

Autism spectrum disorder (ASD) and attention deficit hyperactive disorder (ADHD) are neurodevelopmental disorders that are identified at an early age and continue to exist through adolescents and adulthood (Leekam et al., 2007; Little et al., 2018). It is frequently reported that children with ASD and ADHD process sensory information differently than the typically developing population (Little et al., 2018; Joshi &Angolkar,2021). Over 90% of children with ASD exhibit sensory processing atypicalities (Baker et al., 2008; Dawson & Watling, 2000; Hilton et al., 2010; Leekam et al., 2007). Similarly, children with ADHD have more trouble processing sensory information compared to the non-ADHD population, especially in taste, touch, visual, and auditory perception (Dunn & Bennett, 2002; Shimizu et al., 2014; Yochman et al., 2004). Studies have further highlighted a significant relationship between sensory processing and psychological correlates such as social, emotional, and behavioural problems (Cheung & Siu, 2009; Tseng et al., 2011) and anxiety and depression (Bitsika et al., 2016; Lane et al., 2012) in ASD and ADHD.

3.2 Operational Definition

Social Problem: Inability or unwillingness to engage in verbal or nonverbal social interactions such as difficulty making eye contact, remaining aloof, and difficulty understanding verbal and nonverbal communication contribute to social problems.

Behavioural and Emotional Problems: The behavioural and emotional problems are disruptive, persistent, and repetitive behaviours, along with withdrawals and mood disorders that are uncharacteristically found in younger and older children.

Depression: The experience of negative emotions, difficulties enjoying things, a lack of hope, aloofness, and panic episodes contribute to depressive symptoms.

Anxiety: Anxiety is the worry of an adverse event's unpredictability and uncontrollability along with the symptoms of moodiness, inflexibility, and excessive worry.

3.3 Need and Justification of the Study

Though studies have investigated sensory processing in children with ASD, however, its relationship to psychological correlates (clinical and non-clinical) is less known. Even though social and behavioural functioning are found to be associated with the core symptoms of ADHD (Friedman et al., 2003; Ponagiotidi et al., 2018), the association between sensory processing and different psychological correlates (social, emotional, or behavioural and anxiety and depression) in this population is hardly explored. Studies have also reported the prevalence of sensory processing issues across age groups as common, however, the research results are mixed (Green et al., 2012; Little et al., 2018;). Ben-Sasson et al. (2019) recently reported that sensory processing abnormalities may worsen, get better, or stay the same throughout the lifespan.

Despite awareness of its high prevalence, there is limited systematic evidence on the patterns of atypical sensory processing in children with ASD and ADHD, especially in a developing country like India. In a recent scoping review, Patra and Kar (2021) reported studies conducted on children with ASD in India, however, the review didn't report any studies that addressed sensory processing in ASD. Although the number of research on ADHD has expanded in India over the past 20 years, the authors of a recent review noted that there is a dearth of quality research (Kuppili et

al., 2017). Furthermore, sensory processing and the associated issues in ADHD have not been studied in the Indian context so far.

Against this backdrop, the main objective of this study is to understand the relationship between sensory processing and psychological correlates such as social, emotional, and behavioural (non-clinical), anxiety and depression (clinical) in children with ASD, ADHD and the typically developing children. It further aimed to examine the difference in sensory processing and clinical and non-clinical variables in different age groups (younger and older children) and gender (male and female) in ASD, ADHD, and the typical population.

3.3.1 Objectives

The present study has the following objectives.

O1: To study the sensory processing patterns in children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

O2: To examine the relationship between sensory processing patterns, clinical (anxiety and depression) and non-clinical (social, emotional, behavioural) aspects in children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

O3: To compare the sensory processing patterns, clinical (anxiety and depression) and non-clinical (social, emotional, behavioural) aspects among children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

O4: To investigate the sensory processing pattern and its relationship with clinical (anxiety and depression) and non-clinical (social, emotional, and behavioural) aspects in children with autism spectrum disorder, attention deficit hyperactive disorder and the control groups across age and gender.

3.3.2 Hypotheses

H1: Children with autism spectrum disorder and attention deficit hyperactive disorder will show different patterns of sensory processing than the control group.

H2: Sensory processing dysfunction will positively correlate with social, emotional and behavioural difficulties in children with autism spectrum disorder and attention deficit hyperactive disorder.

H3: Sensory processing dysfunction will positively correlate with anxiety and depression in children with autism spectrum disorder and attention deficit hyperactive disorder.

H4: Children with autism spectrum disorder and attention deficit hyperactive disorder will score higher on the sensory processing difficulties scale than the control group.

H5: Children with autism spectrum disorder and attention deficit hyperactive disorder will show higher impairment on social, emotional, and behavioural scales than the control group.

H6: Children with autism spectrum disorder and attention deficit hyperactive disorder will score higher on anxiety and depression than the control group.

H7: There will be significant gender differences in sensory processing patterns and their relationship with social, emotional, and behavioural problems and depression and anxiety in children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

H8: There will be significant age group differences in sensory processing patterns and their relationship with social, emotional, and behavioural problems and depression and anxiety in children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

CHAPTER IV

METHODOLOGY

This chapter covers the research methodology and techniques used in this study. It is divided into the following section: first, it provides the methodological approaches in social science, and second briefly discusses the research designs and the geographical area of the present study. Next, it provides the details of the participants including the sampling strategy and inclusion criteria for selection of the participants. Further, ethical considerations, measures, procedures, and statistical techniques are discussed.

4.1 Methodological Concerns

The formal proposal of applying scientific methods to the social world and humanity was proposed by Auguste Comte, Claude-Henri de Saint-Simon, Adolphe Quetelet, and John Stuart Mill in the 19th century (Bernard& Bernard, 2013). In the field of social sciences, research is done to understand social phenomena where the research is deeply rooted and grounded in the ideas and rituals of the social world (Bryman, 2016). The laboratory here is the society and the aware and active human beings are the instruments and objects of the laboratory. Social researchers are generally interested in the discovery and interpretation of social processes and patterns of behaviour of persons or groups of the unit the researcher is studying at a time (Bhandarkar et al., 2013). The research question generally focuses on the social group than on a particular individual. This is so because what is applicable to a group may be applicable to most members of the group, whereas vice versa may not be true. While conceptualizing the abstract knowledge of the social world, the researchers make use of scientific as well as a systematic framework (Raiyani, 2012).

Methodology indicates the process in which measures are recorded to find answers to the framed questions. Research methodology focuses more on the process of the study than the end product of the study (Kumar, 2014). There are two families of social sciences research methods, they are qualitative and quantitative methodologies. In quantitative research methodology, the social phenomenon is looked at through the lens of quantifiable evidence and depends on statistical analysis. On the other hand, qualitative research methodology uses direct observation, communication, and subjective interpretation (Creswell & Clarks, 2007). The quantitative research method is the dominant research framework in social sciences which allows the researcher to conduct simple to most sophisticated analysis to fulfil the objectives of the studies. It usually includes questionnaires, structured observations, or experiments (Ahmad et al., 2019). Quantitative research usually, however, not compulsorily consists of the following process, i.e., theory, hypothesis, research design, devising measures of concepts, research sites, research participants, research instruments, data processing, data analysis, findings, and conclusion. The fact that it starts with a theory, the broad deductive approach is taken towards the relationship between theory and research (Bryman, 2016). Qualitative research is an in-depth study of social phenomena within their natural setting (Ahmad et al., 2019). It is also known as, cultural investigation, constructive paradigm, natural enquiry, phenomenological investigation, post-modernism, post-positivism-attitude, and post-structuralism (Mehrad & Zangenah, 2019). It focuses on the ‘why’ rather than the ‘what’ of the social phenomena and majorly relies on the first-hand experience of the participants. Unlike the quantitative method, qualitative research uses biography, case study, historical analysis, discourse analysis, ethnography, grounded theory, and phenomenology to analyse their data (Ahmad et al., 2019).

Considering the objectives of the present study, quantitative research methodology has been used in the process of data collection, data analysis and data interpretation.

4.2 Research Design

Research design is generally known as the blueprint of the research. It is a detailed plan, where everything is well structured and defined. It covers the complete framework of the research covering the sample, sample size, tools used, in the data collection, the procedure involved, and the data analysis. The research design used in a research work solely depends on the research purpose (Bhandarkar et al., 2013). There are different types of research designs in social sciences. The most known ones are experimental design, cross-sectional design, longitudinal design, case history design, and comparative. Experimental research designs are mostly used in psychology and organizational studies (Bryman, 2016). An experimental research design is used when the research focuses on testing the hypothesis of a causal relationship between the variables (Bhandarkar et al., 2013). The cross-sectional research design refers to collecting data from more than one case at a single point in time in connection with two or more variables which are then analysed to examine the patterns of associations. In the longitudinal research design, data is collected from the sample at a particular time and is again surveyed on at least one further occasion. This research design includes time and cost constraints which limit its usage. On the other hand, case study research design involves an intensive and detailed study of a single case. Comparative research designs are commonly used in cross-cultural and cross-national studies where the focus is to look into the similarities and differences or to gain greater awareness and a deeper understanding of social reality (Bryman, 2016).

The descriptive research design was used to fulfil the objectives of the present study.

4.3 Geographical Area

The present study was conducted in different districts (Jalpaiguri, Darjeeling, Kalimpong, Kolkata, North 24 Praganas, South 24 Praganas, Hawrah, Nadia, Cooch Behar, Alipurduar and Bardhaman) of West Bengal, India.

4.4.1 Participants

To fulfil the objectives of the present study, a purposive sampling technique was used. The participants of the present study consisted of the mothers of children with ASD, ADHD, and the typical population. These children were divided into two age groups: younger (6-11 years) and older (12-18 years). A total of 362 mothers participated in the study, with the median age of the participants being between 30 and 35 years old. These mothers included 139 mothers of children in the typical group, 123 mothers of children with ASD, and 100 mothers of children with ADHD.

Children with ASD

This sample included 123 moms (73 of younger children and 50 of older children) who had received a clinical diagnosis of ASD based on ICD 10 from a professional. The Indian Scale for Assessment of Autism (ISAA) (Chakraborty et al., 2015), which was completed by the mothers, was used to confirm the diagnosis of ASD before participation. Conners' Abbreviated Parent Questionnaire (Parker et al., 1996) was used to confirm the comorbidity of ADHD in children with ASD, and children exhibiting comorbid ADHD symptoms were disqualified from the study. According to the mother's account, neither the ADHD diagnosis nor any other neurodevelopmental problems were co-diagnosed with the ASD children (Crastra et al., 2020).

Children with ADHD

This cohort included 100 mothers, 50 of whom had younger children and 50 of whom had older children. These children had received a verified ICD 10 diagnosis of ADHD from a mental health specialist. The Abbreviated Parent Questionnaire developed by Conners (Parker et al., 1996) was used to validate the ADHD diagnosis before participation. The mothers filled out the ISAA (Chakraborty et al., 2015), which was used to confirm the comorbidity of ASD. The data did not include children who had ASD symptoms. According to the mother's account, neither ASD nor any other neurodevelopmental abnormalities were comorbidly diagnosed in ADHD children (Crastra et al., 2020).

Typical group

Third, a control group of 139 mothers (74 mothers of younger children, 6–11 years old, and 65 mothers of older children, 12–18 years old) volunteered from the mainstream school. These mothers were matched for age with other clinical groups and their children had no known physical, neurological, or behavioural disorders. ASD and ADHD were also carefully screened for using the ISAA (2009) and Conners' Abbreviated Parent Questionnaire (Parker et al., 1996), respectively. The clinical cutoff points for these scales were not met by these children. Table 4.1 represents the number of participants taken from each centre.

Table 4.1

Sample distribution according to centres and schools (N=362)

Serial no.	Name of the Centre	No. of Participants	Younger		Older	
			Male	Female	Male	Female
1.	Institute of Sensory Integration and Research Centre (Siliguri)	21	14	4	3	0
2.	Institute of Sensory Integration and Research Centre (Kolkata Saltlake)	12	10	2	2	1
3.	Institute of Sensory Integration and Research Centre (Kolkata)	26	13	7	6	0
4.	Rhythmic therapeutic centre, Kolkata	35	17	08	5	1
5.	Care for Autism, Kolkata	06	3	2	3	0
6.	Pradeep special school, Kolkata	27	4	7	14	2
7.	Dwish, Kolkata	08	4	2	1	1
8.	Speech Plus, Kolkata	04	2	1	2	0
9.	Cynosures, Kolkata	10	5	3	2	0

10.	Sunshine, Kolkata	08	4	2	3	1
11.	Soul steps, Kolkata	03	2	0	2	0
12.	Reborn, Asansol	13	6	2	3	1
13.	Darjeeling Hope Special School,	08	2	2	1	2
14.	Uttaran North Bengal Handicapped Rehabilitation Society	18	7	2	3	2
15.	Prerna, North Bengal Council for the Disabled	05	1	2	1	1
16.	Special School, Jalpaiguri	11	3	2	2	2
17.	Montessori School, Darjeeling	25	13	0	5	2
18.	Himalayan English School, Siliguri	16	3	5	4	4
19.	Kamal Jyoti School, Kalimpong	30	10	02	7	5
20.	Paramount, Kalimpong	20	02	02	5	6
21.	Spring dale, Kalimpong	23	2	3	10	8
22.	Parnami girls' school, Kalimpong	29	0	6	0	18
23.	SaptashriGyanpeeth, Kalimpong	12	03	03	04	02

4.4.2 Inclusion Criteria

1. Children who are diagnosed by professionals according to the diagnostic criteria of ICD-10 with ASD and ADHD were included.
2. Children with ASD and ADHD attending special schools or therapeutic centres were included.
3. The typical population consisted of those who do not suffer from any major illness (physical and psychological).
4. The typical population attending private schools in West Bengal were included.
5. Children between the age of 6-18 years old were included.
6. Only the residents of West Bengal were included in the study.

4.5 Ethical Consideration

The Sikkim University ethical committee approved the present study for collecting data from the field. The study's objective was disclosed in advance to the centre heads and participants. The consent form was filled out by the participants to indicate their willingness to participate in the study. The volunteers were not at all coerced into taking part. Participants were also made aware that they might withdraw from the study at any point during the data collection process. No financial aid was given to the participants to complete the questionnaires. The confidentiality of their responses was also assured.

4.6 Measures

To fulfil the objectives of the present study, the following measures were used:

4.6.1 Socio-demographic Datasheet (Self, 2021)

The socio-demographic data sheet was developed to know more about the participants' backgrounds. Participants' demographic information, including their age, gender, educational background, marital status, religion, social group, income, and

family structure, was covered by this questionnaire. The child's age, gender, and a few details about the disorder, such as its diagnosis, age of onset, and its severity (mild, moderate, or severe), were also included.

4.6.2 Short Sensory Profile (SSP) (Dunn, 2014)

The Sensory Profile measures the sensory processing abilities of children and highlights its effects on daily functioning (Dunn, 1999). The scale consists of 125 items with three broad dimensions: sensory modulation and emotional and behavioural responses, and thirteen plus subareas. The normative data were collected on 1,037 (524 girls and 510 boys) children aged between 3 to 10 years old. The subscale coefficients ranged from 0.47 to 0.90 (Brown et al., 2010). The Short Sensory Profile (SSP) is a shorter version of the Sensory Profile (Dunn, 1999). The scale consists of seven domains and the internal consistency of the domains within the scale ranged from 0.70 to 0.90 and was significant at $p<0.01$ (Tomchek & Dunn, 2007).

Tactile sensitivity includes items related to behavioural discomfort from the touch such as aggressive reaction to touch, rubbing or scratching the spot when touched. The scale has seven items and the score ranges from 7-35. Taste/ smell includes items related to a certain taste and smell like avoiding or preferring certain food or smell of food. The dimension has four items and the score ranges from 4-20. Movement sensitivity includes items that are related to fear of falling, or when the feet leave the ground. It has 3 items and the score range is 3-15. Under responsiveness/ sensation seeking includes items such as seeking or making inappropriate noises and touching people and objects. The low score in this subscale indicates higher sensory seeking behaviour. It includes 7 items and the score ranges from 7-35. Auditory filtering indicates the difficulty to attend to relevant information

while filtering distractions. It includes items like not responding to name calling, and difficulty functioning in loud noise. The dimension has 6 items and the score ranges from 6-36. Low energy refers to the sensitive physical manifestation of atypical sensory processing (weak grasp and muscles, tries easily). It has 6 items, and the scores range from 6-30. A low score in all the dimensions indicates the child's behavioural sensory functioning away from the typical standard. Visual/auditory sensitivity indicates an awkward response to visual/auditory stimuli. It has 5 items with scores ranging from 5-20 (Derakhshanrad et al., 2022).

Administration of the tool

Given its shorter version, it takes approximately 10 mins to fill in the SSP and is recommended for research protocols. The participants are required to select the option that best indicates their child's response to the sensory stimuli.

Scoring

The caregivers fill the SSP on a five-point Likert scale where 5 indicates never, 4= frequently, 3= occasionally, 2= seldom, and 1= always. A high score on the scale indicates better sensory functioning, whereas a low score indicates high sensory processing difficulties when compared to children without disabilities.

Purpose of usage

SSP was used to assess the sensory processing functioning in children with ASD, ADHD, and the typical population.

4.6.3 Child Behaviour Checklist (CBCL) (Achenbach, 1991)

CBCL (Achenbach, 1991) is one of the most common scales used to assess the psycho pathologies in children aged between 4-18 years old (Tseng, et al., 2011). It consists of 113 items and is divided into 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. Internalizing behavioural problems include anxiety/depression, withdrawal/ depression, and somatic complaints, whereas externalizing behaviour problems include aggressive behaviour and delinquent behaviour. The CBCL also includes DSM-oriented scales such as depressive problems, anxiety problems, somatic problems, attention deficit/hyperactive disorder, and oppositional defiant problems for 6-18 years old. In the present study, social problem dimension, internalizing, externalizing, DSM-oriented depression, and anxiety scales were taken to measure social problems, emotional and behavioural problems along with clinical aspects, such as anxiety and depression were included.

The dimension of social problems has 11 items that measure the social functioning of the child. The items included in the dimensions are, does not get along with others, loneliness, clinging to adults, not liked by others, and others. The score of the dimension ranges from 1 to 33. A higher score in the dimension indicates a higher problem and a low score indicates better social functioning of the child. The internalizing behaviour includes three other dimensions namely anxiety/depression, withdrawal/ depression, and somatic complaints. The total items of internalizing behaviour problems are 27 and the score ranges from 1 to 81. Externalizing behaviour items include two dimensions namely, aggressive behaviour and delinquent behaviour. The total number of items of the dimension is 33 and the score ranges from 1 to 99. DSM-oriented depression and anxiety scales have 13 and 9 items, respectively. The depression scale includes items such as being underactive, overtired, trouble sleeping, does not eat well etc. The score ranges from 1 to 36. The DSM-oriented anxiety scale has 9 items and the score ranges from 1 to 27. The items included are clinging to adults, fears of animals or situations, nervous/ tensed and so

on. A high score indicates greater problems and a low score indicates better emotional and behavioural functioning and minimum anxiety and depression problems in children.

Administration of the tool

CBCL comprises 113 items and takes around 30 minutes to fill up the questionnaire. The participants are required to select from the options 1= not true, 2= often true and 3= very true, that best represent their child's behavioural responses.

Scoring

The primary caretaker may deploy 1= not true, 2= often true and 3= very true. A higher score on the scale indicates a higher child behavioural problem.

Purpose of usage

CBCL was used in the study to access the social, behavioural, and emotional problems and anxiety and depression in children with ASD, ADHD, and the typical population.

4.6.4 Conners' Abbreviated Parent or Teacher Questionnaire (Conner 1990)

Description of the tool

The questionnaire aims to assess the hyperactive and inattentive symptoms in children. The items include being restless or overactive, inattentive, especially distracted, excitable or impulsive and having quick and drastic mood swings.

Administration of the tool

The tool was administered to the mothers to understand the presence of ADHD symptoms in the children. The questionnaire contained 10 items and took less than five minutes to respond.

Scoring

The questionnaire is scored between 1-3; with 1 indicating just a little, 2= pretty much and 3= very much. The maximum score on the scale is 30 and a score of 15 and above indicates symptoms of ADHD. A higher score on the scale indicates higher ADHD symptoms.

Purpose of usage

The Conners' Abbreviated Parent or Teacher Questionnaire was used to control the comorbidity of ADHD in children diagnosed with ASD.

4.6.5 The Indian Scale for Assessment of Autism (ISAA) (ISAA, 2009)

Description of the tool

The ISAA (2009) consists of 40 items distributed in six dimensions; social relationship and reciprocity include items related to social functioning in children with ASD such as poor eye contact, unable to relate to people, and lacks of a social smile. The dimension consists of nine items and the score ranges from 9-45. The dimension of emotional responsiveness consists of five items. It contains questions related to emotional responses such as lack fear of danger, shows exaggerated emotions, and being excited or agitated for no apparent reason. The score on the dimension ranges from 5-25. The dimension of speech-language and communication includes items related to speech and communication e.g., acquired, and lost speech, unable to initiate or sustain the conversation, and engaging in echolalic speech. The dimension consists of six items and the score ranges from 6-30. Behavioural patterns include questions related to behavioural problems like shows hyperactivity/ restlessness, insists on sameness, and throwing temper tantrums. The dimension has seven items and the score ranges from 7-35. The dimension sensory aspect contains items related to sensory problems such as insensitivity to pain, difficulty tracking objects, and unusually sensitive to sensory stimuli. It has six items and the score

ranges from 6-30. The last dimension on the scale, the cognitive component assesses cognitive functioning. The items include the existence of savant quality, inconsistent attention and concentration and delay in responding. It has four items and the score on the dimension ranges from 4-20.

Administration of the tool

The tool was administered to mothers to assess the symptoms of ASD in children. The participants took around 10-15 minutes to respond to the scale.

Scoring of the scale

The scale is scored on a five-point Likert scale, 1= rarely (symptoms ranging up to 20%), 2= sometimes (21-40%), 3= frequently (41-60%), 4= mostly (61-80%) and 5= always (81-100%). The score ranged from 40-200 and participants scoring less than 70 indicated no symptoms of ASD, 70-106= mild autism, 107-153= moderate autism and scores above 153 represented severe autism.

Purpose of usage

The ISSA was filled by the mothers of children with ADHD to crosscheck the comorbidity of ASD.

4.6.6 Socio-economic Status Scale (Kumar et al., 2012)

Description of the tool

The modified Socioeconomic Status Scale by Kuppuswamy is used (Kumar et al., 2012). This scale is commonly used in Indian studies and has three domains namely, education, occupation, and income. The scale has been revised from time to time to match the income concerns of the current scenario. The scale covers three areas; the education qualification provides options for academic degrees from a) professional or honours, b) graduate/postgraduate, c) intermediate/ post-high school diploma, d) high school certificate, e) middle school certificate, f) primary school

certificate, and g) illiterate. The dimension of occupation covers different professional fields such as a) professional, b) semi-professional, c) clerical/ shop/ owner/ farmer, d) skilled worker, e) semi-skilled worker, f) unskilled worker, and g) unemployed. The dimension, family income per month in rupees (August 2016 current price index for industrial workers) includes the income range that is primarily applicable to Indian society: a) $\geq 42,876$ b) 21, 438-42, 875 c) 16,078-21,437 d) 10,719-16,077 and e) 6,431-10,718.

Administration of the tool

The scale is to be filled out by the participants by marking the options that best highlight their socioeconomic status. It takes about two minutes to fill up the scale.

Scoring

The domain of education qualification has seven options with different scoring: a) professional or honors=7, b) graduate/postgraduate= 6, c) intermediate/ post-high school diploma= 5, d) high school certificate= 4, e) middle school certificate= 3, f) primary school certificate= 2, and g) illiterate= 1. The occupation/ profession has seven options and scores as follows: a) professional= 10, b) semi-professional= 6, c) clerical/ shop/ owner/ farmer= 5, d) skilled worker= 4, e) semi-skilled worker= 3, f) unskilled worker= 2, and g) unemployed= 1. The last domain, family income has seven options and are scored as a) $\geq 42,876 = 12,$ b)21, 438-42, 875= 10, c) 16,078-21,437= 6, d) 10,719-16,077=4, and e) 6,431-10,718= 3, f) 2, 2165- 6,430= 2, g) < 2164= 1. The total score on the different domains of the scale categorizes the participants into a) upper class, b) upper middle class, c) lower middle class, d) upper lower class, and e) lower class.

Table 4. 2

Socioeconomic Status Scale Scoring Chart

Serial no.	Score	Socioeconomic status
1.	26-29	upper class
2.	16-25	upper middle class
3.	11-15	lower middle class
4.	5-10	upper lower class
5.	<5	lower class

Table 4. 2 exhibits in detail the distribution of socioeconomic status as per the scores in the Kuppuswamy socioeconomic scale. The participants scoring 26-29 fall under the upper class, 16-25= upper middle class, 11-15= lower middle class, 5-10= upper lower class, and <5= lower class.

Purpose of usage

The scale was used to understand the socioeconomic status of the participants and to monitor that the distribution of participants does not fall in the extreme socioeconomic status.

4.7 Psychometric Properties of Scales

The psychometric properties of the Short Sensory Profile and Child Behaviour Checklist are reported below.

Table 4. 3

Psychometric Properties of Short Sensory Profile (SSP) subscales

Scales	Minimum	Maximum	Mean	SD	Cronbach's alpha
TSSP	2.75	4.64	127.68	17.89	0.87

Tactile sensitivity	3.95	4.64	29.44	4.41	0.57
Taste and smell	3.38	3.97	14.44	3.91	0.75
Movement sensitivity	3.37	4.26	11.53	3.20	0.73
Underresponsiveness/ sensation seeking	2.80	3.80	23.36	5.58	0.72
Auditory filtering	2.75	3.31	9.26	3.06	0.68
Low energy	2.99	4.57	23.21	4.67	0.75
Visual and auditory sensitivity	1.44	1.91	16.44	3.61	0.65

*TSSP- total score of the short sensory profile

Table 4.3 shows the psychometric properties of each dimension of SSP. Cronbach alpha of tactile sensitivity is 0.57. To increase the reliability, one item was removed, however, the Cronbach alpha value remained the same. The mean and SD of the dimension are 29.44 and 19.04, respectively. The maximum mean is 4.64, whereas the minimum mean is 3.95. The dimension of taste and smell showed good reliability with the Cronbach alpha value of 0.75. Its mean and SD are 14.44 and 3.91, whereas the minimum and maximum mean values are 3.38 and 3.97, respectively. Movement sensitivity showed sound reliability (0.73) with mean and SD values of 11.53 and 3.20, respectively. Similarly, the dimension underresponsive/ sensation seeking indicated sound reliability with the Cronbach alpha value of 0.73. The mean and SD of the dimension are 23.36 and 5.58, respectively.

The initial reliability value of the dimension auditory filtering was 0.53. The dimension initially consisted of six items out of which three items were removed: a) distracted by loud sound b) can’t walk with background noises c) trouble completing tasks with the ratio on. With the changes implemented, the Cronbach alpha value increased to 0.68. The dimension of low energy indicated sound reliability with a

Cronbach alpha value of 0.75. The last dimension of the SSP, visual and auditory filtering initially showed low reliability with a Cronbach alpha value of 0.46. The dimension had five items out of which one item was removed: watches everyone's movement. With the changes, the Cronbach alpha value increased to 0.65.

Table 4.4

Psychometric Properties of Child Behaviour Checklist (CBCL) Subscales

Scales	Minimum	Maximum	Mean	SD	Cronbach's Alpha
Social problem	1.66	1.94	8.70	2.06	0.62
Internalizing	1.02	1.87	43.02	5.87	0.81
Externalizing	1.02	2.01	42.96	5.63	0.80
DSM Depression	1.03	1.33	10.75	1.87	0.60
DSM Anxiety	1.04	1.53	8.59	1.84	0.71

Table 4.4 shows the reliability, mean, SD minimum and maximum mean values of different dimensions of CBCL. The dimension social problem had 11 items and the Cronbach alpha value was 0.35. Six items were removed from the dimension and five items such as clinging to adults, loneliness, does not get along, being clumsy, and speech problems were included. The new Cronbach alpha value increased to 0.62. The mean and SD of the dimension are 8.70 and 2.06, respectively with a minimum mean value of 1.66 and a maximum mean value of 1.94. The internalizing comprises three other dimensions of CBCL, anxious depression, withdrawn depression and somatic complaints. The dimension showed sound reliability with the Cronbach alpha value of 0.81. The mean and SD of the dimension are 43.02 and 5.87, respectively. Externalizing consists of two dimensions from CBCL namely, rule-breaking

behaviour and aggressive behaviour. the reliability of the dimension was found to be good with Cronbach alpha value of 0.80 and mean and SD values of 42.96 and 5.63, respectively. DSM-oriented anxiety and depression were used to measure anxiety and depression in children with ASD, ADHD, and the typical population. DSM-oriented depression scale has thirteen items and a Cronbach alpha value of 0.53. Four items (sleeps more, harms oneself, underactive and cries a lot) were deleted after which the Cronbach alpha value increased to 0.60. The initial reliability of DSM oriented anxiety scale was 0.62 and by removing two items; clings to others and being self-conscious, the Cronbach alpha value raised to 0.71.

4.8 Procedure for Data Collection

Between August 2021 and May 2022, data were collected for the current study from West Bengal. For gathering information from mothers of children with ASD and ADHD, 35 government and non-government centres were contacted. To gather the information from mothers of children in the typical population, private schools for the typical population were contacted. 23 out of 35 centres approved the request for the collection of data. Before administering questionnaires, permission was obtained from the directors of the centres and informed consent was also obtained from the participants. For the normal population, information was gathered from mothers of children attending ordinary schools. The researcher built a rapport with the participants initially and guaranteed their confidentiality throughout the investigation. Along with the socio-demographic questionnaire, participants received a series of questionnaires that included SSP and CBCL forms. Data were gathered one-on-one with each participant for a minimum of 40-45 minutes.

4.9 Data Analysis

Data analyses were performed using the Statistical Package of Social Sciences (SPSS), version 23. Descriptive statistics such as percentage, mean, and SD were calculated. The percentage was calculated to highlight the distribution of socio-demographic data such as age, gender, and educational qualification. Mean distribution was plotted to understand the sensory processing patterns in children with ASD, ADHD, and the typical population.

Inferential statistics were also calculated such as correlation, regression analysis, t-test, ANOVA and MANOVA. Pearson correlation was computed to know the relationship between sensory processing and clinical (anxiety and depression) and non-clinical (social, emotional, and behavioural) aspects in children with ASD, ADHD, and the typical population. Linear regression was computed to identify the sensory patterns that predicted social, emotional, behavioural, anxiety and depression in three groups. t test was computed to know the gender difference in children with ASD, ADHD and the typical population and F-test was computed to examine the difference in sensory processing and psychological correlates for social problems, emotional, behavioural, anxiety and depression in children with ASD, ADHD, and the typical population. Further, MANOVA was computed to understand the differences in sensory processing and psychological correlates in younger and older children with ASD, ADHD, and the typical population.

CHAPTER V

RESULTS AND INTERPRETATION

This chapter focuses on the statistical analysis and interpretation of data collected from 362 mothers of children with ASD, ADHD and the typically developing children. Data were analyzed using the statistical package for social studies (SPSS) version 23. Descriptive statistics on the age of the participants, education qualification, profession, and socioeconomic status are represented through pie charts and descriptive tables. A separate mean distribution of sensory processing in children with ASD, ADHD and the typical population is shown through a graph. Pearson correlation was computed to understand the relationship between sensory processing and psychological correlates (clinical and non-clinical aspects) in children with ASD, ADHD, and the typical population. Regression analysis helped to identify the sensory features that predicted clinical (depression and anxiety) and non-clinical variables (social, emotional, and behavioural problems) in these populations. F test was computed to examine the differences in sensory processing and psychological correlates (clinical and non-clinical aspects) in children with ASD, ADHD, and the typical population. t test was computed to understand the gender difference in children with ASD, ADHD, and the typical population. Further, MANOVA was computed to examine the differences in sensory processing and psychological correlates in ASD, ADHD, and the typical populations across age groups. The statistical analysis of the data and its interpretation are provided in the following sections.

Section I: Descriptive Statistics

Descriptive statistics were computed to understand the nature of the socio-demographic variables understudy, namely the age group of the participants, education qualification, profession, and socio-economic status of the participants.

Section II: Mean Distribution of Sensory Processing

The first objective of the present study was to understand the patterns of sensory processing in children with ASD, ADHD, and the typical population. The mean distribution of sensory processing of each group; ASD, ADHD and the typical population is discussed in detail through graphs in section II of this chapter.

Section III: Correlation Analysis

The Pearson correlation coefficient was computed to understand the relationship between sensory features and psychological correlates. It helped in mapping the relationship between sensory processing patterns and social, emotional, and behavioural problems along with anxiety and depression in children with ASD, ADHD, and the typical population.

Section IV: Regression Analysis

The linear regression analysis was computed to identify the sensory features that significantly contributed to the social, social, emotional, and behavioural problems, anxiety, and depression in children with ASD, ADHD, and the typical population. The results from linear regression analysis are reported and discussed in section IV of this chapter.

Section V: F Test

F test was computed to understand the group difference in sensory processing and social, emotional, and behavioural aspects along with depression and anxiety in

three groups: ASD, ADHD, and the typical population. The results from F test are reported and disused in section V of this chapter.

Section VI: t test

t test was computed to understand the gender difference in the three groups. The test was conducted to understand if the males and females in ASD, ADHD, and the typical population differed in their experience of sensory processing and psychological correlates (non-clinical and clinical). t test and its interpretation for each group; ASD, ADHD and the typical population are discussed in section VI of this chapter.

Section VII: MANOVA

To understand the age group in sensory processing and psychological correlates in children with ASD, ADHD, and the typical population, multivariate analysis of variance (MANOVA) was computed. The analysis helped in understanding if sensory processing and the psychological correlates (non-clinical and clinical) differed across age groups (younger and older).

Section I: Descriptive Statistics

The following tables and figures deal with the socio-demographic variables of the participants. The frequency and percent of different demographic variables such as age and gender-wise sample distribution of children with ASD, ADHD and the typical population, age distribution of the participants (mothers of these children), and their education qualification, profession and socioeconomic status were computed and interpreted in detail in the present section.

5.1 Descriptive Statistics of Selected Socio-demographic Variables

5.1.1 Age and Gender wise Sample Distribution

The sample size of the present study was determined using the sample size calculation formula for the unknown population ($z^2xp(1-p)\div\varepsilon^2$, indicating a sample size of 383. A total of 463 questionnaires were filled out by the mothers of children with ASD, ADHD, and the typical population. Of 187 children with ASD, 64 were found to have symptoms of ADHD and were excluded from the ASD data.

Table 5.1

Age and Gender wise Sample Distribution of Children with ASD, ADHD, and the Typical Population (N=362)

Sample	**ASD**		**ADHD**		**Typical Population**	
	Male	Female	Male	Female	Male	Female
Younger	45	28	42	08	33	32
Older	41	09	33	17	39	35
Total	123		100		139	
Sub Total	362					

Among 137 children diagnosed with ADHD, 37 were found to have symptoms of ASD and were excluded. Mothers of 139 children from the typical group participated in the study. Therefore, a total of 362 mothers of children with ASD, ADHD and the typical population were included in the study which is near the estimated 382 sample size. Also, it must be observed that the present study includes the clinical population, and the data was collected during the period of COVID-19.

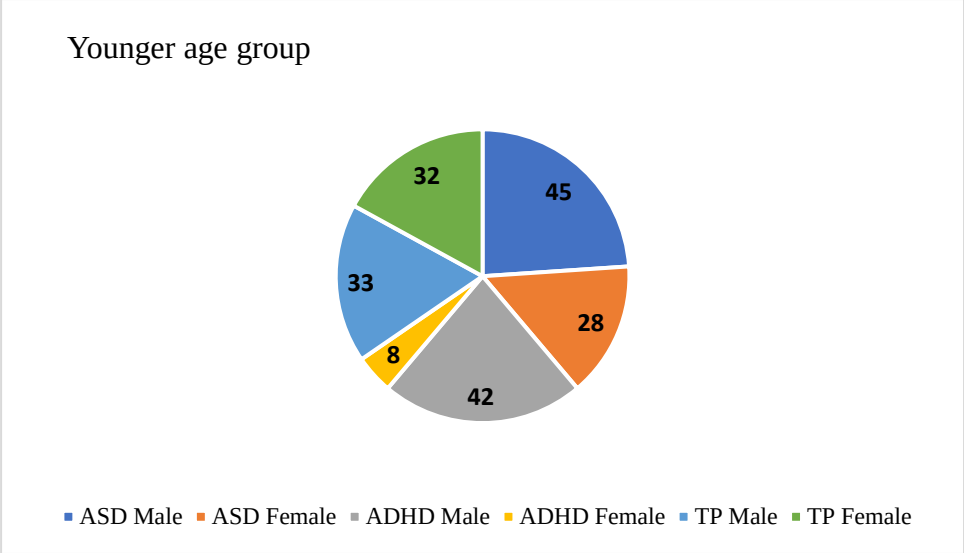


Figure 5.1: Male and Female in ASD, ADHD, and Typical Population in the Younger Age Group (N= 188)

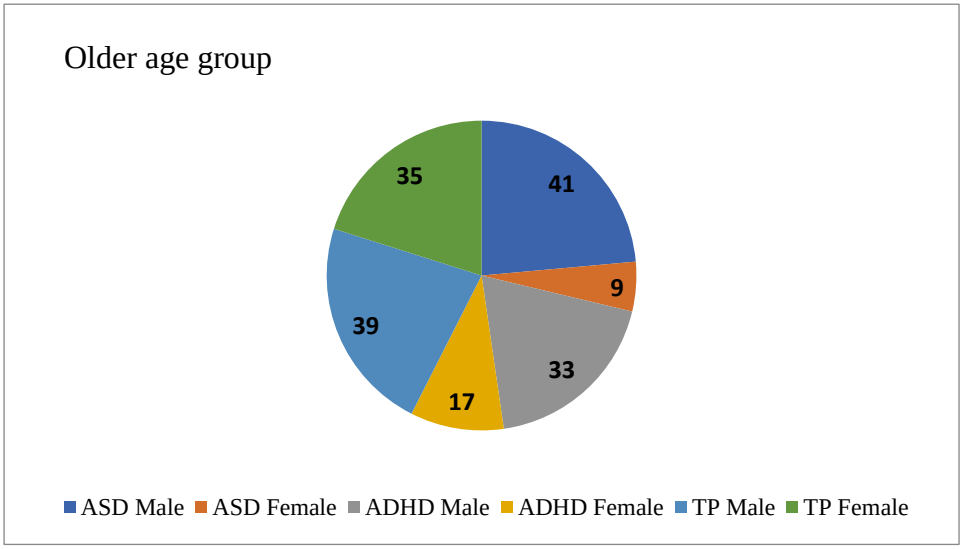


Figure 5.2: Male and Female in AS, ADHD and Typical Population in the Older Age Group (N=174)

Table 5.1 and Figures 5.1 and 5.2 showed the age-wise sample distribution of children with ASD, ADHD and typically developing children. The mothers of 123 children with ASD; 73 younger children (male=45, female=28) and 50 older children (male= 41, female= 09) participated in the present study. 100 mothers of children with ADHD; 50 in the younger age group (male=42, female=08) and 50 in the older age group (male=33, female=17) took part in the study. Mothers of 139 typically developing children, 65 children from the younger age group (male=33, female= 32)

and 74 mothers of older children (male=39, female=35) filled up the questionnaire. A total of 362 mothers of children with ASD, ADHD and the typically developing participated in the present study.

5.1.2 Age-wise Distribution of Participants

The participant's age is one of the crucial factors that help in understanding their perspective on any issue. In the present study, the age of the mothers was divided into the interval of five years forming six categories: 1) 25-30 years; 2) 30-35 years; 3) 35-40 years; 4) 40-45 years; 5) 45-50 years; and 6) 50-55 years (Table 5.2 & Fig 5.3).

Table 5.2

Age-wise Frequency and Percentage of Participants (N=362)

Age (in Years)	Frequency	Per cent	Mean	SD
25-30	29	8.0	3.84	1.11
30-35	123	34.0		
35-40	125	34.5		
40-45	57	15.7		
45-50	19	5.2		
50-55	9	2.5		

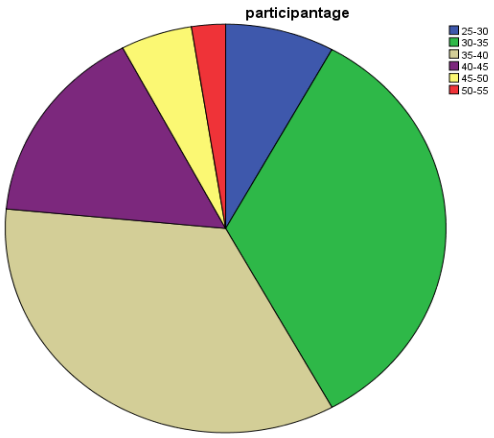


Figure 5.3: Age-wise Percentage of the Participants (N=362)

Table 5.2 and Fig 5.3 represent the age of the participants. The mean and SD of the participants' age groups were 3.84 and 1.11, respectively. Data showed that the majority of the participants belonged to the 35-40 age group (34.5 per cent) and 30-35 age group (34 per cent) followed by the 40-45 age group (15.7 per cent), 25-30 age group (8 per cent), 45-50 (5.2 per cent), and 50-55 age group (2.5 per cent).

5.1.3 Education-wise Distribution of Participants

Education plays an important role in the manner in which an individual perceives a given situation. The educational background of the participants may determine the way the mothers perceive the sensory issues and behavioural problems in their children. Therefore, it becomes important to understand the educational background of the respondents. In the following table and figure, the education level of the participants is reported.

Table 5.3

Frequency and Percentage of Education Qualification of the Participants (N=362)

Education	Frequency	Per cent	Mean	SD
PhD	4	1.1		
Postgraduate	67	18.5		
Graduate	115	31.8		
Higher Secondary	79	21.8	3.77	1.45
Secondary	53	14.6		
Middle school	22	6.1		
Primary school	19	5.2		
Illiterate	3	.8		

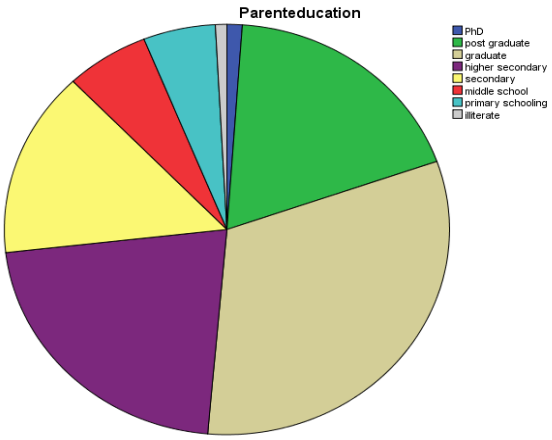


Figure 5.4: Percentage of Education Qualification of the Participants (N=362)

The educational level of the participants was grouped under seven heads. It is represented in descending order in Table 5.3 and Figure 5.4. The highest level of qualification is a PhD, and it steadily descends to illiteracy. Table 5.3 represented the mean and SD of educational qualifications of the primary caregivers as 3.77 and 1.45, respectively. It was found that the maximum number of participants in the study were graduates (Frequency=115, Percent= 31.8). 21.8 per cent (79) of the participants had completed High school, whereas 53 participants had (14.6 per cent) completed their secondary education. It is found that only 6.1 per cent (22) of the participants had middle school qualifications and 5.2 per cent (19) had attended primary schooling. However, 3 participants in the present study were illiterate (0.8 per cent). On the other hand, 67 (18.5 per cent) participants were postgraduates and 4 participants had doctorate degrees (1.1 per cent).

5.1.4 Occupation-wise Distribution of Participants

In the present study, the professional position of the participants was divided into 6 groups. The different sectors included were the government sector, private sector, business, homemaker, retired professional and student. The professional backgrounds of the mothers are represented in Table 5.4 and Figure 5.5.

Table 5.4

Frequency and Percentage of Occupation of the Participants (N=362)

Profession	Frequency	Per cent	Mean	SD
Government Sector	26	7.2	3.92	1.41
Private Sector	45	12.4		
Business	78	21.5		
Home Maker	210	58.0		
Retired	2	0.6		
Student	1	0.3		

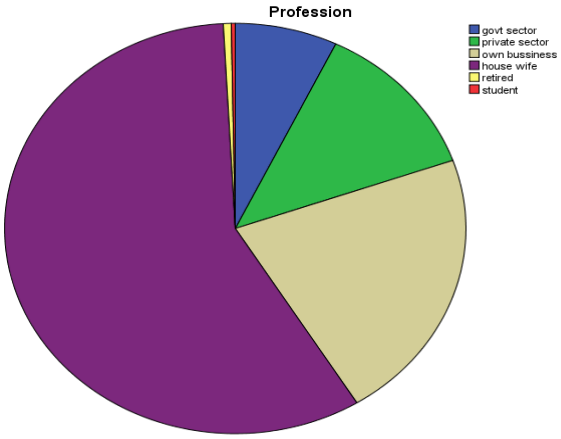


Figure 5.5: Percentage of Occupation of the Participants (N=362)

Table 5.4 and Figure 5.5 represent the mean and SD for the profession of mothers as 3.92 and 1.41, respectively. It was found that a maximum number of participants (210) were homemakers (58 per cent). Among the participants, 78 (21.4 per cent) ran their own enterprises. 7.2 per cent of the participants (26) were employed by the government, while 12.4 per cent of the participants (45) were employed by the private sector. While two participants (0.6 per cent) were retired government employees and one of the participants (0.3 per cent) was pursuing PhD.

5.1.5 Socio-economic Status (Kumar et al., 2012)

The Modified Socioeconomic Status Scale by Kuppuswamy (Kumar et al., 2012) was used in the present study to determine the socioeconomic status of the participants. This scale is commonly used in India and has three domains namely, education, occupation, and income. The socioeconomic details of the primary caregivers were retrieved and reported in Table 5.5 and Figure 5.6.

Table 5.5

Frequency and Percentage of Socioeconomic Status of the Participants (N=362)

Socio Economic Status	Frequency	Per cent	Mean	SD
Upper Class	20	5.5		
Upper Middle Class	151	41.7		
Lower Upper Class	147	40.6	2.60	.78
Upper Lower Class	43	11.9		
Lower Class	1	0.3		

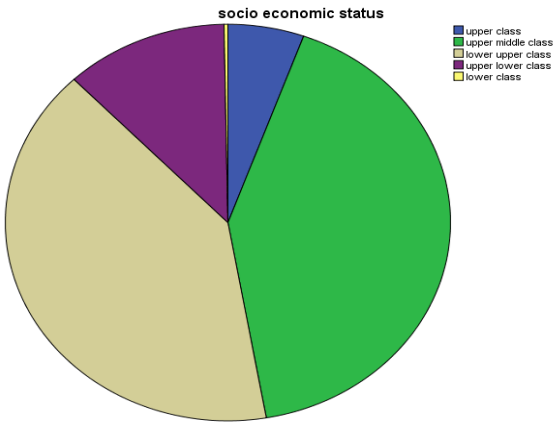


Figure 5.6: Percentage of Socioeconomic Status of the Participants (N=362)

Table 5.5 and Figure 5.6 represent the five categories of socio-economic status of the participants: upper class, upper middle class, lower upper class, upper lower class, and lower class. A maximum number of participants belonged to the upper middle class (41.7 per cent) and upper lower class (40.6 per cent), followed by upper lower class (11.9 per cent), upper class (5.5 per cent), and the lower class (0.3 per cent).

Section II: Mean Distribution of Sensory Processing

H1: Children with ASD and ADHD will show different patterns of sensory processing than the control group. The hypothesis one of the present study was fulfilled using a mean graph. The sensory processing patterns in children with ASD, ADHD and the typically developing children were plotted in the graph below. The mean score of different domains of sensory processing for the three groups is discussed in detail.

5.2 Mean Distribution of Sensory Processing in Children with ASD, ADHD and the Typical Population

The mean value was used to explain the sensory processing in children with ASD, ADHD, and the typical population. Figure 5.7 depicted the sensory processing patterns in children with ASD, ADHD, and the typical population using mean distribution.

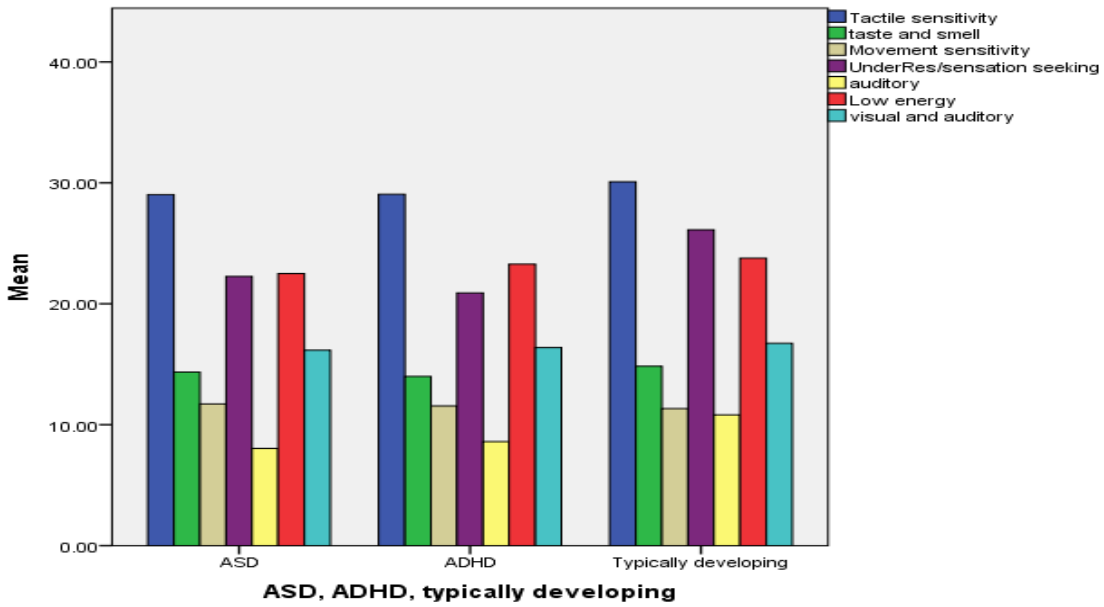


Figure 5.7: Mean Distribution of Sensory Processing in Children with ASD, ADHD, and the Typical Group (N=362)

Figure 5.7 represented that children with ASD experienced higher problems in the domain of auditory filtering (mean=8.04), followed by movement sensitivity (mean= 11.72) and taste and smell sensitivity (mean= 14.36). In the dimension of visual and auditory filtering, the mean score was 16.16, indicating higher deficits in visual and auditory functioning in children with ASD. Additionally, it was discovered that children with ASD performed better in the areas of tactile sensitivity (mean= 29.02), low energy (mean= 22.50), and sensation seeking (mean= 22.25).

In children with ADHD, higher sensory issues were found in the domain of auditory filtering (mean= 8.60), movement sensitivity (mean= 11.55), taste and smell (mean= 13.99) and visual and auditory filtering (mean= 16.38). Further, children with ADHD indicated better sensory functioning in the areas of tactile sensitivity (mean= 29.06), low energy (mean= 23.28) and sensation seeking (mean= 20.89).

Typically developing children showed sensory dysfunctions in the domains of auditory (mean= 10.81), movement sensitivity (mean= 11.34), taste and smell (mean= 14.84) and visual and auditory sensitivity (mean= 16.73). Better sensory functioning

was found in the dimensions of tactile sensitivity (mean= 30.09), sensation seeking (mean= 26.12) and low energy (mean= 23.78) in the typical group. Though all three groups were found to have sensory difficulties in the domains of auditory filtering movement sensitivity, taste and smell sensitivity and visual and auditory sensitivity, the clinical population (ASD and ADHD) were found to have higher problems compared to the typical population.

SECTION III: Correlation Analysis

H2: Sensory processing dysfunction will positively correlate with social, emotional and behavioural difficulties in children with ASD and ADHD.

H3: Sensory processing dysfunction will positively correlate with anxiety and depression in children with ASD and ADHD.

Hypotheses two and three of the present study focused on the relationship between sensory processing and psychological correlates (clinical and non-clinical aspects) in children with ASD, ADHD and typically developing groups. To verify the same, Pearson's correlation was computed for each group separately ASD (Table 5.6), ADHD (Table 5.7) and the typical Group (Table 5.8

5.3 Relationship between Sensory Processing and Psychological Correlates in Children with ASD

The link between various sensory processing facets and social, emotional, behavioural, depressive, and anxiety symptoms in children with ASD is covered in this section. The relationship between sensory processing and psychosocial correlates in children with ASD is displayed in Table 5.6. The Pearson correlation results showed that there is a substantial positive association between all the short sensory profile dimensions. It was found that tactile sensitivity strongly positively correlated with all the other SSP parameters. Tactile sensitivity positively correlated with taste

and smell sensitivity (0.23*), movement sensitivity (0.23**), under responsiveness/ sensation seeking (0.40**), auditory filtering (0.42**), low energy (0.30**) and visual and auditory sensitivity (0.22*) significant at 0.01 level and 0.05 levels.

The taste and smell sensitivity of SSP was found to have a strong positive correlation with the other dimensions of SSP, except for auditory filtering and low energy. It positively correlated with movement sensitivity (0.28**), underesposnive/ sensation seeking behaviour (0.25**), and visual and auditory sensitivity (0.27**) significant at 0.01 and 0.05 levels. In the same line, movement sensitivity positively correlated with all the dimensions namely, underresponsive/ sensation seeking (0.27**), low energy (0.27**) significant at 0.01 level, except for auditory filtering and visual and auditory sensitivity. As mentioned, underresponsive/ sensation seeking is found to have a positive correlation with tactile sensitivity, movement sensitivity, sensation seeking, along with auditory filtering (0.48**), low energy (0.29**), visual and auditory sensitivity (0.23*) significant at 0.01 and 0.05 levels.

Auditory filtering was found to have a positive correlation with tactile sensitivity and sensation seeking, along with low energy (0.24**) visual and auditory sensitivity (0.19*) significant at 0.01 and 0.05 levels. However, no significant relationship was found between auditory filtering and taste, smell, and movement sensitivity. Low energy positively correlated with the other dimensions of SPP significant at 0.01 and 0.05 levels, except for taste and smell sensitivity and visual and auditory sensitivity. Lastly, visual, and auditory sensitivity was found to have a positive correlation with the other dimensions significant at 0.01 and 0.05 levels, except for movement sensitivity and visual and auditory filtering.

Table 5.6

Relationship between Sensory Processing and Psychological Correlates in children with ASD (123)

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TS	29.02	3.84	1												
2. TnS	14.36	3.78	.23*	1											
3. MS	11.72	3.25	.23**	.28**	1										
4. UR/SS	22.25	5.18	.40**	.25**	.27**	1									
5. AF	8.04	2.61	.42**	.10	.15	.48**	1								
6. LE	22.50	5.30	.30**	.11	.27**	.29**	.24**	1							
7. VnAF	16.16	3.79	.22*	.27**	.11	.23*	.19*	.16	1						
8. TSSP	124.07	16.74	.66**	.52**	.53**	.73**	.57**	.63**	.51*	1					
9. SP	10.30	1.33	-.29**	.03	-.11	-.29**	-.36**	-.13	-.05	-.28**	1				
10. Int	41.25	3.46	-.14	-.06	.01	.08	-.15	-.13	-.09	-.11	.11	1			
11. Ext	45.22	5.36	-.33**	-.17	-.07	-.26**	-.30**	-.17	-.17	-.35**	.09	.26**	1		
12. DSMD	10.70	1.37	-.14	-.14	.01	.11	-.25**	-.11	-.04	-.11	.09	.42**	.10	1	
13. DSMA	8.25	1.29	-.09	-.13	-.06	.08	-.18	-.04	-.15	-.11	.04	.69**	.21*	.34**	1

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

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

TS- Tactile sensitivity, TnS- Taste and smell, MS- Movement sensitivity, UR/SS- Underresponsive/Sensationseeking, AF- Auditory filtering, LE-Low energy, VnAF- Visual and auditory filtering, TSSP- Total short sensory profile, Int- Internalizing, Ext- Externalizing, SP- Social problem, DSMD- depression, DSMA- Anxiety

The results further highlighted the relationship between different dimensions of sensory processing and social, emotional, and behavioural problems and anxiety and depression in children with ASD. A significant negative relationship was found between tactile sensitivity and social problems (-0.29**) and externalizing problems (-0.33**) significant at 0.01 level. Meaning, higher tactile sensitivity indicated higher social and behavioural problems in children with ASD. However, no significant relationship was found between tactile sensitivity and internalizing problems, depression, and anxiety. In the same line, the dimension of underresponsive/ sensation seeking significantly negatively correlated with social problems (-0.29**) and externalizing problems (-0.26**) sig at 0.01 level.

Higher sensory seeking behaviour led to higher social and behavioural problems in children with ASD. The dimension of auditory filtering significantly negatively correlated with social problems (-0.36**), externalizing (-0.30**) and depression (-0.25**), indicating that higher auditory sensitivity is related to higher social, and behavioural problems and depression. Further, the total scores of SSP significantly negatively correlated with social (-0.28**) and externalizing problems (-0.38**) in children with ASD sig at .01 level. However, the dimensions of taste and smell sensitivity, movement sensitivity, low energy and visual and auditory sensitivity did not correlate with social, behavioural, and emotional problems and depression and anxiety in children with ASD.

5.3.1 Relationship between Sensory Processing and Psychological Correlates in Children with ADHD

The association between various sensory processing facets and social, emotional, and behavioural issues, as well as depression and anxiety in children with ADHD, is covered in this section. Table 5.7 deals in detail with the relationship

among the dimensions of SSP and its relationship with the social, emotional, and behavioural problems and anxiety and depression in children with ADHD. The dimensions of SSP showed sound intra-correlation among the dimensions. Tactile sensitivity was found to have a strong positive correlation with all the other dimensions of SSP. Tactile sensitivity positively correlated with taste and smell sensitivity (0.37^{**}), movement sensitivity (0.23^{*}), under responsiveness/ sensation seeking (0.46^{**}), auditory filtering (0.24^{*}), low energy (0.31^{**}) and visual and auditory sensitivity (0.55^{**}) significant at 0.01 and 0.05 levels. The taste and smell sensitivity of SSP was found to have a strong positive correlation with the other dimensions of SSP. It positively correlated with movement sensitivity (0.23^{*}), underesponsive/ sensation seeking behaviour (0.26^{**}), auditory filtering (0.26^{**}), low energy (0.44^{**}) and visual and auditory sensitivity (0.31^{**}) significant at 0.01 and 0.05 levels. The dimension of movement sensitivity positively correlated with underresponsive/ sensation seeking (0.23^{*}), low energy (0.35^{**}) significant at 0.5 levels. However, no significant relationship was found between movement sensitivity and auditory filtering and visual and auditory sensitivity.

As mentioned, underresponsive/ sensation seeking positively correlated with tactile sensitivity, movement sensitivity, along with auditory filtering (0.37^{**}) and low energy (0.23^{*}) significant at 0.01 and 0.05 levels, except for visual and auditory sensitivity. A positive correlation was found between auditory filtering and tactile sensitivity, movement sensitivity, and sensation seeking, along with low energy (0.28^{**}) significant at 0.01 level. However, no significant relationship was found between auditory filtering, taste and smell sensitivity and visual and auditory sensitivity. The dimension low energy positively correlated with all the dimensions of SPP along with visual and auditory filtering (0.30^{*}) significant at 0.05 level. Finally, it

was found that tactile sensitivity, taste and smell sensitivity and low energy were positively correlated with visual and auditory sensitivity. However, there was no significant difference between movement sensitivity, underresponsive/sensory seeking, auditory filtering and visual or auditory sensitivity.

The results further highlighted the relationship between different dimensions of sensory processing and social, emotional, and behavioural problems and, anxiety and depression in children with ADHD. A significant relationship was found between tactile sensitivity and internalizing problems (-0.49^{**}), depression (-0.31^{**}) and anxiety (-0.28^{**}) significant at 0.01 level. Meaning, higher problems in tactile. Auditory filtering was found to have a positive correlation with tactile sensitivity and sensation seeking, along with low energy (0.24^{**}) visual and auditory sensitivity (0.19^{*}) significant at 0.01 and 0.05 levels. However, no significant relationship was found between auditory filtering and taste, smell, and movement sensitivity. Low energy positively correlated with the other dimensions of SPP significant at 0.01 and 0.05 levels, except for taste and smell sensitivity and visual and auditory sensitivity. Lastly, visual, and auditory sensitivity was found to have a positive correlation with the other dimensions significant at 0.01 and 0.05 levels, except for movement sensitivity and visual and auditory filtering. The results further highlighted the relationship between different dimensions of sensory processing and social, emotional, and behavioural problems and anxiety and depression in children with ASD. A significant negative relationship was found between tactile sensitivity and social problems (-0.29^{**}) and externalizing problems (-0.33^{**}) significant at 0.01 level. Meaning, higher tactile sensitivity indicated higher social and behavioural problems in children with ASD. However, no significant relationship was found between tactile sensitivity and internalizing problems, depression, and anxiety.

Table 5.7

Relationship between Sensory Processing and Psychological Correlates in children with ADHD (N=100)

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TS	29.06	4.69	1												
2. TnS	13.99	4.48	.37**	1											
3. MS	11.55	3.33	.23*	.23*	1										
4. UR/SS	20.89	4.70	.46**	.26**	.22*	1									
5. AF	8.60	3.07	.24*	.26*	.02	.37**	1								
6. LE	23.28	4.47	.31**	.44**	.35**	.23*	.28**	1							
7. VnAF	16.38	3.45	.55**	.31**	.16	.19	.15	.30*	1						
8. TSSP	123.75	17.81	.75**	.68**	.49**	.65**	.50**	.67**	.60**	1					
9. SP	9.03	1.84	-.17	.16	.25*	-.12	-.32**	.15	-.10	-.03	1				
10. Int	41.68	5.80	-.49**	-.42**	-.39**	-.16	-.04	-.51**	-.49**	-.58**	-.02	1			
11. Ext	46.38	5.85	-.17	-.18	-.10	-.33**	-.35**	-.33**	-.03	-.34**	.22*	.20*	1		
12. DSMD	10.60	1.80	-.31**	-.41**	-.14	-.28**	-.06	-.42**	-.36**	-.47**	-.12	.61**	.25*	1	
13. DSMA	8.44	1.78	-.28**	-.34**	-.32**	-.02	.10	-.37**	-.45**	-.39**	-.19	.74**	-.03	.41**	1

*.

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

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

TS- Tactile sensitivity, TnS- Taste and smell, MS- Movement sensitivity, UR/SS- Underresponsive/Sensation seeking, AF- Auditory filtering, LE-Low energy, VnAF- Visual and auditory filtering, TSSP- Total short sensory profile, Int- Internalizing, Ext- Externalizing, SP- Social problem, DSMD- depression, DSMA- Anxiety

In the same line, the dimension of underresponsive/ sensation seeking significantly negatively correlated with social problems (-0.29**) and externalizing problems (-0.26**) sig at 0.01 level.

Taste and smell sensitivity did not significantly correlate with social problems and externalizing problems. A significant negative correlation was found between the dimension of movement sensitivity and social problems (-0.25*), internalizing problems (-0.39**) and anxiety (-0.32**) significant at 0.01 and 0.5 levels. Meaning, higher movement sensitivity in children with ADHD indicated poor social skills and higher emotional problems and anxiety symptoms. The dimension, underresponsive/ sensation seeking significantly correlated with externalizing problems (-0.33**) and depression (-0.28**) significant at 0.01 level. However, no significant relationship was found between underresponsive/ sensation seeking and social problems, internalizing, and anxiety.

On the other hand, auditory filtering was found to have a significant relationship between social problems (-0.32) and externalizing behaviour (-0.35**) problems. The children with ADHD with high auditory issues demonstrated higher social and behavioural problems. The dimension of low energy significantly correlated with internalizing (-0.51**) and externalizing problems (-0.33**) and depression (-0.42**) and anxiety (-0.37**), and not with social problems. Children with high inertia indicated higher emotional and behavioural problems, along with higher depression and anxiety symptoms in children with ADHD. The last dimension of SSP, visual and auditory filtering, significantly correlated with internalizing problems (-0.49**), depression (-0.36**) and anxiety (-0.45**). The total scores of SSP significantly negatively correlated with emotional (-0.58**) and behavioural problems (-0.34**) and anxiety (-0.47**) and depression (-0.39**) in children with ADHD.

However, no significant relationship was found between visual and auditory filtering and social problems and externalizing behaviour.

5.3.2 Relationship between Sensory Processing and Psychological Correlates in Typically Developing Children

In the Table 5.8, the relationship between different dimensions of sensory processing and social, emotional, behavioural, depression and anxiety in typically developing children is discussed in detail. Tactile sensitivity was found to have a strong positive correlation with all the other dimensions of SSP. Tactile sensitivity significantly positively correlated with taste and smell sensitivity (0.39^{**}), movement sensitivity (0.36^{*}), under responsiveness/ sensation seeking (0.30^{**}), low energy (0.32^{**}) and visual and auditory sensitivity (0.55^{**}) at 0.01. However, no significant relationship was found between tactile sensitivity and auditory filtering.

The taste and smell sensitivity significantly positively correlated with tactile sensitivity (0.39^{**}), energy positively correlated with the other dimensions of SPP significant at 0.01 and 0.05 levels, except for taste and smell sensitivity and visual and auditory sensitivity. Lastly, visual, and auditory sensitivity was found to have a positive correlation with underresponsive/ sensation seeking (0.24^{**}), low energy (0.27^{**}), visual and auditory filtering (0.32^{**}) significant at 0.01. However, no significant relationship was found between movement sensitivity and auditory filtering. As mentioned, underresponsive/ sensation seeking positively correlated with tactile sensitivity, and movement sensitivity, along with auditory filtering (0.52^{**}), low energy (0.27^{**}) and visual and auditory sensitivity (0.29^{**}) significant at 0.01.

Table 5.8

Relationship between Sensory Processing and Psychological Correlates in Typically Developing Children (139)

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TS	30.09	4.62	1												
2. TnS	14.84	3.56	.39**	1											
3. MS	11.34	3.06	.36**	.25**	1										
4. UR/SS	26.13	5.37	.30**	.29**	.24**	1									
5. AF	10.81	2.76	.09	.27**	-.01	.52**	1								
6. LE	23.78	4.15	.32**	.35**	.27**	.27**	.33**	1							
7. VnAF	16.73	3.56	.55**	.32**	.32**	.29**	.05	.38**	1						
8. TSSP	133.70	17.32	.70**	.64**	.53**	.70**	.48**	.66**	.67**	1					
9. SP	7.05	1.40	-.08	-.21*	-.16	-.37**	-.33**	-.22*	-.08	-.33**	1				
10. Int	43.05	7.42	-.37**	-.19*	-.14	-.03	.07	-.33**	-.51**	-.34**	.23**	1			
11. Ext	41.38	4.95	-.13	-.12	.04	-.40**	-.35**	-.25**	-.32**	-.36**	.41**	.49**	1		
12. DSMD	10.90	2.27	-.35**	-.153	-.138	-.049	.053	-.31**	-.41**	-.31**	.19*	.88**	.45**	1	
13. DSMA	9.00	2.19	-.39**	-.192*	-.215*	-.103	.106	-.20*	-.51**	-.35**	.15	.86**	.42**	.76**	1

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

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

TS- Tactile sensitivity, TnS- Taste and smell, MS- Movement sensitivity, UR/SS- Underresponsive/Sensation seeking, AF- Auditory filtering, LE-Low energy, VnAF- Visual and auditory filtering, TSSP- Total short sensory profile, Int- Internalizing, Ext- Externalizing, SP- Social problem, DSMD- depression, DSMA- Anxiety

A positive correlation was found between auditory filtering, taste and smell sensitivity, and sensation seeking, along with low energy (0.33**) significant at0.01 level. Similarly, low energy positively correlated with all the dimensions of SPP along with visual and auditory filtering (0.38*) significant at 0.05 and 0.01 levels. In the end, visual and auditory sensitivity is found to have a positive correlation with tactile sensitivity, taste and smell, movement sensitivity, underresponsive/sensory seeking and low energy significant at 0.01 and 0.05 levels. However, no significant difference was found between visual and auditory sensitivity and auditory filtering.

The results further highlighted the relationship between different dimensions of sensory processing and social, emotional, and behavioural problems and, anxiety and depression in the typically developing children. A significant relationship was found between tactile sensitivity and internalizing problems (-0.37**), depression (-0.35**) and anxiety (-0.39**) significant at 0.01 level. Meaning, higher problems in tactile sensitivity indicated higher emotional problems and depression and anxiety in typically developing children. However, no significant relationship was found between tactile sensitivity and social problems and externalizing problems.

Along the same line, the dimension of taste and smell sensitivity significantly correlated with social problems (-0.21*), internalizing problems (-0.19**), and anxiety (-0.19*) significant at 0.01 and 0.5 levels. Taste and smell sensitivity did not significantly correlate with externalizing problems and depression. A significant negative correlation was found between the dimension of movement sensitivity and anxiety symptoms (-0.22*) alone, significant at 0.01 level. Meaning, children with higher movement sensitivity reported higher symptoms of anxiety in the typical population. However, no relationship was found between movement sensitivity and social problems, internalizing problems, behavioural problems, and depression. The

dimension, underresponsive/ sensation seeking significantly correlated with social problems (-0.37**), and externalizing problems (-0.40**) significant at 0.01 level. However, no significant relationship was found between underresponsive/ sensation seeking and emotional problems and anxiety and depression. Auditory filtering was found to have a significant relationship between social problems (-0.33**) and externalizing behaviour (-0.35**) problems significant at 0.01 level. The typically developing children with high auditory issues demonstrated higher social and behavioural problems. No relationship was found between auditory filtering and emotional problems, and anxiety and depression. The dimension of low energy significantly correlated with social problems (-0.22*), internalizing (-0.33**), externalizing problems (-0.25**), depression (-0.31**) and anxiety (-0.20*) significant at 0.01 and 0.5 levels. The last dimension of SSP, visual and auditory filtering, significantly correlated with internalizing problems (-0.51**), behavioural problems (-0.32**), depression (-0.41**) and anxiety (-0.51**) significant at 0.01 level. However, no significant difference was found between visual and auditory filtering and social problems in the typically developing children.

Section IV: Regression Analysis

Linear regression was computed to identify the sensory features that significantly predicted clinical (depression and anxiety) and non-clinical (social, emotional, and behavioural) problems in children with ASD, ADHD, and the typical population.

5.4 Linear Regression of SSP (tactile sensitivity, taste and smell sensitivity, movement sensitivity, sensation seeking, auditory filtering, low energy, visual and auditory sensitivity) on Dimension of CBCL on Children with ASD

Linear regression was computed to identify the sensory issues that predicted different clinical and non-clinical dimensions of CBCL in children with ASD, ADHD and the typical population. To identify the dimensions of SSP that best predicted the social, behavioural, and emotional problems and anxiety and depression in children with ASD, linear regression was computed and reported in the tables below.

Table 5.9 shows that tactile sensitivity, underresponsive /sensory seeking, auditory filtering, and the total score of SSP significantly predicted social problems in children with ASD. The variance explained by dimensions are 0.08 (tactile sensitivity), 0.08 (underresponsive/ sensation seeking), 0.13 (auditory filtering) and 0.08 (total of SSP). The externalizing behavioural problems were significantly predicted by tactile sensitivity and auditory filtering. The variance explained is 0.11 (tactile sensitivity) and 0.09 (auditory filtering). Auditory filtering alone significantly predicted depression with a degree of variance of 0.06. The results further highlighted that the sensory features did not significantly predict emotional problems and anxiety in children with ASD.

Table 5.9

Linear Regression of different dimensions of SSP (tactile sensitivity, taste and smell sensitivity, movement sensitivity, sensation seeking, auditory filtering, low energy, visual and auditory sensitivity) on clinical and non-clinical variables of CBCL in children with ASD (N=123)

	TS	**TnSS**	**MS**	**UR**	**AF**	**LE**	**VnAF**	**TSenPro**
Social problem								
R^2	.08	.00	.01	.08	.13	.02	.00	.08
B	-.10**	.01	-.05	-.08**	-.18***	-.03	-.02	-.02**
SE	.03	.03	.04	.02	.04	.02	.03	.01
Internalizing								
R^2	.02	.00	.00	.01	.02	.02	.01	.01
B	-.13	-.06	.01	.05	-.20	-.09	-.09	-.02
SE	.08	.08	.10	.06	.12	.60	.08	.02
Externalizing								
R^2	.11	.03	.01	.07	.09	.03	.03	.12
B	-.47***	-.24	-.11	-.27	-.62**	-.17	-.24	-.11
SE	.12	.13	.15	.09	.18	.09	.13	.03
DSM Depression								
R^2	.02	.02	.00	.01	.06	.01	.00	.01
B	-.05	-.05	.00	.03	-.13*	-.03	-.01	-.01

SE	.03	.03	.04	.02	.05	.02	.03	.01
DSM Anxiety								
R^2	.01	.02	.00	.01	.03	.00	.02	.01
B	-.03	-.04	-.02	.02	-.09	-.001	-.05	-.01
SE	.03	.03	.04	.02	.04	.02	.03	.01

TS= tactile sensitivity, TnSS= taste and smell sensitive, MS= movement sensitivity, US= underresponsive/sensation seeking, AF= auditory filtering, LE= low energy, VnAF= visual and auditory filtering, TSenPro= Total sensory processing
*p<.05, **p<.01, ***p<.001

5.4.1 Linear Regression of SSP (tactile sensitivity, taste and smell sensitivity, movement sensitivity, sensation seeking, auditory filtering, low energy, visual and auditory sensitivity) on Dimension of CBCL on Children with ADHD

To identify the dimensions of SSP that best predicted the social, behavioural, and emotional problems and anxiety and depression in children with ADHD, linear regression was computed and reported in the table below.

Table 5.10 explained the predicting variables of social, emotional, and behavioural problems, depression, and anxiety in children with ADHD. The results from the regression analysis highlighted that auditory filtering significantly predicted social problems with a degree of variance of 0.10. The different dimensions of SSP significantly predicted emotional problems in children with ADHD. Tactile sensitivity, taste and smell sensitivity, low energy, visual and auditory sensitivity and the total score of SSP significantly predicted the emotional problems in this population. The total variance explained by each dimension is 0.24 (tactile sensitivity), 0.17 (taste and smell sensitivity), 0.26 (low energy), 0.24 (visual and auditory sensitivity) and 0.33 (total score of SSP).

The behavioural problems in children with ADHD were significantly predicted by underresponsive/ sensation seeking, auditory filtering, low energy, and the total score of SSP. The total variance explained by each dimension is 0.11 (underresponsive/ sensation seeking, 0.13 (auditory filtering), 0.11 (low energy) and 0.12 (total score of SSP). All the dimensions of SSP significantly predicted depression symptoms in children with ADHD, except for movement sensitivity and auditory filtering.

Table 5.10

Linear Regression of different dimensions of SSP (tactile sensitivity, taste and smell sensitivity, movement sensitivity, sensation seeking, auditory filtering, low energy, visual and auditory sensitivity) on clinical and non-clinical variables of CBCL in children with ADHD (N=100)

	TS	**TnSS**	**MS**	**UR**	**AF**	**LE**	**VnAF**	**TSenPro**
Social problem								
R^2	.03	.02	.06	.01	.10	.01	.01	.00
B	-.07	.06	.14*	-.05	-.19***	.06	-.05	-.00
SE	.04	.04	.05	.04	.06	.04	.05	.01
Internalizing								
R^2	.24	.17	.15	.03	.00	.26	.24	.33
B	-.61***	-.54***	-.681	-.200	-.079	-.67***	-.83***	-.19***
SE	.11	.12	.16	.12	.19	.11	.15	.03
Externalizing								
R^2	.03	.03	.01	.11	.13	.11	.00	.12
B	-.21	-.23	-.17	-.41***	-.67***	-.43***	-.05	-.11
SE	.12	.13	.18	.12	.18	.13	.17	.03
DSM Depression								
R^2	.10	.17	.02	.08	.00	.17	.13	.22
B	-.12**	-.17***	-.078	-.1**	-.03	-.17***	-.19***	-.05***

SE	.04	.04	.05	.04	.06	.04	.05	.01
DSM Anxiety								
R^2	.08	.11	.10	.00	.01	.14	.20	.15
B	-.11	-.13***	-.17***	-.01	.06	-.15***	-.23***	-.04***
SE	.04	.04	.05	.04	.06	.04	.05	.01

TS= tactile sensitivity, TnSS= taste and smell sensitive, MS= movement sensitivity, US= underresponsive/sensation seeking, AF= auditory filtering, LE= low energy, VnAF= visual and auditory filtering, TSenPro= Total sensory processing
*p<.05, **p<.01, ***p<.001

The total degree of variance explained is 0.10 (tactile sensitivity), 0.17 (taste and smell sensitivity), 0.08 (underresponsive/ sensation seeking), 0.17 (low energy), 0.13 (visual and auditory sensitivity) and 0.22 (total score of SSP). The dimensions of taste and smell, movement sensitivity, low energy, visual and auditory sensitivity, and the total score of SSP significantly predicted anxiety in children with ADHD with a degree of variance as 0.11, 0.10, 0.14, 0.20 and 0.15, respectively.

5.4.2 Linear Regression of SSP (tactile sensitivity, taste and smell sensitivity, movement sensitivity, sensation seeking, auditory filtering, low energy, visual and auditory sensitivity) on Dimension of CBCL on Typically Developing Children

To identify the dimensions of SSP that best predicted the social, behavioural, and emotional problems and anxiety and depression in the typically developing children, multiple regression was computed and reported in the table below. Table 5.11 highlighted that the dimensions of taste and smell, underresponsive/sensation seeking, auditory filtering, low energy, and total score of SSP significantly predicted the social problems in typically developing children. The percentage of the variance of each dimension is 0.04, 0.14, 0.11, 0.05 and 0.11, respectively. Along the same line, the emotional problem was significantly predicted by tactile sensitivity, taste and smell sensitivity, low energy and visual and auditory sensitivity and total score of SSP. The percentage of variance explained by each dimension is 0.14 (tactile sensitivity), 0.04 (taste and smell sensitivity), 0.11 (low energy), 0.26 (visual and auditory sensitivity) and 0.12 (total score of SSP).

The dimensions of underresponsive/sensation seeking, auditory filtering, low energy, visual and auditory sensitivity, and total score of SSP significantly predicted the externalizing behavioural problems in typically developing children with the total

variance explained as 0.16, 0.12, 0.06, 0.10, and 0.13, respectively. The dimensions of tactile sensitivity, low energy, visual and auditory sensitivity, and the total score of SSP significantly predicted depression in this population with a percentage of th variance of 0.12, 0.10, 0.16 and 0.10, respectively. Along the same line, the dimensions of tactile sensitivity, taste and smell sensitivity, movement sensitivity, low energy, visual and auditory sensitivity, and the total score of SSP significantly predicted anxiety in typically developing children with the percentage of the variance explained as 0.15, 0.04, 0.05, 0.04, 0.26 and 0.12, respectively.

Table 5.11

Linear Regression of different dimensions of SSP (tactile sensitivity, taste and smell sensitivity, movement sensitivity, sensation seeking, auditory filtering, low energy, visual and auditory sensitivity) on clinical and non-clinical variables of CBCL in the typical population (N=139)

	TS	**TnSS**	**MS**	**UR**	**AF**	**LE**	**VnAF**	**TSenPro**
Social problem								
R^2	.01	.04	.03	.14	.11	.05	.01	.11
B	-.03	-.08*	-.07	-.10***	-.17***	-.07*	-.03	-.03***
SE	.03	.03	.04	.02	.04	.03	.03	.01
Internalizing								
R^2	.14	.04	.02	.00	.00	.11	.26	.12
B	-.59***	-.40*	-.34	-.04	.18	-.58***	-1.1***	-.15***
SE	.13	.18	.21	.12	.23	.14	.15	03
Externalizing								
R^2	.02	.01	.00	.16	.12	.06	.10	.13
B	-.14	-.17	.06	-.37***	-.62***	-.30**	-.44***	-1.25***
SE	.09	.12	.13	.07	.14	.10	.11	.28
DSM Depression								
R^2	.12	.02	.02	.00	.00	.10	.16	.10***
B	-.71***	-.24	-.19	-.12	.06	-.57***	-.64***	-2.39
SE	.16	.13	.11	.20	.10	.15	.12	.62

DSM Anxiety								
R^2	.15	.04	.05	.01	.01	.04	.26	.12
B	-.82***	-.31*	-.30*	-.25	.13	-.37*	-.82***	-2.75***
SE	.17	.14	.12	.21	.11	.16	.12	.63

TS= tactile sensitivity, TnSS= taste and smell sensitive, MS= movement sensitivity, US= underresponsive/sensation seeking, AF= auditory filtering, LE= low energy, VnAF= visual and auditory filtering, TSenPro= Total sensory processing.
*p<0.05, **p<0.01, ***p<0.001

Section V: F test

H4: Children with ASD and ADHD will score higher on the sensory processing difficulties scale than the control group.

H5: Children with ASD and ADHD will show higher impairment on social, emotional and behavioural scales than the control group.

H6: Children with ASD and ADHD will score higher on anxiety and depression than the control group.

F test was computed to understand if there was a significant group difference (ASD, ADHD and the typically developing children) regarding sensory issues and clinical and non-clinical variables.

5.5 Group Difference among ASD, ADHD and the Typically growing population in SSP

F test was used to identify the group difference in sensory processing among the three groups (ASD, ADHD, and the typical population). The following table and figure explained in detail the group differences among ASD, ADHD and typical populations across different dimensions sensory features and psychological correlates.

Table 5.12 and Figure 5.8 showed that all three groups (ASD, ADHD and typically) significantly differed in the domains of sensation seeking/ under responsiveness and auditory filtering significant at 0.001 level. It was found that the children with ASD (mean= 22.25) and ADHD (mean=20.89) reported greater unresponsiveness/ sensory seeking behaviour compared to the children in the typical population (mean= 26.12).

Table 5.12

Mean, Standard Deviation and F test of SSP (N=362)

	ASD		**ADHD**		**Typical population**		**F (2,359)**	***p***	**η^2**
	Mean	SD	Mean	SD	Mean	SD			
Tactile sensitivity	29.02	3.84	29.06	4.69	30.09	4.62	2.43	.09	.013
taste and smell	14.36	3.78	13.99	4.48	14.84	3.56	1.43	.20	.008
Movement sensitivity	11.72	3.25	11.55	3.33	11.34	3.06	.48	.62	.003
UnderRes/ sensation seeking	22.25	5.18	20.89	4.70	26.16	5.36	34.59 ASD, ADHD>TP	.000	.162
Auditory filtering	8.04	2.61	8.60	3.07	10.81	2.76	35.80 ASD, ADHD>TP	.000	.166
Low energy	22.50	5.30	23.28	4.47	23.78	4.15	2.46	.09	.014
visual and auditory	16.16	3.79	16.30	3.45	16.73	3.61	.81	.44	.005

sensitivity									
Total SSP	124.07	16.73	123.75	17.81	133.70	17.32	13.73 ASD, ADHD>TP	.000	.071
Social problems	10.30	1.33	9.03	1.84	7.05	1.40	153.92 ASD, ADHD>TP	.000	.462
Internalizing	41.25	3.46	41.68	5.80	43.02	7.44	3.35 TP>ASD	.04	.018
Externalizing	45.22	5.36	46.38	5.85	41.38	4.95	29.74 ADHD, ASD, >TP	.000	.142
DSM Depression	10.70	1.36	10.60	1.80	10.90	2.27	.81	.45	.004
DSM Anxiety	8.25	1.29	8.44	1.78	9.00	2.19	6.05 TP>ASD	.003	.033

*p<0.05,**p<0.01, ***p<0.001

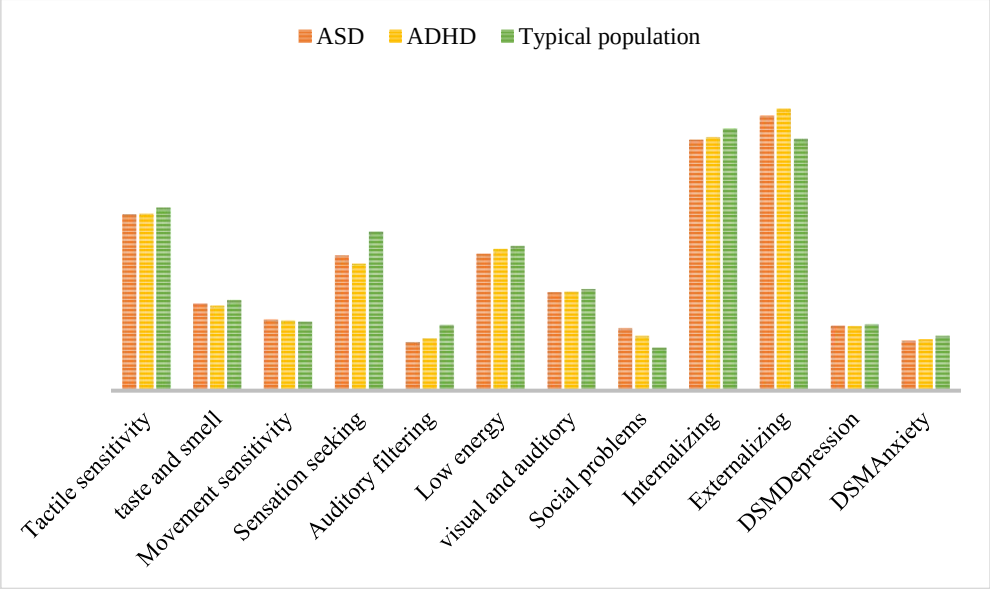


Figure 5.8: Mean distribution of Sensory Processing and Psychological Correlates in Three Groups (N=362)

In the same line, children within the clinical group significantly differed from the typical population in the dimension of auditory filtering significant at 0.05 level. From the mean scores, it was found that children with ADHD (mean=20.77) reported higher auditory issues followed by children with ASD (mean=21.20) and the typical group (mean=22.55). Further, the clinical population (ASD- mean= 138.73, ADHD- mean= 138.25) significantly differed from the control group (mean= 147.91) in the overall score of SSP significant at 0.01 level. On the other hand, no significant group difference was found in the dimensions of tactile sensitivity, taste and smell, movement sensitivity, low energy and visual and auditory filtering.

The children with ASD, ADHD and the typical population significantly differed in the domains of CBCL sig at 0.01 and 0.05 levels. The clinical population significantly differed from the typical population in the dimensions of social problems and externalizing problems. Children with ASD (mean= 18.14) and ADHD (mean= 17.67) reported higher social problems compared to children in the typical population (mean= 15.60). Similarly, ASD (mean= 45.22) and ADHD (mean= 46.38)

experienced greater externalizing behaviour problems compared to the typical population (mean= 41.38). Additionally, children with ASD significantly differed from children with the typical group in internalizing and anxiety significant at 0.05 level. Interestingly, children in the typical population (mean= 43.02) were found to have a greater problem with internalizing behaviour compared to children with ASD (mean= 41.25). In the same line, children in the typical population scored more in the dimension of anxiety (mean= 12.57) compared to the children with ASD (mean= 11.60).

Section IV: t test

H7: There will be significant gender differences in sensory processing patterns and their relationship with social, emotional, and behavioural problems and depression and anxiety in children with ASD, ADHD, and the control group.

t test was computed to understand the gender difference in three groups, including children with ASD, ADHD, and the typical population. The gender differences in sensory processing, social, emotional, and behavioural challenges, as well as anxiety and depression, are covered in detail in tables (17, 18 and 19) below.

5.6 Gender Difference in Sensory Processing and Psychological Correlates in Children with ASD

Table 5.13 represents the gender difference in sensory processing and psychological correlates in children with ASD.

Table 5.13

Gender Difference in Sensory Processing and Psychological Correlates in Children with ASD (N=123)

Variables	**Male**		**Female**		***t***	***p***	***df***	**CI**	***d***
	Mean	SD	Mean	SD					
Tactile sensitivity	29.02	3.91	29.03	3.74	-.01	.99	121	[-1.51, 1.50]	0.002
Taste and Smell	14.31	3.84	14.46	3.69	-.20	.85	121	[-1.62, 1.33]	0.04
Movement sensitivity	11.94	3.24	11.22	3.26	1.14	.25	121	[-.54, 1.99]	0.22
UnderRes/sensation seeking	22.98	5.39	20.57	4.27	2.41	.02	121	[4.30, 4.39]	0.50
Auditory filtering	8.37	2.67	7.27	2.34	2.19	.03	121	[.100, 2.10]	0.44
Low energy	23.26	4.81	20.76	5.99	2.45	.02	121	[.48, 4.52]	0.46
visual and auditory sensitivity	16.24	3.72	15.97	3.99	.36	.72	121	[-1.21, 1.75]	0.07
Total SSP	126.13	16.88	119.27	15.58	2.11	.04	121	[.43, 13.28]	0.42
Social problems	10.34	1.31	10.22	1.40	.46	.65	121	[-.40, .64]	0.09
Internalizing	41.28	3.60	41.19	3.17	.13	.90	121	[-1.26, 1.44]	0.03
Externalizing	45.65	5.78	44.22	4.09	1.37	.17	121	[-.64, 3.51]	0.29
DSM Depression	10.79	1.37	10.49	1.35	1.13	.26	121	[-.23, .84]	0.22
DSM Anxiety	8.24	1.27	8.27	1.35	-.10	.92	121	[-.53, .48]	0.02

*p<0.05,**p<0.01, ***p<0.001

The male and female significantly differed in the dimensions of underresponsiveness/ sensation seeking [t= 2.41 (121),p= 0.02], auditory filtering [t= 2.19 (121), p= 0.03], low energy [t= 2.45 (121), p= 0.02] and in the total scores Short Sensory Profile (SSP) [t= 2.11 (121), p= 0.04].The findings showed that in comparison to males with ASD, females with ASD demonstrated greater difficulties in the dimensions of sensation seeking (mean=20.57, SD=4.27), auditory filtering (mean=7.27, SD=2.34), and low energy (mean=20.76, SD=5.99). Additionally, compared to males (mean=126.13, SD=16.88), females with ASD scored lower (mean= 119.27, SD= 15.58), indicating greater issues in the overall SSP score. However, males and females with ASD did not significantly differ in psychological correlates (both clinical and non-clinical).

5.6.1 Gender Difference in Sensory Processing and Psychological Correlates in Children with ADHD

The following Table 5.14 represents the gender difference in sensory processing and social, behavioural, and emotional problems and anxiety and depression in children with ADHD.

The findings of the t test revealed a significant difference between males and females in movement sensitivity and low energy (t (98) = 2.40, p=0.02 and t (98) = 2.16, p=0.03, respectively). It was discovered that compared to males with ADHD (mean= 12.00, SD= 3.28; mean= 23.83, SD= 4.02, respectively), females with ADHD showed higher movement sensitivity (mean= 10.20, SD= 3.16) and inertia (mean= 21.64, SD= 5.36) scores. However, the males and females with ADHD did not differ in social, emotional, and behavioural problems and anxiety and depression.

Table 5.14

Gender Difference in Sensory Processing and Psychological Correlates in Children with ADHD (N=100)

Variables	**Male**		**Female**		***t***	***p***	***df***	**CI**	***d***
	Mean	SD	Mean	SD					
Tactile sensitivity	28.87	4.45	29.64	5.40	-.71	.48	98	[-2.93, 1.38]	0.16
taste and smell	13.99	4.28	14.00	5.15	-.01	.99	98	[-2.08, 2.05]	0.002
Movement sensitivity	12.00	3.28	10.20	3.16	2.40	.02	98	[.31, 3.29]	0.56
UnderRes/sensation seeking	20.52	4.53	22.00	5.11	-1.37	.17	98	[-3.62, .66]	0.31
Auditory filtering	8.67	3.07	8.40	3.12	.37	.71	98	[-1.15, 1.68]	0.09
Low energy	23.83	4.02	21.64	5.36	2.16	.03	98	[.18, 4.20]	0.46
visual and auditory sensitivity	16.33	3.48	16.52	3.44	-.23	.82	98	[-1.78, 1.40]	0.05
Total SSP	124.20	16.83	122.40	20.80	.44	.66	98	[-6.40, 9.99]	0.10
Social problems	9.20	1.87	8.52	1.69	1.61	.11	98	[-.16, 1.52]	0.38
Internalizing	41.47	5.32	42.32	7.13	-.55	.59	98	[-4.01, 2.31]	0.14
Externalizing	46.48	5.82	46.08	6.05	.30	.77	98	[-2.29, 3.09]	0.07
DSM Depression	10.65	1.89	10.44	1.56	.51	.61	98	[-.62, 1.04]	0.12
DSM Anxiety	8.23	1.57	9.08	2.22	-1.78	.08	98	[-1.83, .12]	0.44

*p<0.05,**p<0.01, ***p<0.001

5.6.2 Gender Difference in Sensory Processing and Psychological Correlates in Typically Developing Children

The results highlighted that males and females in the typically developing group significantly differed in the dimensions of movement sensitivity [t(137)= 2.11, p= 0.04] and behavioural problems [t(137)= 2.07, p= 0.04].

It was found that females (mean= 10.78, SD= 2.96) in the typically developing had higher problems in movement sensitivity compared to the males (mean= 11.86, SD= 3.08). Results further showed that the typical population significantly differed in behavioural problems across gender. The males (mean= 42.21, SD= 5.11) in the typical population reported higher behavioural issues compared to the females (mean= 40.49, SD= 4.65).

Table 5.15

Gender Difference in Sensory Processing and Psychological Correlates in Typically Developing Children (N= 139)

Variables	**Male**		**Female**		***t***	***p***	***df***	**CI**	***d***
	Mean	SD	Mean	SD					
Tactile sensitivity	30.50	4.82	29.64	4.40	1.09	.28	137	[-.69, 2.41]	0.19
taste and smell	15.36	3.75	14.28	3.28	1.80	.08	137	[-.11, 2.26]	0.31
Movement sensitivity	11.86	3.08	10.78	2.96	2.11	.04	137	[.069, 2.10]	0.36
UnderRes/sensation seeking	25.75	5.58	26.51	5.12	-.83	.41	137	[-2.56, 1.04]	0.14
Auditory filtering	10.76	2.67	10.87	2.87	-.22	.83	137	[-1.03, .83]	0.04
Low energy	24.42	3.26	23.09	4.87	1.87	.06	137	[-.08, 2.73]	0.32
visual and auditory sensitivity	16.99	3.46	16.45	3.67	.89	.38	137	[-.66, 1.73]	0.15
Total SSP	135.64	16.84	131.61	17.71	1.37	.17	137	[-1.77, 9.82]	0.23
Social problems	7.03	1.39	7.07	1.41	-.20	.84	137	[-.52, .42]	0.03
Internalizing	42.43	6.07	43.72	8.65	-1.01	.32	137	[-3.81, 1.24]	0.17
Externalizing	42.21	5.11	40.49	4.65	2.07	.04	137	[.07, 3.36]	0.35
DSM Depression	10.65	1.90	11.16	2.59	-1.32	.19	137	[-1.28, .26]	0.22
DSM Anxiety	8.69	2.01	9.33	2.33	-1.72	.09	137	[-1.36, .10]	0.29

*p<0.05,**p<0.01, ***p<0.001

Section VII: MANOVA

H8: There will be significant age group differences in sensory processing patterns and their relationship with social, emotional, and behavioural problems and depression and anxiety in children with ASD, ADHD, and the control group.

To check the age group difference in children with ASD, ADHD, and the typical population, MANOVA was computed. The findings of the same are represented in Table 20 and Figure 9.

5.7 Sensory Processing and Psychological Correlates in Younger and Older Children with ASD, ADHD, and the Typical Population

This section explains the difference in sensory processing and psychological correlates in younger and older children with ASD, ADHD, and the typical population. Table 5.16 and Figure 5.9 highlighted that the older children with ADHD (mean= 10.60, SD= 3.31) scored low indicating higher problems in the dimension of movement sensitivity significant at .01 level. The older children with ADHD were followed by the older children with ASD (mean= 11.00, SD= 3.25).

The older children with ASD and ADHD were more sensitive to movement, for example, anxious when their feet left the ground and experienced fear of heights compared to the children in the other groups. The results further highlighted that children with ADHD (younger, mean= 21.04, SD= 5.17; older, mean= 20.74, SD= 4.23) showed higher problems in the dimension of sensory seeking/underresponsiveness, followed by children with ASD (younger, mean= 22.30, SD= 4.69; older, mean= 22.18, SD= 5.88).

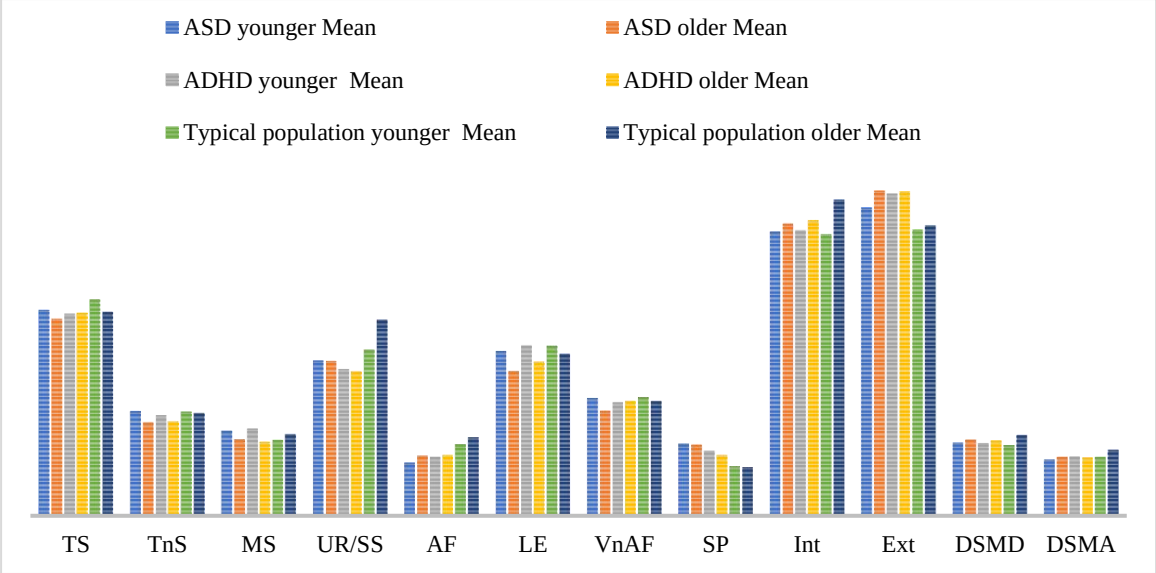
Table 5.16

Group Differences in Sensory Processing and Psychological Correlates in Younger and Older Children With ASD, ADHD, and the Typical Population (N= 362)

	ASD				**ADHD**				**Typical Population**				**Population*Age**		
	Younger		Older		Younger		Older		Younger		Older		F (2,359)	*p*	η^2
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD			
TS	29.55	3.18	28.26	4.58	28.98	4.03	29.14	5.31	31.05	3.73	29.24	5.17	1.52	.22	.01
TnS	15.01	3.57	13.40	3.91	14.42	4.41	13.56	4.56	14.92	3.80	14.77	3.36	1.13	.33	.01
MS	12.22	3.17	11.00	3.25	12.50	3.10	10.60	3.31	10.89	3.22	11.73	2.88	6.33	.002	.03
UR/SS	22.30	4.69	22.18	5.88	21.04	5.17	20.74	4.23	23.83	5.22	28.12	4.65	8.68	.000	.05

AF	7.64	2.54	8.62	2.64	8.46	3.07	8.74	3.10	10.29	2.42	11.27	2.96	.57	.57	.00
LE	23.68	5.12	20.78	5.12	24.46	3.85	22.10	4.76	24.42	3.94	23.23	4.28	1.19	.31	.01
VnAF	16.92	3.76	15.06	3.59	16.28	3.24	16.48	3.69	17.06	3.22	16.43	3.83	2.31	.10	.01
TSSP	127.33	14.03	119.30	19.21	126.14	17.41	121.36	18.06	132.46	15.67	134.78	18.69	3.09	.04	.02
SP	10.38	1.13	10.18	1.59	9.32	1.81	8.74	1.85	7.12	1.13	6.99	1.60	.69	.50	.00
Int	40.79	3.14	41.92	3.82	40.94	4.88	42.42	6.55	40.45	5.99	45.34	7.84	4.30	.01	.02
Ext	44.25	4.62	46.64	6.05	46.22	5.09	46.54	6.57	41.09	4.20	41.64	5.55	1.33	.27	.01
DSMD	10.53	1.44	10.94	1.22	10.42	1.55	10.78	2.02	10.14	1.78	11.57	2.44	3.49	.03	.02
DSMA	8.11	1.26	8.46	1.31	8.52	1.74	8.36	1.84	8.46	1.98	9.47	2.26	3.20	.04	.02

TS= tactile sensitivity, TnSS= taste and smell sensitive, MS= movement sensitivity, US= underresponsive/sensation seeking, AF= auditory filtering, LE= low energy, VnAF= visual and auditory filtering, TSenPro= Total sensory processing
*p<0.05, **p<0.01, ***p<0.001



TS= tactile sensitivity, TnSS= taste and smell sensitive, MS= movement sensitivity, US= underresponsive/sensation seeking, AF= auditory filtering, LE= low energy, VnAF= visual and auditory filtering, TSenPro= Total sensory processing

Figure 5.9: Group Difference in Sensory Processing and Psychological Correlates Across Age Groups (N=362)

It was found that older children with ASD (mean= 119.30, SD= 19.21) and ADHD (mean= 121.36, SD= 18.06) scored less, indicating higher sensory issues in the overall scale of SSP compared to the younger children with ASD (mean= 127.33, SD= 14.03) and ADHD (mean= 126.14, SD= 17.41) and the typically developing population (younger, mean= 132.46, SD= 15.67; older, mean= 134.78, SD= 18.69). However, no significant difference was found in the dimensions of tactile sensitivity, taste and smell sensitivity, auditory filtering, low energy, and visual and auditory sensitivity.

Unexpectedly, in the dimension of internalizing problems of CBCL, the older children in the typical population showed higher problems (mean= 45.34, SD= 7.84). They were followed by the older children with ADHD (mean= 42.42, SD= 6.55) and ASD (mean= 41.92, SD= 3.82). Meaning, the older children with ASD, ADHD, and the typically developing population reported higher emotional problems compared to the younger children with ADHD (mean= 40.94, SD= 4.88), ASD (mean= 40.79, SD=

3.14), and the typically developing population (mean= 40.45, SD= 5.99). The results further highlighted a significant difference in the dimension of DSM depression on the CBCL scale. When compared to younger children with ASD (mean= 10.53, SD= 1.44), ADHD (mean= 10.42, SD= 1.55), and typically developing children (mean= 10.14, SD= 1.78), older children in the typical population (mean=11.57, SD= 2.44) reported higher problems with depression. These older children were followed by older children with ASD (mean= 10.94, SD= 1.22) and ADHD (mean= 10.78, SD= 2.02). Similarly, the older children in the typical population scored higher in the dimension DSM anxiety (mean=9.47, SD= 2.26) followed by younger children with ADHD (mean= 8.52, SD= 1.74) and older children with ASD (mean= 8.46, SD= 1.31). However, no significant difference was found in the dimensions of social problems and behavioural problems.

CHAPTER VI

DISCUSSION

The present chapter covers a detailed discussion of the results reported in the last chapter. The chapter is divided into seven sections. Each section covers the objectives of the present study. Hypothesis one aimed to understand the patterns of sensory processing in children with ASD, ADHD and typically developing children. The results of the mean distribution that represents the patterns of sensory processing will be discussed in section 6.1 of this chapter. The second and third hypothesis of the present study was to understand the relationship between sensory processing and psychological correlates in children with ASD, ADHD and the typically developing population. The results from Pearson correlation and linear regression results will be discussed in section 6.1.1 of this chapter. The fourth, fifth and sixth hypotheses aimed to compare sensory processing and psychological correlates in children with ASD, ADHD, and the typical population. The results from the F test will be discussed in section 6.1.2 of this chapter. The study further aimed to understand the differences in sensory processing and psychological correlates in children with ASD, ADHD and the typically developing children in different age groups and gender which covers hypotheses seven and eight. The results t test and MANOVA will be discussed in section 6.1.3 of this chapter.

6.1 Sensory Processing Patterns in Children with ASD, ADHD, and the Typical Population

H1: Children with ASD and ADHD will show different patterns of sensory processing than the control group.

Results from the mean highlighted that children with ASD and ADHD have higher sensory processing difficulties in the dimensions of auditory filtering, movement sensitivity, taste and smell sensitivity and visual and auditory sensitivity than the typical population. Therefore, the hypothesis is accepted. Sensory processing abnormalities are frequently found in children with ASD with an estimated prevalence of 42-88% (Baranek, 1999; Dawson & Watling, 2000). Sensory abnormalities are frequently reported in overresponsivity in tactile and auditory hypersensitivity in ASD (Tomchek & Dunn, 2007). The abnormalities in tactile and auditory may cause excessive symptoms of anxiety, the atypical pattern of behaviour, social withdrawal, and abnormal focus in children with ASD and ADHD (Cheung & Siu, 2009). The strong association between sensory processing and psychological correlates has been established in the present study as well.

Studies have further highlighted that children with ASD are hypersensitive to olfactory input which is in line with the findings of the present study (Fernandez-Prieto et al., 2021; Leekam, 2006). Children with ASD are often picky eaters and are particular to certain smells and food textures. This population further reported challenges in oral sensitivity such as smelling or licking uneatable objects (Stehli, 1991). Other studies have found similar findings which reported that children with ASD are often particular about the taste, smell, and texture of the food, which is linked to their hyperresponsiveness to olfactory (Leekam, 2006; Rogers et al., 2003). Studies have found that children with ASD showed higher sensory difficulties in the dimension of auditory and olfactory (taste and smell) compared to typically developing children (Fernandez-Prieto et al., 2021; Green et al., 2015; Sanz-Cervera et al., 2015). Further, both hypo and hyperreactivity in auditory filtering have been reported in children with ASD (Green et al., 2015; Tomchek & Dunn, 2007; Woodard

et al., 2012). The caretakers of children with ASD have reported that children fail to respond when called by their name, however, they may be particularly active to the sound of birds chirping or are sensitive to buzzing horns. Parents have also reported that their children are often particular to the taste depending on the smell and texture of the food.

Studies have reported that children with ADHD have more sensory difficulties compared to children without ADHD (Engel-Yeger & Ziv-On, 2011; McIntosh et al., 1999). ADHD population are found to have higher difficulties in sensory modulation compared to children without ADHD in both parent reports and physiological measures (Mangeot et al., 2001). Studies have reported that children with ADHD have greater impairment in the visual, auditory, and tactile domains (Green et al., 2015; Leekam et al., 2006; Cheung& Siu, 2009) which is in line with the findings of the present study. In the study conducted by Dunn and Bennett (2002), it was reported that children with ADHD significantly differed in the dimensions of sensory processing, particularly in the domains of multisensory, tactile, and auditory from the control group.

Some studies reported that children with ADHD significantly differed from the control group in the dimension of olfactory, whereas other studies reported that ADHD showed higher sensory difficulty in the domains of auditory, visual, touch and olfactory (Parush et al., 1997; Mangeot et al., 2001; Yochman et al., 2004). Due to the sensory processing abnormality, children with ADHD have difficulty producing appropriate behavioural responses at home, school, and in the community (Cheung & Siu, 2009; Dunn & Bennett, 2002). Their sensitivity to environmental stimuli may hamper their ability to focus on the given task affecting their performance.

Self-reported individuals with ADHD described hypo and hypersensitivity to sensory processing particularly in low registration, sensory sensitivity, and sensory seeking (Bijlenga et al., 2017; Kamath et al., 2020). Children with low registration to sensory stimuli may tend to miss the sensory inputs in the environment. On the other hand, children with sensory sensitivity are able to attend to the subtlest sensory input or respond quickly. However, this may also mean that children with sensory sensitivity are easily distracted or have difficulty paying attention for a period of time. Individuals who show more sensory seeking behaviour look for opportunities to increase their sensory experience. However, they tend to get easily bored with the low stimulus experience and look for more intense sensory stimuli which instead may lead to distracting themselves and/ or others (Kamath et al., 2020).

6.1.1 Relationship between Sensory Processing and Psychological Correlates in Children with ASD, ADHD, and the Typical Population

H2: Sensory processing dysfunction will positively correlate with social, emotional, and behavioural difficulties in children with ASD and ADHD.

H3: Sensory processing dysfunction will positively correlate with anxiety and depression in children with ASD and ADHD.

This section explains the relationship between sensory processing and psychological correlates in children with ASD, ADHD, and the typical population. Therefore, the hypotheses are accepted. The results from the Pearson correlation highlighted that tactile sensitivity, underresponsive/ sensation seeking, and auditory filtering significantly correlated with social and behavioural problems in children with ASD. The results further highlighted that tactile sensitivity, auditory filtering and underresponsive/ sensation seeking significantly predicted social problems, whereas

tactile sensitivity and auditory filtering significantly predicted behavioural problems in this population.

The results of the present study fall in line with the previous studies. The researchers found that tactile sensitivity, auditory filtering and olfactory significantly correlated and predicted social problems in children with ASD (Cheung & Siu, 2009; Hilton et al., 2010; Matsushima & Kato, 2013). Social deficits in children with ASD are identified at an early age in the form of avoiding eye contact and difficulty or delay in verbal and non-verbal communication (Barker et al., 2008; Kojovic et al., 2019). Researchers have further proposed that sensory features and social functions may be interdependent or bidirectional. Meaning, a child who is hypersensitive to sensory stimuli may avoid social environments that are overstimulating which leads to low participation in the social environment ultimately affecting the overall social interaction pattern (Thye et al., 2018). In the study conducted by Fernandez-Prieto et al. (2021), it was found that children with ASD reported greater dysfunction in all the domains of sensory processing at home and in the classroom. Further, a significant association was reported between sensory dysfunction and social problems. The findings are in line with the present study. The social deficit is one of the prominent characteristics of ASD. Additionally, these children are found to dislike grooming, are sensitive to certain sounds, and are often particular to certain tastes. These sensory atypicalities not only affect the social network of the children with ASD but also their parents. The families of these children often avoid social gatherings because of their child's sensitivity to sensory stimuli.

Tactile sensitivity, underresponsive/ sensation seeking and auditory filtering significantly correlated with behavioural problems in the ASD population. It has been indicated that such behaviours are attempted to achieve a homeostasis state and to

modulate sensory systems. Studies from the past have highlighted that tactile hyperresponsiveness is related to stereotypical behavioural patterns in children with ASD, including inflexible and repetitive behaviours. (Baranek et al., 1997; Baker et al., 2008; Liss et al., 2008). Lane et al. (2010) found a strong association between taste, smell sensitivity, auditory filtering, movement sensitivity, and maladaptive behaviour in children with ASD. Along the same line, studies have found that behavioural and emotional problems are significantly correlated with underresponsive/ sensation seeking, auditory filtering and low energy (Barker et al., 2008; Boyd et al., 2009; Chen et al., 2009; Fernandez-Prieto et al., 2021). Further, the atypical behavioural patterns have been linked with behavioural disorders like isolation, self-aggression, irritability, an atypical response to change, disinterest and indifference (Gonthier et al., 2016).

The results further highlighted that auditory filtering significantly correlated with and predicted depression in children with ASD. A recent study conducted by Rossow et al. (2022) aimed to understand the association between sensory hyperreactivity and mental health in preschool children with ASD. The results from the study highlighted that tactile, visual, and auditory significantly correlated with mental health in this population. Researchers have found that hyposensitivity/ hyporesponsiveness and hypersensitivity to sensory stimuli may significantly contribute to depression in children with ASD (Ben-Sasson et al., 2009; Serafini et al., 2016; Bitsika et al., 2016; Pfeiffer et al., 2005). Researchers have found greater activation in primary sensory areas of the brain such as the amygdala, hippocampus, and orbitofrontal cortex to positively correlate with the parent-reported sensory overresponsiveness in the ASD group. Such correlation hints at the possible link between sensory processing abnormalities and the regulation of emotions like

depression and anxiety (Green et al., 2012). Due to auditory sensitivity and susceptibility to sensory seeking behaviour, children with ASD exhibit behavioural and emotional problems such as hand flapping, excessive screaming, extreme mood swings and constant hyperreactivity.

The results from the present study reported a significant relationship between sensory processing and psychological correlates in children with ADHD. Auditory filtering and movement sensitivity significantly correlated with and also predicted social problems in children with ADHD. Further, it was found that tactile sensitivity, taste and smell sensitivity, movement sensitivity, low energy and visual and auditory sensitivity significantly correlated with emotional problems in this population. On the other hand, auditory filtering, underresponsive/ sensation seeking and low energy significantly correlated with and predicted behavioural problems in children with ADHD.

The findings add to the present body of literature. In recent years, studies have found that the core symptoms of ADHD affect the social and communicational function of individuals with ADHD (Carpenter Rich et al., 2009; Chen et al., 2020; Huang et al., 2018). Cantwell (1996) has described the social impairment in the ADHD population as a 'lack of savoire faire', meaning, the inability to interact appropriately in social situations. Studies have reported that social impairment in children with ADHD is identified at an early age and continues to exist through adolescents (Bagwell et al., 2001; Kofler et al., 2015) and adulthood (Friedman et al., 2003). The inability to appropriate social response may affect 20% of ADHD children and adolescents (Carpenter Rich et al., 2009). Studies have reported that children with ADHD are rejected or disliked by their peer groups within the first few minutes of interaction (Pelham & Bender, 1982). Further, the social impairment in ADHD is

often manifested as low performance at school (Hoza et al., 2005). A recent study aimed to explore the social skill acquisition deficit, performance deficit and strength in children with and without ADHD. Interestingly, the results highlighted that children with ADHD acquired age-specific social skills, however, failed to be consistent in performing those skills at home and in school settings (Aduen et al., 2018).

Psychologists have stated that the relationship between sensory and social functioning may take place at many hierarchical levels. The basic level is the sensory receptors that receive information from the environment which is then formed into subjective neural representation as perception. The dysfunctional sensation leads to the lack or disoriented perception, while without perception the activation of sensation is meaningless. Though sensation and perception are interrelated, the confounding variable of the two is attention (Thye et al., 2018). For example, the individual may sense and perceive the stimulus right but fails to pay the required attention to it. Therefore, the altered sensation, perception, and attention to different sensory features such as tactile and auditory stimuli, in the case of the present study may lead to social dysfunction in children with ASD and ADHD.

Their inability to stay focused on a task, explosive behaviour, lack of self-control, and disruptive behaviour, pushes them away from their age-grouped peers. Specifically, 50-60 % of children with ADHD are rejected by their peer groups (Barkley et al., 1991). The failure of being accepted manifests in them other behavioural problems. Children with ADHD gradually turn into a bully, among other children, are prone to rule-breaking, are inflexible, controlling, explosive, argumentative, easily irritated, and frustrated (Pelham et al., 1990). Studies from the past have highlighted that children with ADHD have difficulty with emotion

regulation, social reciprocity and compliance with social norms compared to their peer groups (Aduen et al., 2018; Bunford et al., 2015; Graziano & Garcia, 2016). Emotional dysregulation has been reported in 70 % of children with ADHD and its prevalence is higher in ADHD compared to the typical population (Beheshti et al., 2020; Skirrow & Asherson, 2013). The symptoms of altered emotional regulation have a negative psychological and unfavourable psychosocial impact on children with ADHD (Hirsch et al., 2019). The symptoms of ADHD such as hyperactive behaviour, impatience during play, and difficulty paying attention, may affect their social interaction with peer groups which directly or indirectly hampers their emotional wellbeing.

Further, tactile sensitivity, taste and smell sensitivity, underresponsive/ sensation seeking, low energy and visual and auditory filtering significantly correlated with and predicted depression in this population. Similarly, tactile sensitivity, taste and smell sensitivity, movement sensitivity, low energy and visual and auditory filtering significantly correlated with and predicted anxiety in children with ADHD. 9-38% of the ADHD population are found to have symptoms of depression. The lack of social achievement, academic failure and lack of self-control may significantly contribute to depressive symptoms in this population. Studies have highlighted that there is a positive correlation between sensory overresponsivity and anxiety symptoms in children with ADHD (Critz et al., 2015; Reynolds & Lane, 2009). Additionally, ADHD symptomology may significantly contribute to anxiety in this population.

Further, Lane et al. (2012) found a significant association between sensory seeking and anxiety in children with ASD and ADHD. Studies have reported that 25 % of the ADHD population suffers from anxiety (Eberhart & Hammen, 2006;

Reynolds & Lane, 2009). Reynolds and Lane (2009) conducted a comparative study on twenty-four children with ADHD and 24 typically developing children aged between 6-10 years old. The study aimed to understand the role of overresponsivity in the experience of anxiety in children with ADHD. The results highlighted more anxiety in children with ADHD (with overresponsivity) compared to those without ADHD and overresponsivity. There is a need to conduct scientific research on the ADHD population, identifying the patterns of sensory processing and its association with various psychological correlates such as social, behavioural, emotional, stress, anxiety, depression, and others.

6.1.2 Differences in Sensory Processing and Psychological Correlates in Children with ASD, ADHD, and the Typical Population

H4: Children with ASD and ADHD will score higher on the sensory processing difficulties scale than the control group.

H5: Children with ASD and ADHD will show higher impairment on social, emotional and behavioural scales than the control group.

H6: Children with ASD and ADHD will score higher on anxiety and depression than the control group.

Results from F test highlighted that the three groups significantly differed in sensory processing and psychological correlates. Therefore, the hypotheses are accepted. Significant group difference was found in the dimensions of tactile sensitivity, underresponsiveness/ sensory seeking, auditory filtering, and low energy. Children with ASD and ADHD reported higher sensory issues in the dimensions of tactile sensitivity, underresponsiveness/ sensory seeking, auditory filtering, and low energy compared to the typical population. Further, the three groups, ASD, ADHD, and the typical population significantly differed in social and behavioural problems

and anxiety. The clinical groups showed higher issues in social and behavioural problems compared to the typical population.

The results further highlighted that children with ASD and ADHD did not significantly differ in the experience of sensory processing and psychological correlates, however, they reported more sensory issues compared to the typical population. The findings are supported by the previous findings. Ahn et al., 2004 reported that sensory processing issues in children with developmental disabilities ranged between 40-88 % (Ahn et al., 2004). Studies have reported that children with ASD and ADHD significantly differed and reported higher problems compared to the control group, however, no significant difference was found between the two clinical groups (Cheung & Siu, 2009; Little et al., 2018). Along the same line, Little et al. (2018) found significant group differences in sensory processing particularly in the domains of visual, olfactory and auditory. The children with ADHD showed higher problems in visual and auditory domains compared to the typically developing children. Whereas children with ASD showed more olfactory issues, followed by ADHD and the typical population, however, no significant difference was found between ASD and ADHD. The non-difference in sensory processing in children with ASD and ADHD could be the overlapping symptomology (Lau-Zhu et al., 2019).

When compared with the control groups, children with ASD showed higher sensory issues. In the study conducted by Rogers and colleagues (2003), the researchers found that children with ASD significantly differed in the dimensions of olfactory sensitivity, auditory filtering and tactile from the control group. In another study, children with ASD showed higher issues in the domain of taste, smell and auditory compared to the typical population (McCormick et al., 2016). Along the same line, children with ADHD showed atypical sensory processing when compared

to their non-ADHD peer group. The ADHD showed higher difficulties in the domain of visual, auditory, taste and tactile processing (Dunn & Bennett, 2002; Yochman et al., 2004).

The present study further highlighted that children with ASD and ADHD reported higher social problems compared to the typical population. One of the core symptoms of ASD is the social deficit. It is found that children with ASD have severe social deficits compared to children with other developmental disorders and typically developing children (Kojovic et al., 2019). Social deficits may range from poor nonverbal communication, lack of socio-emotional reciprocity and difficulty in initiation, progress, and maintenance of social relationships. Children with ASD are often reported to have irregular social communication, are mostly aloof and irritable and lack quality relationships. Studies have highlighted that social deficits are related to cognitive or brain function functions and the abnormalities in cerebellum, amygdala, inferior frontal gyrus, and ventromedial prefrontal cortex (Lin et al., 2022). Further studies have reported the prevalence of emotional (anxiety and depression) and behavioural problems (e.g., aggressive, and challenging behaviour) (Tsai et al., 2020) in children with ASD. Along the same line, a few studies have reported the prevalence of social (Carpenter Rich et al., 2009; Ponagiotidi et al., 2018) and behavioural (Erfanian et al., 2018) in children with ADHD. Further, studies have found that children with ADHD are often found to have symptoms of anxiety (Lane et al., 2012; Reimherr et al., 2017) which supports the findings of the present study.

6.1.3 Differences in Sensory Processing in Children with ASD, ADHD and the Typical Population in Different Age Groups (Younger and Older) and Gender (Males and Females)

H7: There will be significant gender differences in sensory processing patterns and their relationship with social, emotional, and behavioural problems and depression and anxiety in children with ASD, ADHD, and the control group.

H8: There will be significant age group differences in sensory processing patterns and their relationship with social, emotional, and behavioural problems and depression and anxiety in children with ASD, ADHD, and the control group.

The results from the t test showed that children with ASD and ADHD significantly differed in sensory processing across gender and age groups. Therefore, it can be said that the hypotheses are accepted. The male and females in the ASD group significantly differed in the dimensions of underresponsiveness/ sensation seeking, auditory filtering and low energy. The results highlighted that females in the ASD group showed higher problems in the dimensions of sensation seeking, auditory filtering and low energy compared to the males. The results further highlighted that females with ADHD indicated higher movement sensitivity and low energy compared to males with ADHD.

The gender difference is the noble finding of the study. Research from the past found no significant gender difference in sensory processing in children with ASD and ADHD (Cheung & Siu, 2009; Dunn & Westman, 1997). Further, the present study found no gender difference in psychological correlates in children with ASD and ADHD. Studies from the past have highlighted gender differences in anxiety and depression in children with ASD and ADHD. Studies have highlighted that females with ASD were more prone to depression, suicidal ideation and anxiety compared to

the males with ASD (Kolves et al., 2021; Bitsika et al., 2021) and with their non-ASD peer group (Hossain et al., 2020; Wigham et al., 2017). Further, females with ADHD reported higher symptoms of anxiety and depression compared to males with ADHD (Nelson & Liebal, 2018), which is contrary to the findings of the present study. One of the limitations of the present study is the uneven sample distribution across gender. The prevalence of ASD and ADHD is 3-4 times more in boys compared to girls which makes it difficult to find female participants on the field. Therefore, the disparity in the findings of the present study is understandable.

The results from the present study further highlighted that older children with ASD and ADHD were more sensitive to movement, for example, anxious when feet left the ground fear heights and others, compared to the children in the other groups. Also, older children with ASD and ADHD were found to have higher sensory seeking/ underresponsiveness compared to the children in the younger age group. Older children with ADHD showed higher symptoms of sensory seeking followed by children with ASD. The current finding is supported by past research. A study was conducted on children with ASD (27) and ADHD (28) in higher education. The results from this particular study highlighted that children with ADHD reported more symptoms of sensory seeking compared to children with ASD (Clince et al., 2016; Kamath et al., 2020). Further, Marche and his colleagues (2012) found that adolescents with ASD showed higher problems in the dimension of sensory seeking which is in line with the findings of the present study.

It was found that older children with ASD and ADHD scored low on the overall scale of SSP indicating that older children with ASD and ADHD experienced higher sensory issues compared to younger children with ASD and ADHD and the typically developing group. In a recent study conducted on adults with ADHD, it was

highlighted that adults with ADHD reported more hypo and hypersensitivity compared to the non-ADHD group. Further, adults with ADHD showed significant sensory processing difficulties, specifically in low registration, sensation seeking, and sensory sensitivity (Kamath et al., 2020). In a longitudinal study conducted by McCormick et al. (2016), it was found that children with ASD showed sensory processing difficulties in the domain of taste, smell, and auditory filtering. The study was conducted across three time periods between 2-8 years old children with ASD, developmental delay, and the typical population. The results of this particular study further highlighted that symptoms of sensory processing were identified at an early and remained stable over a period of time.

Similarly, Cheung and Siu (2009) conducted a study on 186 children diagnosed with either ASD or ADHD and 1840 typically developing children. The age of the children ranged from 6-12 years. The results from the study highlighted that sensory processing issues in children with ASD and the typically developing children increased over the span of years, whereas children with ADHD showed a substantial increase in sensory processing difficulties, especially in auditory processing. Further, Leekam and his colleagues (2007) conducted a study on a wide range of age groups (32 months to 38 years) in children with ASD. The results highlighted that children with ASD experienced higher sensory issues compared to the control group. The study further indicated a mixed result, where the symptoms of sensory processing remained constant as the individual moved into adulthood and adolescents and for some the symptoms of sensory deficits changed with age and IQ.

The older children in the typical population, with ASD and ADHD, showed higher depressive symptoms compared to younger children. Similarly, the older children in the typical population, ADHD and ASD reported higher anxiety compared

to the children in the younger age group. A comparative study was conducted between children and adolescents with ASD. The results from the study highlighted that adolescents with ASD (20.2%) aged between 13- 17 years reported higher depression compared to the younger children aged between 6-12 years (4.8%) (Greenlee et al., 2016). Studies from the past have reported that both hypo and hyperreactivity have been linked with depression in children (Ben-Sasson et al., 2009) and adolescents with ASD (Pfeifer et al., 2005). Unexpectedly, children in the typical population were found to have higher emotional problems compared to the clinical populations. Such results can be explained by recent findings that have reported increased mental health issues and psychosocial problems in children attending normal schools during and after the COVID-19 pandemic (Harjuleet al., 2021; Singh et al., 2020).

Studies from the past have reported that hypersensitivity in relation to emotional dysregulation has been linked with anxiety in different age groups in children with ASD (Hofmann & Bitran, 2007; McMahon et al., 2019). Studies have reported that sensory atypicalities are identified at an early and continue to exist through adolescents and adulthood. These atypical sensory abnormalities significantly contribute to anxiety in adolescents and adults with ASD (Green et al., 2012; Pfeiffer et al., 2005). Further, it has been found that college-going students with ADHD reported higher symptoms of anxiety and depression compared to their peer groups (Nelson & Liebal, 2018). About 25 % of children with ADHD are found anxiety later in their lives (Eberhart & Hammen, 2006; Lane et al., 2012). Studies have identified various factors that lead to negative emotions like depression later in their life such as academic failure (Kent et al., 2011), social impairment and interpersonal impairment (Herman et al., 2007; Hoza et al., 2005) and parent-child conflict (Humphreys et al., 2013).

Studies on sensory processing in children with ASD and ADHD across age groups are scarce and the findings are inconclusive. A few researchers have reported that sensory processing decreased with age. However, older children with ADHD showed increased sensory processing difficulties, particularly in the auditory domain, compared to children in the younger age group (Cheung & Siu, 2009; Kern et al., 2006; Little et al., 2018). Another study reported that sensory abnormalities tend to stabilize with age, however, sensory sensitivity increases with age (Talay-Ongan & Wood, 2000). Other studies found no significant difference in sensory processing across developmental ages (Ausderau et al., 2014; Green et al., 2012). However, the recent meta-analysis conducted by Ben-Sasson et al. (2019) reported that sensory processing atypicalities may increase, decrease, or remain stable over a period of time.

The special schools and therapy centres are mostly equipped for younger children (childhood) with neurodevelopmental disorders. Soon after the diagnosis the child, they are taken under the care of the institutions. These centres are equipped with resources that are specific to the needs of children with developmental disorders. However, such facilities are available for children who are in their adolescence, especially in a country like India. the country lacks programmes or institutions that cater to the physical and psychological needs of adolescents/ older children with developmental disabilities. Also, it is during adolescence period that children are more aware of their psychological needs, experiencing different emotions such as love, happiness, and hope as well as anxiety and depression. It is essential that provisions are made that focuses on the psychological wellbeing of these population, especially during adolescence.

CHAPTER VII

SUMMARY, CONCLUSION, AND RECOMMENDATIONS FOR FUTURE RESEARCH

7.1 Summary

Autism spectrum disorder (ASD) and attention deficit hyperactive disorder (ADHD) are neurodevelopmental disorders that are identified at an early age and continue to exist through adolescents and adulthood (Leekam et al., 2007; Little et al., 2018). The behavioural, social, and communication issues that define ASD typically appear within the first three years of life. The deficits in sustained attention, impulse control, and activity regulation, on the other hand, are signs of ADHD (APA, 2013; WHO, 1992). It is estimated that 1 in 68 children by the age of 8 years old (Little et al., 2018) are affected by ASD, while ADHD affects 1 in 11 children between the ages of 4 to 17 years old globally (Tengsujaritkul et al., 2020). In India, 1 in 125 children between the ages of 3 to 6 years old and 1 in 85 children between the ages of 6 to 9 years old have an ASD diagnosis (Arora et al., 2018; Juneja & Saira, 2018), whereas 2% to 17% of children have an ADHD diagnosis (Joshi & Angolkar, 2021).

Studies have shown that children with ASD have an abnormal pattern of sensory processing, with sensory processing abnormalities affecting over 90% of this population (Baker et al., 2008; Hilton et al., 2010). Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) has added "hyper- or hyporeactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, and visual fascination with lights or movement)" as one of the diagnostic criteria of ASD (APA, 2013; Thye et al.,

2018). Higher sensory abnormalities are present in the areas of taste and smell sensitivity, underresponsive/sensation seeking, auditory filtering, and tactile in children with ASD (Baker et al., 2008). Similarly, sensory processing abnormalities in children with ADHD have been found (Ghanizadeh, 2011), with increased impairment in the sensory domains of vision, hearing, taste, smell, and touch compared to the non-ADHD peer groups (Panagiotidi et al., 2020).

Additionally, children with ASD and ADHD typically exhibit psychological correlates including anxiety, depression, and social, behavioural, and emotional problems (Ben-Sasson et al., 2008; Kojovic et al., 2019; McMahon et al., 2019). Auditory filtering and tactile sensitivity were found to be significantly associated with social deficits in children with ASD (Hilton et al., 2010; Matsushima & Kato, 2013). Similarly, adults with ADHD self-reported that they felt less able in controlling their social behaviour in social situations (Friedman et al., 2003; Ponagiotidi et al., 2018). Sensory seeking, hypo and hyperresponsiveness, taste and smell sensitivity and auditory filtering have been associated with emotional and behavioural problems in ASD (Boyd et al., 2009; Fernandez-Prieto et al., 2021). Both hypo and hyperreactivity have been linked to depression in children (Ben-Sasson et al., 2008) and adolescents with ASD (Pfeifer et al., 2005), whereas overresponsivity has been linked with anxiety. Lack of self-control, inability to establish healthy relationships and poor academic performance increases the likelihood of developing depressive symptoms in ADHD (Schoeler et al., 2018; Thapar et al., 2012).

Justification of the Study

The government of India has made only a little amount of effort in terms of policies and programming, despite the fact that children are at risk for developmental delays and impairments, which would worsen health problems, lower educational

attainment, and poorer wellbeing. In addition, there is a dearth of information on the prevalence of and studies into children with ASD and ADHD. A recent review collated research on ASD in Indian children, however, the review did not identify any study on sensory processing in ASD (Patra & Kar, 2021). The studies on children with ADHD have increased in recent years, however, a recent review stated that there is still not enough high-quality research. Additionally, they stressed the importance of doing future studies with perspective designs, higher sample sizes, and control groups (Kuppili et al., 2017). It was further found that studies on sensory processing in these populations with regard to age group and gender difference are less researched and have inconclusive findings (Ben-Sasson et al., 2019; Cheung & Siu, 2009; Little et al., 2018). Therefore, the present study aimed to understand sensory processing and psychology correlates in children with ASD, ADHD, and the typical population.

Objectives

O1: To study the sensory processing patterns in children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

O2: To examine the relationship between sensory processing patterns, clinical (anxiety and depression) and non-clinical (social, emotional, behavioural) aspects in children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

O3: To compare the sensory processing patterns, clinical (anxiety and depression) and non-clinical (social, emotional, behavioural) aspects among children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

O4: To investigate the sensory processing pattern and its relationship with clinical (anxiety and depression) and non-clinical (social, emotional, and behavioural) aspects

in children with autism spectrum disorder, attention deficit hyperactive disorder and the control groups across age and gender.

Hypotheses

H1: Children with autism spectrum disorder and attention deficit hyperactive disorder will show different patterns of sensory processing than the control group.

H2: Sensory processing dysfunction will positively correlate with social, emotional, and behavioural difficulties in children with autism spectrum disorder and attention deficit hyperactive disorder.

H3: Sensory processing dysfunction will positively correlate with anxiety and depression in children with autism spectrum disorder and attention deficit hyperactive disorder.

H4: Children with autism spectrum disorder and attention deficit hyperactive disorder will score higher on the sensory processing difficulties scale than the control group.

H5: Children with autism spectrum disorder and attention deficit hyperactive disorder will show higher impairment on social, emotional, and behavioural scales than the control group.

H6: Children with autism spectrum disorder and attention deficit hyperactive disorder will score higher on anxiety and depression than the control group.

H7: There will be significant gender differences in sensory processing patterns and their relationship with social, emotional, and behavioural problems and depression and anxiety in children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

H8: There will be significant age group differences in sensory processing patterns and their relationship with social, emotional, and behavioural problems and depression

and anxiety in children with autism spectrum disorder, attention deficit hyperactive disorder and the control group.

Method

Sample

A purposive sampling strategy was used for data collection. The mothers of children with ASD, ADHD, and the control group participated in the study. The children with ASD and ADHD were divided into two age groups: younger (6–11 years) and older (12–18 years). The present study involved 123 mothers of children with ASD including 73 younger (male: 45, female: 28) children and 50 older (male: 41, female: 9) children.100 mothers of children with ADHD participated in the study, 50 of whom were younger age group (males: 42, females: 8), and 50 were in the older age group (males: 33, females: 17). The questionnaire was completed by 139 mothers of typically developing children, 65 mothers of younger children (males: 33, females: 32), and 74 mothers of older children (males: 39, females: 35). Therefore, a total of 362 mothers of children with ASD, ADHD and the typical population participated in the study. Data were collected from 16 centres dealing with special children and seven schools for typically developing children.

Inclusion Criteria

1. Children who are diagnosed by professionals according to the diagnostic criteria of ICD-10 with ASD and ADHD alone, were included in the study.
2. Children with ASD and ADHD attending special schools or therapeutic centres were included in the study.
3. The typical population consisted of those who do not suffer from any major illness (physical and psychological).

4. The typical population attending private schools in West Bengal were included in the study.
5. Children between the age of 6-18 years old were included in the study.
6. Only the residents of West Bengal were included in the study.

Ethical Considerations

The present study was approved by the ethical committee of Sikkim University. The institution heads and the participants were informed in advance about the research aim and purpose. The participants provided their consent to participate in the study. By no means, the participants were forced into the study. The freedom to leave the study at any phase of data collection was also informed to participants. The participants were not provided with any financial assistance for filling out the questionnaires.

Measures

Along with the demographic information, the participants filled out *the Short Sensory Profile (SSP)* developed by Dunn (1999) and *Child Behaviour Checklist (CBCL)* developed by Achenbach (1991), *Conners' Abbreviated Parent or Teacher Questionnaire* developed by Conner (Conners, 1990; Rowe & Rowe, 1997) and the *Indian Scale for Assessment of Autism (ISAA)* (ISAA, 2009). SSP is a condensed form of the Sensory Profile and was used to evaluate sensory processing in these children. It measures the frequency of sensory activities and consists of 38 items. The mothers deployed their responses on a five-point Likert scale, 1 = always, 2= seldom, 3= occasionally, 4= frequently and 5= never. A high score on the scale implied low sensory concerns, whereas a low score indicated strong sensory processing difficulties. The total score ranged from 38 to 190. CBCL is one of the most popular scales for evaluating psychopathologies in children between the ages of 4 and 18. It is

comprised of 113 items and is broken down into two broad dimensions of internalizing and externalizing, as well as eight specific aspects: withdrawn/depression, anxious/depression, somatic complaints, delinquent behaviour, violent behaviour, social problem, thought problem, and attitude problem. It is a three-point Likert scale where the participants deployed 1= not true, 2= often true, and 3= very true. A higher rating on the scale denotes a greater issue in the population involved.

To cross-check the diagnosis and the comorbidity, The Conners' Abbreviated Parent or Teacher Questionnaire and ISAA were used. The ISAA consists of 40 items distributed in six dimensions: social relationship and reciprocity, emotional responsiveness, speech-language and communication, behavioural patterns, sensory aspect, and the cognitive domain. The scale is graded on a five-point Likert scale, with 1 representing rarely (symptoms up to 20%), 2 representing occasionally (21-40%), 3 representing frequently (41-60%), 4 representing mostly (61-80%), and 5 representing always (81-100%). ISAA was used in the present study to identify the symptoms of ASD in the ADHD population. Conners' Abbreviated Parent or Teacher Questionnaire is used to identify the symptoms of ADHD in children. It consists of ten items and a three-point Likert scale, the participants deployed 1= just a little, 2= pretty much, and 3= very much. Higher scores on the scale correspond to more severe symptoms of ADHD. In the present study, Conners' Abbreviated Parent or Teacher Questionnaire was used to identify the symptoms of ADHD in the ASD population.

Procedure for data collection

Data for the present study were collected between August 2021 to May 2022 from West Bengal. 35 government and non-government centres were contacted during this period. The mothers of children in the typical population were contacted

through private schools in the same geographical area. 23 out of 35 centres approved the request for the collection of data. Permission was obtained from the directors of the centres and informed consent was also obtained from the participants before administering questionnaires. The researcher built a rapport with the participants and guaranteed their confidentiality. Along with the socio-demographic questionnaire, participants filled out a series of questionnaires that included the SSP and CBCL forms. Data were gathered one-on-one with each participant for a minimum of 40-45 minutes.

Statistical Analysis

Along with descriptives, inferential statistics were used for data analysis. Pearson correlation was calculated to determine the association between sensory processing and clinical (anxiety and depression) and non-clinical (social, emotional, and behavioural) problems in children with ASD and ADHD. To determine the gender differences between children with ASD, ADHD, and the typical population, t test was computed. To identify the group difference in sensory processing and psychological correlates, the F-test was computed. To comprehend the differences in sensory processing and psychological correlates in younger and older children with ASD, ADHD, and the control group, MANOVA was computed.

Major Findings

- The mean graph highlighted that children with ASD and ADHD had more sensory issues in the domains of auditory filtering, movement sensitivity, taste and smell sensitivity, and visual and auditory sensitivity.
- From the F test results, it was found that children with ASD and ADHD reported more sensory difficulties in the areas of tactile sensitivity, underresponsiveness/sensory seeking, auditory filtering, and low energy compared

to the typical population. Furthermore, there were notable differences across the three groups in social and behavioural problems as well as anxiety.

- Pearson correlation analysis found strong associations between tactile sensitivity, underresponsiveness/sensation seeking, auditory filtering and social and behavioural problems in children with ASD.
- Auditory filtering, movement sensitivity, tactile sensitivity, taste and smell sensitivity, low energy and visual and auditory sensitivity significantly correlated with and predicted social and emotional problems in this population. Additionally, auditory filtering, underresponsive/ sensation seeking, and low energy significantly correlated with and predicted behavioural problems in children with ADHD.
- The results from the t test highlighted that females had higher problems in the dimensions of sensation seeking, auditory filtering and low energy compared to the males with ASD.
- A significant gender difference was found in the domains of movement sensitivity and low energy in the ADHD group.
- The results from MANOVA highlighted that older children with ASD and ADHD reported higher problems in movement sensitivity, and sensory seeking/underresponsive compared to the children in the other groups.
- The younger and older children with ASD and ADHD significantly differed in the dimension of emotional problems, depression, and anxiety.

7.2 Implications of the Study

The findings from the present study can be utilised by clinicians and therapists in planning an inclusive intervention paradigm that attends to the sensory processing needs along with the diagnosis of the child. The results further highlighted that older

children with ASD and ADHD showed higher difficulties in sensory processing compared to younger children. Age-appropriate interventions can be planned that are accessible and effective for these populations. Specific attention should be given in planning treatment plans that focus on the psychopathologies (anxiety and depression) that were significantly found in older children with ASD, ADHD, and the typical population.

7.3 Strengths, Limitations and Recommendations for Future Research

The present study focused not only on sensory processing in two different age groups in children with ASD and ADHD but also explored its relationship to the different psychological correlates. The study highlighted the prevalence of sensory processing difficulties in children with neurodevelopmental disorders in childhood and adolescence. The findings suggest the need for treatment plans that focus on the disorder as well as the sensory dysfunctions related to it. The findings further highlighted the importance to consider the psychological needs of children with ASD and ADHD at different developmental stages. The study so far is the first of its kind to be conducted in an Indian context.

Like any other research, the present is bound to limitations. The current study did not include male parents which limits our understanding if there exists gender difference in the way the male and female parents perceive sensory difficulties in their children. Also, the findings of the present study are subjected to the inputs given by the mothers of these children. Therefore, future studies may include both parent reports and direct behavioural assessments of children. The current study is cross-sectional, hence its conclusions on age group disparities have inherent limitations. Despite its limitations, the present study findings support the prevalence of sensory processing difficulties in ASD and ADHD and the possibility that sensory features

could change as the child develops. Our findings highlight the importance of the diagnosis of the disorder along with the comorbidities such as sensory processing, social issues, behavioural and emotional problems, and psychiatric disorders at an early age. Along with the interventions that focus on the symptoms of ASD and ADHD, it is crucial that comprehensive interventions are planned that take care of the difficulties related to the psychological correlates that frequently accompany these populations. It is important that the relationship between sensory processing and related psychological correlates is well understood by professionals, including therapists, special educators, and clinicians. As sensory processing was found to be prevalent in both younger and older children with ASD and ADHD, it is important that age-appropriate interventions are planned that are accessible and feasible to these populations.

Longitudinal studies may be conducted that are aimed to understand sensory processing and psychological correlates in children with ASD and ADHD, especially in the Indian context. Additionally, future investigations may focus on a larger sample. The present study included fewer female participants, therefore, may look into the gender difference with promising female participants. Studies have reported positive outcomes of sensory deficits like an increase in resilience and focused coping behaviour in ASDs, however, future research is needed to confirm the findings.

7.4 Conclusion

The sensory processing dysfunctions in children with ASD and ADHD are significantly associated with psychological correlates, such as social, emotional, and behavioural problems and psychiatric disorders. However, the present body of literature is limited in understanding the evolution and progress of sensory processing in different age groups. Results from the present study highlighted that children with

ASD and ADHD experienced maximum sensory dysfunctions in the domains of taste and smell sensitivity, auditory filtering and movement sensitivity. The sensory atypicalities are significantly associated with social and behavioural problems in children with ASD, while the different dimensions of sensory processing significantly correlated and predicted social, emotional, and behavioural problems and anxiety and depression in the ADHD population. Further, the three groups significantly differed in the domains of auditory filtering and underresponsive/ sensory seeking along with social, emotional, and behavioural problems and anxiety. Children with ASD showed significant gender differences in the domains of auditory filtering, underresponsive/ sensory seeking, and low energy, while the females with ADHD reported higher movement sensitivity and inertia compared to males. Further, the younger and older children with ASD and ADHD significantly differed in the domains of underresponsive/ sensory seeking and movement sensitivity. Older children with ADHD were found to have higher problems in internalizing problems, whereas older children with ASD were found to have higher depression.

The present study supports the results from the earlier studies that sensory processing features are detected early in life and persist through adolescence and adulthood, which negatively impacts their social, emotional, and behavioural functioning and escalates psychiatric symptoms such as anxiety and depression. The findings of the present study certainly add to the scarce pool of resources on the prevalence of sensory processing deficits and their relationship to different psychological correlates in different age groups, especially in the Indian context.

Therefore, early recognition and intervention are important to ensure the allocation of appropriate resources and treatment plans for both sensory processing and its associated psychological correlates in children with ASD and ADHD. The

treatments must be panned that focus on the psychological needs of children with ASD and ADHD at different developmental stages. It is important that the therapists understand the association between sensory processing difficulties and psychological correlates to plan intervention goals that are customised for everyone. Future studies may be conducted to understand the sensory processing dysfunction and its association with psychological correlates in children with ASD and ADHD across developmental stages, especially in the Indian context.

REFERENCES

Abikoff, H. B., Jensen, P. S., Arnold, L. E., Hoza, B., Hechtman, L., Pollack, S., ... & Wigal, T. (2002). Observed classroom behavior of children with ADHD: Relationship to gender and comorbidity. *Journal of Abnormal Child Psychology*, *30*, 349-359. https://doi.org/10.1023/a:1015713807297

Achenbach, T. M. (1991). *Manual for the Child Behavior Checklist/4-18 and 1991 Profile.* University of Vermont, Department of Psychiatry.

Aduen, P. A., Day, T. N., Kofler, M. J., Harmon, S. L., Wells, E. L., & Sarver, D. E. (2018). Social problems in ADHD: Is it a skills acquisition or performance problem? *Journal of Psychopathology and Behavioral Assessment*, *40*, 440-451. https://doi.org/10.1007/s10862-018-9649-7.

Ahmed, E. R., Islam, M. A., Alabdullah, T. T. Y., & Amran, A. B. (2019). A qualitative analysis on the determinants of legitimacy of sukuk. *Journal of Islamic Accounting and Business Research*. https://doi.org/10.1108/JIABR-01-2016-0005

Ahn, R. R., Miller, L. J., Milberger, S., & McIntosh, D. N. (2004). Prevalence of parents' perceptions of sensory processing disorders among kindergarten children. *American Journal of Occupational Therapy, 58*(3), 287-293. https://doi.org/10.5014/ajot.58.3.287.

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review, 30*(2), 217-237. https://doi.org/ 10.1016/j.cpr.2009.11.004.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (Vol. 5, No. 5). Washington, DC: American Psychiatric Association.

Andersen, P. N., Hovik, K. T., Skogli, E. W., & Oie, M. G. (2017). Severity of autism symptoms and degree of attentional difficulties predicts emotional and behavioral problems in children with high-functioning autism; a two-year follow-up study. *Frontiers in Psychology*, *8*. https://doi.org/10.3389/fpsyg.2017.02004

Aron, E. N., Aron, A., & Jagiellowicz, J. (2012). Sensory processing sensitivity: A review in the light of the evolution of biological responsivity. *Personality and Social Psychology Review*, *16*(3), 262-282. https://doi.org/10.1177/1088868311434213

Arora, N. K., Nair, M. K. C., Gulati, S., Deshmukh, V., Mohapatra, A., Mishra, D., ... & Vajaratkar, V. (2018). Neurodevelopmental disorders in children aged 2-9 years: Population-based burden estimates across five regions in India. *PLoS Medicine*, *15*(7), e1002615. https://doi.org/10.1371/journal.pmed.1002615

Ashburner, J., Ziviani, J., & Rodger, S. (2008). Sensory processing and classroom emotional, behavioral, and educational outcomes in children with autism spectrum disorder. *The American Journal of Occupational Therapy*, *62*(5), 564-573. https://doi.org/10.5014/ajot.62.5.564

Auger, R. W. (2013). School counselors and children's mental health: Introduction to the special issue. *Professional School Counseling*, *16*(4), 1-8. https://doi.org/2156759X12016002S01.

Ausderau, K. K., Furlong, M., Sideris, J., Bulluck, J., Little, L. M., Watson, L. R., ... & Baranek, G. T. (2014). Sensory subtypes in children with autism spectrum

disorder: Latent profile transition analysis using a national survey of sensory features. *Journal of Child Psychology and Psychiatry*, *55*(8), 935-944. https://doi.org/10.1111/jcpp.12219

Ayres, A. J. (1963). The Eleanor Clarke Slagle Lecture: The development of perceptual-motor abilities: A theoretical basis for treatment of dysfunction. *American Journal of Occupational Therapy, 17*, 221-225.

Ayres, A. J. (1966). Interrelationships among perceptual-motor functions in children. *American Journal of Occupational Therapy*, *20*, 68-71.

Ayres, A. J. (1972). *Sensory integration and learning disorders*. Los Angeles: Western Psychological Services.

Ayres, A. J. (1989). *Sensory Integration and Praxis Tests*. Los Angeles: Western Psychological Services.

Bagwell, C. L., Molina, B. S., Pelham Jr, W. E., & Hoza, B. (2001). Attention-deficit hyperactivity disorder and problems in peer relations: Predictions from childhood to adolescence. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*(11), 1285-1292. https://doi.org/10.1097/00004583-200111000-00008.

Baker, A. E., 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,* 867-875. https://doi.org/10.1007/s10803-007-0459-0.

Baranek, G. T. (1999). Autism during infancy: A retrospective video analysis of sensory-motor and social behaviors at 9-12 months of age. *Journal of Autism and Developmental Disorders*, *29*, 213-224. https://doi.org/10.1023/a:1023080005650.

Baranek, G. T., Foster, L. G., & Berkson, G. (1997). Tactile defensiveness and stereotyped behaviors. *American Journal of Occupational Therapy, 51*(2), 91-95. https://doi.org/10.5014/ajot.51.2.91.

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 Neuroscience, 29,* 30-40. https://doi.org/10.1016/j.dcn.2017.08.006.

Baranek, G.T., Boyd, B.A., Poe, M., David, F., & Watson, L.R. (2007). Hyperresponsive sensory patterns in young children with autism, developmental delay, and typical development. *American Journal of Mental Retardation, 112*, 233-245. https://doi.org/10.1352/0895-8017.

Baranek, G.T., 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. https://doi.org/10.1017/S0954579412001071.

Barkley, R. A., Murphy, K. R., & Fischer, M. (2010). *ADHD in adults: What the science says*. Guilford Press.

Barkley, R. A., Anastopoulos, A. D., Guevremont, D. C., & Fletcher, K. E. (1991). Adolescents with ADHD: Patterns of behavioral adjustment, academic functioning, and treatment utilization. *Journal of the American Academy of Child & Adolescent Psychiatry, 30*(5), 752-761. https://doi.org/10.1016/s0890-8567(10)80010-3.

Beheshti, A., Chavanon, M. L., & Christiansen, H. (2020). Emotion dysregulation in adults with attention deficit hyperactivity disorder: a meta-analysis. *BMC Psychiatry*, *20*(1), 1-11. https://doi.org/10.1186/s12888-020-2442-7

Ben-Sasson, A., Carter, A. S., & Briggs-Gowan, M. J. (2009). Sensory Over-Responsivity in Elementary School: Prevalence and Social-Emotional Correlates. *Journal of Abnormal Child Psychology, 37,* 705-716. https://doi.org/10.1007/s10802-008-9295-8

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. https://doi.org/10.1007/s10803-019-04180-0

Bernaras, E., Jaureguizar, & Garaigordobil, M. (2019). Child and Adolescent Depression: A Review of Theories, Evaluation Instruments, Prevention Programs, and Treatments. *Frontiers in Psychology. 10,* (543). https://doi.org/10.3389/fpsyg.2019.00543

Bernard, H. R., & Bernard, H. R. (2013). *Social research methods: Qualitative and quantitative approaches*. Sage.

Bernard, J. E. R. (2018). Depression: A review of its definition. *MOJ Addiction Medicine Therapy*, *5(1)*, 6-7. https://doi.org/10.15406/mojamt.2018.05.00082

Bhandarkar, P. L., Wilkinson, T. S., & Laldas, D. K. (2010). *Methodology & Techniques of Social Research*. Himalaya Publishing House.

Bijlenga, D., Tjon-Ka-Jie, J. Y. M., Schuijers, F., & Kooij, J. J. S. (2017). Atypical sensory profiles as core features of adult ADHD, irrespective of autistic symptoms. *European Psychiatry*, *43*, 51-57. https://doi.org/10.1016/j.eurpsy.2017.02.481

Bishop, S., Reichler, J., & Lord, C. (2006). Association between restricted and repetitive behaviors and nonverbal IQ in children with autism spectrum disorders. *Child Neuropsychology, 12*(4-5), 247-267. https://doi.org/10.1080/09297040600630288.

Bitsika, V., & Sharpley, C. F. (2015). Differences in the prevalence, severity and symptom profiles of depression in boys and adolescents with an autism spectrum disorder versus normally developing controls. *International Journal of Disability, Development and Education*, *62*(2), 158-167. https://doi.org/10.1080/1034912X.2014.998179

Bitsika, V., Sharpley, C. F., & Mills, R. (2016). Are Sensory Processing Features Associated with Depressive Symptoms in Boys with an ASD? *Journal of Autism Development Disorder,46,* 242-252. https://doi.org/10.1007/s10803-015-2569-4.

Bitsika, V., Sharpley, C. F., & Mills, R. (2021). Associations between sensory processing and depression in autistic girls. *Research in Autism Spectrum Disorders, 89,* 101881.https://doi.org/10.1016/j.rasd.2021.101881

Boat, T. F., & Wu, J. T. (2015). *Mental disorders and disabilities among low-income children*. Washington (DC): National Academies Press.

Bodfish, J. W., Symons, F. J., Parker, D. E., & Lewis, M. H. (2000). Varieties of repetitive behavior in autism: Comparison to mental retardation. *Journal of Autism and Developmental Disabilities, 30*, 237-243. https://doi.org/10.1023/a:1005596502855.

Boyd, B. A., Baranek, G. T., Sideris, J., Poe, M. D., Watson, L. R., Patten, E., & Miller, H. (2010). Sensory Features and Repetitive Behaviors in Children with Autism and Developmental Delays. *Autism Research 3,* 78-87. https://doi.org/10.1002/aur.124.

Brown, T. A., & Barlow, D. H. (2002). Classification of anxiety and mood disorders. *Anxiety and its Disorders: The Nature and Treatment of Anxiety and Panic*, *2*, 292-327.

Brown, T., Morrison, I. C., & Stagnitti, K. (2010). The Convergent Validity of Two Sensory Processing Scales used with School-Age Children: Comparing the Sensory Profile and the Sensory Processing Measure. *New Zealand Journal of Occupational Therapy*, *57*(2), 56-65.

Bruggink, A., Huisman, S., Vuijk, R., Kraaij, V., & Garnefski, N. (2016). Cognitive emotion regulation, anxiety and depression in adults with autism spectrum disorder. *Research in Autism Spectrum Disorders*, *22*, 34-44. https://doi.org/10.1016/j.rasd.2015.11.003

Brugha, T. S., McManus, S., Bankart, J., Scott, F., Purdon, S., Smith, J., ... & Meltzer, H. (2011). Epidemiology of autism spectrum disorders in adults in the community in England. *Archives of general psychiatry*, *68*(5), 459-465. https://doi.org/10.1001/archgenpsychiatry.2011.38.

Bryman, A. (2016). *Social Research Methods*. Oxford university press.

Bundy, A. C., & Murray, E. A. (2002). Sensory integration: A. Jean Ayres' theory revisited. In A. C. Bundy, S. J. Lane, & E. A. Murray (Eds.), *Sensory integration: Theory and practice* (2nd ed., pp. 3–33). Philadelphia: F. A. Davis.

Bunford, N., Evans, S. W., & Wymbs, F. (2015). ADHD and emotion dysregulation among children and adolescents. *Clinical Child and Family Psychology Review*, *18*(3), 185-217. https://doi.org/10.1007/s10567-015-0187-5.

Caminha, R. C., & Lampreia, C. (2012). Findings on sensory deficits in autism: implications for understanding the disorder. *Psychology and Neuroscience, 5*(2), 231e237. https://doi.org/10.1590/S1983-32882012000200014

Campbell, S. B. (1995). Behavior problems in preschool children: A review of recent research. *Journal of Child Psychology and Psychiatry*, *36*(1), 113-149. https://doi.org/10.1111/j.1469-7610.1995.tb01657.x.

Campbell, S. B. (1997). Behavior problems in preschool children: Developmental and family issues. *Advances in Clinical Child Psychology*, 1-26.

Campbell, S. B., Shaw, D. S., & Gilliom, M. (2000). Early externalizing behavior problems: Toddlers and preschoolers at risk for later maladjustment. *Development and Psychopathology*, *12*(3), 467-488. https://doi.org/10.1017/s0954579400003114.

Cantwell, D. P. (1996). Attention deficit disorder: a review of the past 10 years. *Journal of the American Academy of Child & Adolescent Psychiatry*, *35*(8), 978-987. https://doi.org/10.1097/00004583-199608000-00008.

Carpenter Rich, E., Loo, S. K., Yang, M., Dang, J., & Smalley, S. L. (2009). Social functioning difficulties in ADHD: Association with PDD risk. *Clinical child Psychology and Psychiatry*, *14*(3), 329-344. https://doi.org/10.1177/1359104508100890

CDC., (2017). *Centers for disease control prevention, attention-deficit/hyperactivity disorder (ADHD).* Data and Statistics. https://www.cdc.gov/ncbddd/adhd/data.html

Chakraborty, S., Thomas, P., Bhatia, T., Nimgaonkar, V. L., & Deshpande, S. N. (2015). Assessment of severity of autism using the Indian scale for assessment

of autism. *Indian Journal of Psychological Medicine*, *37*(2), 169-174. https://doi.org/10.4103/0253-7176.155616

Chauhan, A., Sahu, J. K., Jaiswal, N., Kumar, K., Agarwal, A., Kaur, J., ... & Singh, M. (2019). Prevalence of autism spectrum disorder in Indian children: A systematic review and meta-analysis. *Neurology India*, *67*(1), 100. https://doi.org/10.4103/0028-3886.253970.

Chen, Y. H., 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 Disorders, 39*(4), 635-642. https://doi.org/10.1007/s10803-008-0663-6.

Cheung, P. P. P, & Siu, A, M, H (2009). A comparison of patterns of sensory processing in children with and without developmental disabilities. *Research in Developmental Disabilities 30,* 1468-1480. https://doi.org/10.1016/j.ridd.2009.07.009.

Chiarotti, F., & Venerosi, A. (2020). Epidemiology of autism spectrum disorders: a review of worldwide prevalence estimates since 2014. *Brain Sciences*, *10*(5), 274. https://doi.org/10.3390/brainsci10050274.

Clince, M., Connolly, L., & Nolan, C. (2016). Comparing and exploring the sensory processing patterns of higher education students with attention deficit hyperactivity disorder and autism spectrum disorder. *American Journal of Occupational Therapy, 70*(2), 1-9. https://doi.org/10.5014/ajot.2016.016816

Cohen, S., Fulcher, B. D., Rajaratnam, S. M., Conduit, R., Sullivan, J. P., St Hilaire, M. A., ... & Lockley, S. W. (2018). Sleep patterns predictive of daytime challenging behavior in individuals with low-functioning autism. *Autism Research, 11*(2), 391-403. https://doi.org/10.1002/aur.1899

Conners, C. K. (1990*). Corners' Abbreviated Symptom Questionnaire: Parent Version, Teacher Version Manual.* Toronto: Multi-Health Systems.

Cosbey, J., Johnston, S. S., Dunn, M. L., & Bauman, M. (2012). Playground behaviors of children with and without sensory processing disorders. *OTJR: Occupation, Participation and Health*, *32*(2), 39-47. https://doi.org/10.3928/15394492-20110930-01

Crasta, J. E., Salzinger, E., Lin, M. H., Gavin, W. J., & Davies, P. L. (2020). Sensory processing and attention profiles among children with sensory processing disorders and autism spectrum disorders. *Frontiers in Integrative Neuroscience*, *14*, 1-10. https://doi.org/10.3389/fnint.2020.00022

Creswell, J. W., & Clarks, V. L. P. (2007). *Designing and Conducting Mixed Method Research.* Thousand Oaks, London, Delhi: Sage Publication.

Critz, C., Blake, K., & Nogueira, E. (2015). Sensory Processing Challenges in Children. The *Journal for Nurse Practitioners, 11(7)*, 710-716. https://doi.org/10.1016/j.nurpra.2015.04.016

Dawson, G., & Watling, R. (2000). Interventions to facilitate auditory, visual, and motor integration in autism: A review of the evidence. *Journal of Autism and Developmental Disorders*, *30*(5), 415. https://doi.org/10.1023/a:1005547422749

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,* 1-9. https://doi.org/10.1080/20473869.2022.2128553.

Diagnostic, A. P. A. (1987). *Statistical Manual of Mental Disorders*. American Psychiatric Association, Washington DC.

Du, Y., Li, M., Jiang, W., Li, Y., & Coghill, D. R. (2018). Developing the symptoms and functional impairment rating scale: a multi-dimensional ADHD scale. *Psychiatry Investigation, 15*(1), 13-23. https://doi.org/10.4306/pi.2018.15.1.13

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

Dunn, W. (2014). *Sensory profile 2 manual*. Pearson, San Antonio: The Psychological Corporation.

Dunn, W., & Bennett, D. (2002). Patterns of sensory processing in children with attention deficit hyperactivity disorder. *Occupational Therapy Journal of Research, 22,* 4-15.

Dunn, W., & Westman, K. (1997). The Sensory Profile: The performance of a national sample of children without disabilities. *American Journal of Occupational Therapy, 51,* 25-34.

Dziobek, I., Fleck, S., Rogers, K., Wolf, O.T., & Convit, A. (2006). The 'amygdala theory of autism' revisited: Linking structure to behavior. *Neuropsychologia, 44,* 1891-1899. https://doi.org/10.1016/j.neuropsychologia.2006.02.005.

Eaves, L. C., & Ho, H. H. (1997). School placement and academic achievement in children with autistic spectrum disorders. *Journal of Developmental and Physical Disabilities, 9,* 277-291.

Eberhart, N. K., & Hammen, C. L. (2006). Interpersonal predictors of onset of depression during the transition to adulthood. *Personal Relationships, 13,* 195-206. https://doi.org/10.1111/j.1475-6811.2006.00113.x

Efron, D., Taylor, K., Payne, J. M., Freeman, J. L., Cranswick, N., Mulraney, M., ... & Williams, K. (2020). Does cannabidiol reduce severe behavioural problems in children with intellectual disability? Study protocol for a pilot single-site phase

I/II randomised placebo-controlled trial. *BMJ Open*, *10*(3), e034362. https://doi.org/10.1136/bmjopen-2019-034362

Elsabbagh, M., Divan, G., Koh, Y. J., Kim, Y. S., Kauchali, S., Marcín, C., ... & Fombonne, E. (2012). Global prevalence of autism and other pervasive developmental disorders. *Autism Research*, *5*(3), 160-179.https://doi.org/10.1002/aur.239.

Emmons, P., & Anderson, L. (2005). *Understanding sensory dysfunction: learning, development and sensory dysfunction in autism spectrum disorders, ADHD, learning disabilities and bipolar disorder*. Jessica Kingsley Publishers.

Engel-Yeger, B., &Ziv-On, D. (2011). The relationship between sensory processing difficulties and leisure activity preference of children with different types of ADHD. *Research in Developmental Disabilities, 32*(3), 1154-62. https://doi.org/10.1016/j.ridd.2011.01.008

Erfanian, F., Hashemi Razini, H., & Ramshini, M. (2018). The relationship between executive functions and sensory processing with emotional recognition in autism spectrum disorder. *International Journal of Sport Studies for Health, 1*(2). https://doi.org/10.5812/intjs sh.74071.

Faraone, S. V., & Larsson, H. (2019). Genetics of attention deficit hyperactivity disorder. *Molecular Psychiatry*, *24*(4), 562-575. https://doi.org/10.1038/s41380-018-0070-0.

Feldman, J. I., Cassidy, M., Liu, Y., Kirby, A. V., Wallace, M. T., & Woynaroski, T. G. (2020). Relations between sensory responsiveness and features of autism in children. *Brain Sciences*, *10*(11), 775. https://doi.org/10.3390/brainsci10110775.

Fernandez-Prieto, M., Moreira, C., Cruz, S., Campos, V., Martínez-Regueiro, R., Taboada, M., ... & Sampaio, A. (2021). Executive functioning: A mediator between sensory processing and behaviour in autism spectrum disorder. *Journal of Autism and Developmental Disorders, 51*, 2091-2103. https://doi.org/10.1007/s10803-020-04648-4.

Friedman, S. R., Rapport, L. J., Lumley, M., Tzelepis, A., VanVoorhis, A., Stettner, L., & Kakaati, L. (2003). Aspects of social and emotional competence in adult attention-deficit/hyperactivity disorder. *Neuropsychology*, *17*(1), 50-58. https://doi.org/10.1037/0894-4105.17.1.50.

Ghanizadeh, A. (2011). Sensory processing problems in children with ADHD, a systematic review. *Psychiatry Research, 8*, 89-94. https://doi.org/10.4306/pi.2011.8.2.89.

Gliga, T., Jones, E. J., Bedford, R., Charman, T., & Johnson, M. H. (2014). From early markers to neuro-developmental mechanisms of autism. *Developmental Review*, *34*(3), 189-207.https://doi.org/10.1016/j.dr.2014.05.003

Gonthier, C., Longuepee, L., & Bouvard, M. (2016). Sensory processing in low-functioning adults with autism spectrum disorder: Distinct sensory profiles and their relationships with behavioral dysfunction. *Journal of Autism and Developmental Disorders, 46*(9), 3078-3089. https://doi.org/doi.org/10.1007/s10803-016-2850-1

Gotham, K., Brunwasser, S. M., & Lord, C. (2015). Depressive and anxiety symptom trajectories from school age through young adulthood in samples with autism spectrum disorder and developmental delay. *Journal of the American Academy of Child & Adolescent Psychiatry*, *54*(5), 369-376. https://doi.org/10.1016/j.jaac.2015.02.005.

Gouze, K. R., Hopkins, J., LeBailly, S. A., & Lavigne, J. V. (2009). Re-examining the epidemiology of sensory regulation dysfunction and comorbid psychopathology. *Journal of Abnormal Child Psychology, 37*, 1077-1087. https://doi.org/10.1007/s10802-009-9333-1.

Graziano, P. A., & Garcia, A. (2016). ADHD and children's emotion dysregulation: A meta-analysis. *Clinical Psychology Review, 46*, 106-123. https://doi.org/10.1016/j.cpr.2016.04.011

Green, S. A., & Ben-Sasson, A. (2010). Anxiety disorders and sensory over-responsivity in children with autism spectrum disorders: Is there a causal relationship? *Journal of Autism and Developmental Disorders, 40*(12), 1495-1504. https://doi.org/10.1007/s10803-010-1007-x

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 Disorders, 42*(6), 112-1119. https://doi.org/10.1007/s10803-011-1361-3.

Green, S. A., Hernandez, L., Tottenham, N., Krasileva, K., Bookheimer, S. Y., & Dapretto, M. (2015). Neurobiology of sensory overresponsivity in youth with autism spectrum disorders. *JAMA Psychiatry, 72*(8), 778-786. https://doi.org/10.1001/jamapsychiatry.2015.0737

Greenlee, J. L., Mosley, A. S., Shui, A. M., Veenstra-Vander Weele, J., & Gotham, K. O. (2016). Medical and behavioral correlates of depression history in children and adolescents with autism spectrum disorder. *Pediatrics, 137*, 105-114. https://doi.org/10.1542/peds.2015-2851I

Gundel, L. K., Pedersen, C. B., Munk-Olsen, T., & Dalsgaard, S. (2018). Longitudinal association between mental disorders in childhood and subsequent depression – A

nationwide prospective cohort study. *Journal of Affective Disorders, 227,* 56-64. https://doi.org/10.1016/j.jad.2017.10.023.

Harjule, P., Rahman, A., & Agarwal, B. (2021). A cross-sectional study of anxiety, stress, perception and mental health towards online learning of school children in India during COVID-19. *Journal of Interdisciplinary Mathematics, 24*(2), 411-424.https://doi.org/10.1080/09720502.2021.1889780

Harman, K. (2014). Autism Spectrum Disorder in an Indian context: impact of socioeconomic factors on the experiences of individuals with ASD and their families. *Independent Study Project (ISP) Collection*.https://digitalcollections.sit.edu/isp_collection/1954

Heady, N., Watkins, A., John, A., & Hutchings, H. (2022). Prevalence of neurodevelopmental disorders and their impact on the health and social well-being among looked after children (LAC): A systematic review protocol. *Systematic Reviews, 11*(1), 49. https://doi.org/10.1186/s13643-022-01923-6.

Hermann, B., Jones, J., Dabbs, K., Allen, C. A., Sheth, R., Fine, J., ... & Seidenberg, M. (2007). The frequency, complications and aetiology of ADHD in new onset paediatric epilepsy. *Brain, 130*(12), 3135-3148. https://doi.org/10.1093/brain/awm227

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 and Developmental Disorders, 40*(8), 937-945. https://doi.org/10.1007/s10803-010-0944-8

Hirsch, C. R., Beale, S., Grey, N., & Liness, S. (2019). Approaching cognitive behavior therapy for generalized anxiety disorder from a cognitive process perspective. *Frontiers in Psychiatry, 10*, 796. https://doi.org/10.3389/fpsyt.2019.00796

Hofmann, S. G., & Bitran, S. (2007). Sensory-processing sensitivity in social anxiety disorder: Relationship to harm avoidance and diagnostic subtypes. *Journal of Anxiety Disorders, 21*(7), 944-954. https://doi.org/10.1016/j.janxdis.2006.12.003

Hofmann, S. G., Sawyer, A. T., Fang, A., & Asnaani, A. (2012). Emotion dysregulation model of mood and anxiety disorders. *Depression and Anxiety 29*, 409-416. https://doi.org/10.1002/da.21888

Holland, M. L., Malmberg, J., & Peacock, G. G. (2017). *Emotional and behavioral problems of young children: Effective interventions in the preschool and kindergarten years*. Guilford Publications.

Hossain, M. M., Khan, N., Sultana, A., Ma, P., McKyer, E. L. J., Ahmed, H. U., & Purohit, N. (2020). Prevalence of comorbid psychiatric disorders among people with autism spectrum disorder: An umbrella review of systematic reviews and meta-analyses. *Psychiatry Research, 287*, 112922. https://doi.org/10.116/j.psychres.2020.112922.

Hoza, B., Mrug, S., Gerdes, A. C., Hinshaw, S. P., Bukowski, W. M., Gold, J. A., ... & Arnold, L. E. (2005). What aspects of peer relationships are impaired in children with attention-deficit/hyperactivity disorder? *Journal of Consulting and Clinical Psychology*, *73*(3), 411. https://doi.org/10.1037/0022-006X.73.3.411

Huang, Y., Xu, H., Au, W., Xu, C., & Wu, K. (2018). Involvement of family environmental, behavioral, and social functional factors in children with

attention-deficit/hyperactivity disorder. *Psychology Research and Behavior Management, 11,* 447-457.https://doi.org/10.2147/PRBM.S178080

Huebner, R. A. (1992). Autistic disorder: A neuropsychological enigma. *The American Journal of Occupational Therapy*, *46*(6), 487-501. https://doi.org/10.5014/ajot.46.6.487.

Humphreys, K. L., Katz, S. J., Lee, S. S., Hammen, C., Brennan, P. A., & Najman, J. M. (2013). The association of ADHD and depression: Mediation by peer problems and parent-child difficulties in two complementary samples. *Journal of Abnormal Psychology*, *122*(3), 854-867. https://doi.org/10.1037/a0033895

ISAA. (2009). *Report on assessment tool for autism: Indian Scale for Assessment of Autism.* New Delhi: Ministry of Social Justice & Empowerment: Government of India.

Johnson, F. N. (1975). Depression: Some proposals for future research. *Diseases of the Nervous System, 36*(5), 228-232.

Jorquera-Cabrera, S., Romeri-Ayuso, D., Rodriguez-Gil, G., & Trivino-Juarez, J. (2017). Assessment of Sensory Processing Characteristics in Children 3 and 11 Years Old: A Systematic Review. *Frontiers in Pediatrics, 5*. https://doi.org/10.33389/fped.2017.00057.

Joshi, H. M., & Angolkar, M. (2021). Prevalence of ADHD in primary school children in Belagavi City, India. *Journal of Attention Disorders,25*, 154-60. https://doi.org/10.1177/1087054718780326

Juneja, M., & Sairam, S. (2018). Autism spectrum disorder-An Indian perspective. *Recent Advances in Autism*, 1-15.

Kamath, M. S., Dahm, C. R., Tucker, J. R., Huang-Pollock, C. L., Etter, N. M., & Neely, K. A. (2020). Sensory profiles in adults with and without

ADHD. *Research in Developmental Disabilities, 104*, 103696.https://doi.org/10.1016/j.ridd.2020.103696.

Kargas, N., Lopez, B., Reddy, V., & Morris, P. (2015). The relationship between auditory processing and retricted, repetitive behaviors in adults with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 45,* 658-668. https://doi.org/10.1007/s10803-014-2219-2.

Keen, D., Couzens, D., Muspratt, S., & Rodger, S. (2010). The effects of a parent-focused intervention for children with a recent diagnosis of autism spectrum disorder on parenting stress and competence. *Research in Autism Spectrum Disorders, 4*(2), 229-241. https://doi.org/10.1016/j.rasd.2009.09.009

Keintz, M. A., & Dunn, W. (1997). A Comparison of the Performance of Children with and Without Autism on the Sensory Profile. *The American Journal Occupational, 51*(7),530-537. https://doi.org/10.5014/ajot.51.7.530.

Kent, K. M., Pelham, W. E., Jr., Molina, B. S., Sibley, M. H., Waschbusch, D. A., Yu, J...Karch, K. M. (2011). The academic experience of male high school students with ADHD. *Journal of Abnormal Child Psychology, 39,* 451-462. https://doi.org/10.1007/s10802-010-9472-4.

Kent, R., & Simonoff, E. (2017). Prevalence of anxiety in autism spectrum disorders. *Anxiety in Children and Adolescents with Autism Spectrum Disorder*, 5-32. https://doi.org/10.3389/fpsyt.2018.00050

Kern, J. K., Garver, C. R., Carmody, T., Andrews, A. A., Trivedi, M. H., & Mehta, J. A. (2007). Examining Sensory Quadrants in Autism. *Research in Autism Spectrum Disorder, 1,* 185-193. https://doi.org/10.1016/j.rasd.2006.09.002

Kern, J. K., Trivedi, M. H., Garver, C. R., Grannemann, B. D., Andrews, A. A., Savla, J. S., … &Schroeder, J. L. (2006). The patterns of sensory processing

abnormalities in autism. *Autism, 10*, 480-494. https://doi.org/10.1177/1362361306066564

Kerns, C. M., & Kendall, P. C. (2014). Autism and anxiety: Overlap, similarities, and differences. *Handbook of Autism and Anxiety*, 75-89.

Khaledi, H., Aghaz, A., Mohammadi, A., Dadgar, H., & Meftahi, G. H. (2022). The relationship between communication skills, sensory difficulties, and anxiety in children with autism spectrum disorder. *Middle East Current Psychiatry*, *29*(1), 1-12. https://doi.org/10.1186/s43045-022-00236-7

Kim, J., Szatmari, P., Bryson, S., Streiner, D., & Wilson, F. (2000). The prevalence of anxiety and mood problems among children with autism and Aspergers syndrome. *Autism*, *4*,117–132. https://doi.org/10.1177/1362361300004002002

Kinnealey, M., & Fuiek, M. (1999). The relationship between sensory defensiveness, anxiety, depression and perception of pain in adults. *Occupational Therapy International*, *6*(3), 195-206. https://doi.org/10.1002/oti.97

Koch, G. (2012). *Theory of Mind, Pragmatic Language, and Social Skills in Male Adolescents with Autism Spectrum Disorders* (Doctoral dissertation, Duquesne University). Retrieved from https://dsc.duq.edu/etd/ 763

Kofler, M. J., Larsen, R., Sarver, D. E., & Tolan, P. H. (2015). Developmental trajectories of aggression, prosocial behavior, and social–cognitive problem solving in emerging adolescents with clinically elevated attention-deficit/hyperactivity disorder symptoms. *Journal of Abnormal Psychology*, *124*(4), 1027. https://doi.org/10.1037/abn0000103

Kojovic, N., Ben Hadid, L., 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*(10), 1508. https://doi.org/10.3390/jcm8101508.

Kolves, K., Fitzgerald, C., Nordentoft, M., Wood, S. J., & Erlangsen, A. (2021). Assessment of suicidal behaviors among individuals with autism spectrum disorder in Denmark. *JAMA Network Open*, *4*(1), e2033565. https://doi.org/10.1001/jamanetworkopen.2020.33565

Kumar, N., Gupta, N., & Kishore, J. (2012). Kuppuswamy's Socioeconomic Scale: Updating Income Ranges for the Year 2012. *Indian Journal of Public Health*, *56*(1). Retrieved from https://www.ijph.in/temp/IndianJPublicHealth561103-2766973_074109.pdf [Dated on 2/01/2021].

Kumar, R. (2014). *Research Methodology: A Step-by-Step Guide for the Beginners*. New Delhi: Sage.

Kumar, R. (2014). *Research Methodology: A Step-by-Step Guide for the Beginners*. New Delhi: Sage.

Kuppili, P. P., Manohar, H., Pattanayak, R. D., Sagar, R., Bharadwaj, B., & Kandasamy, P. (2017). ADHD research in India: A narrative review. *Asian Journal of Psychiatry*, *30*, 11-25. https://doi.org/10.1016/j.ajp.2017.07.022

Lane, A. E., Young, R. L., Baker, A. E., & Angley, M. T. (2010). Sensory processing subtypes in autism: Association with adaptive behavior. *Journal of Autism and Developmental Disorders*, *40*, 112-122. https://doi.org/10.1007/s10803-009-0840-2.

Lane, S. J., Miller, L. J., & Hanft, B. (2000). Towards a consensus in terminology in sensory integration theory and practice: Part two. Sensory integration: Patterns of function and dysfunction. *Sensory Integration Special Interest Section Quarterly*, *23*(2), 1-3.

Lane, S. J., Reynolds, S., & Dumenci, L. (2012). Sensory overresponsivity and anxiety in typically developing children and children with autism and attention deficit hyperactivity disorder: cause or coexistence? *The American Journal of Occupational Therapy, 66(5),* 595-603. http://doi.org/10.5014/ajot.2012.004523.

Lane, S. J., Reynolds, S., & Thacker, L. (2010). Sensory overresponsivity and ADHD: Differentiating using electrodermal responses, cortisol, and anxiety. *Frontiers in Integrative Neuroscience, 4,* 1-14. http://doi.org/10.3389/fnint.2010.00008

Lau-Zhu, A., Fritz, A., & McLoughlin, G. (2019). Overlaps and distinctions between attention deficit/hyperactivity disorder and autism spectrum disorder in young adulthood: Systematic review and guiding framework for EEG-imaging research. *Neuroscience & Biobehavioral Reviews, 96,* 93-115.http://doi.org/10.1016/j.neubiorev.2018.10.009

Leekam, S. R., Nieto, C., Libby, S. J., Wing, L., & Gould, J. (2007). Describing the Sensory Abnormalities of Children and Adults with Autism. *Journal of Autism and Developmental Disorders, 37,* 894- 910.http://doi.org/ 10.1007/s10803-006-0218-7

Lidstone, J., Uljarevic, M., Sullivan, J., Rodgers, J., McConachie, H., Freeston, M., … &Leekam, S. (2003). Relations among restricted and repetitive behaviors, anxiety and sensory features in children with autism spectrum disorders. *Research in Autism Spectrum Disorder, 8,* 82-92. https://doi.org/10.1016/j.rasd.2013.10.001

Lin, Y. J., Chiu, Y. N., Wu, Y. Y., Tsai, W. C., & Gau, S. S. F. (2022). Developmental changes of autistic symptoms, ADHD symptoms, and attentional performance in children and adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders,* 1-15. http://doi.org/10.1007/s10803-022-05609-9.

Lindor, E., Sivaratnam, C., May, T., Stefanac, N., Howells, K., & Rinehart, N. (2019). Problem behavior in autism spectrum disorder: considering core symptom severity and accompanying sleep disturbance. *Frontiers in Psychiatry*, *10*, 487. http://doi.org/10.3389/fpsyt.2019.00487

Liss, M., Mailloux, J., & Erchull, M. J. (2008). The relationships between sensory processing sensitivity, alexithymia, autism, depression, and anxiety. *Personality and Individual Differences*, *45*(3), 255-259. https://doi.org/10.1016/j.paid.2008.04.009

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 Pediatrics*, *38*(3), 243-254. http://doi.org/10.1080/01942638.2017.1390809

Loomes, R., Hull, L., & Mandy, W. P. L. (2017). What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, *56*(6), 466-474. http://doi.org/10.1016/j.jaac.2017.03.013.

Mangeot, S. D., Miller, L. J., McIntosh, D. N., McGrath-Clarke, J., Simon, J., Hagerman, R. J., &Goldson, E. (2001). Sensory modulation dysfunction in children with attention-deficit-hyperactivity disorder. *Developmental Medicine and Child Neurology*, *43*, 399-346. http://doi.org/10.1017/s0012162201000743

Marche, W. D., Steyaert, J., & Noens, I. (2012). Atypical sensory processing in adolescents with autism spectrum disorder and their non-affected siblings. *Research in Autism Spectrum Disorder*, *6*, 639-645. https://doi.org/10.1016/j.rasd.2011.09.014

Mathison, J. (2012). Sensory Processing in Children with ADHD: A Classroom Study and Rational Item Analysis. *PCOM Psychology Dissertations,* 212. http://doi.org/10.1016/j.ridd.2005.12.004

Matson, J. L., & Nebel-Schwalm, M. S. (2007). Comorbid psychopathology with autism spectrum disorder in children: An overview. *Research in Developmental Disabilities*, *28*(4), 341-352. http://doi.org/1016/j.ridd.2005.12.004.

Matsushima, K., & Kato, T. (2013). Social interaction and atypical sensory processing in children with Autism Spectrum Disorder. *Hong Kong Journal of Occupational Therapy*, *23*, 89-96. https://doi.org/10.1016/j.hkjot.2013.11.003

May-Benson, T. A., & Koomar, J. A. (2010). Systematic review of the research evidence examining the effectiveness of interventions using a sensory integrative approach for children. *The American Journal of Occupational Therapy*, *64*(3), 403-414. http://doi.org/10.5014/ajot.2010.09071

Mayes, S. D., Calhoun, S. L., Murray, M. J., Ahuja, M., & Smith, L. A. (2011). Anxiety, depression, and irritability in children with autism relative to other neuropsychiatric disorders and typical development. *Research in Autism Spectrum Disorders*, *5*(1), 474-485. https://doi.org/10.1016/j.rasd.2010.06.012

McCormick, C., Hepburn, S., Young, G. S., & Rogers, S. J. (2016). Sensory symptoms in children with autism spectrum disorder, other developmental disorders and typical development: A longitudinal study. *Autism*, *20*(5), 572-579. http://doi.org/10.1177/1362361315599755

McIntosh, D. N., Miller, L., Shyu, V., & Dunn, W. (1999). Overview of the short sensory profile (SSP). *The sensory profile: Examiner's Manual*, 59-73.

McMahon, K., Anand, D., Morris-Jones, M., & Rosenthal, M. Z. (2019). A path from childhood sensory processing disorder to anxiety disorders: the mediating role

of emotion dysregulation and adult sensory processing disorder symptoms. *Frontiers in Integrative Neuroscience*, 22. http://doi.org/10.3389/fnint.2019.00022.

Mehrad, A., & Zangeneh, M. H. T. (2019). Comparison between qualitative and quantitative research approaches: Social sciences. *International Journal For Research in Educational Studies, Iran*, 1-7. https://www.researchgate.net/deref/https%3A%2F%2Forcid.org%2F0000-0003-4364-5709

Miller, L. J., Anzalone, M. E., Lane, S. J., Cermak, S. A., &Osten, E. T. (2007). Concept evolution in sensory integration: A proposed nosology for diagnosis. *American Journal of Occupational Therapy, 61*(2), 135-140. http://doi.org/10.5014/ajot.61.2.135

Mordre, M., Groholt, B., Sandstad, B., & Myhre, A. M. (2012). The impact of ADHD symptoms and global impairment in childhood on working disability in midadulthood: A 28-year follow-up study using official disability pension records in a high-risk in-patient population. *BMC Psychiatry*, *12*(1), 174.http://doi.org/10.1186/1471-244X-12-174.

Neal, J., Edelmann, R. J., & Glachan, M. (2002). Behavioral inhibition and symptoms of anxiety and depression: Is there a specific relationship with social phobia? *British Journal of Clinical Psychology*, *41*, 361-374. http://doi.org/10.1348/014466502760387489

Nelson, J. M., & Liebel, S. W. (2018). Anxiety and depression among college students with attention-deficit/hyperactivity disorder (ADHD): Cross-informant, sex, and subtype differences. *Journal of American College Health*, *66*(2), 123-132.http://doi.org/10.1080/07448481.2017.1382499

Nixon, E. (2001). The social competence of children with attention deficit hyperactivity disorder: A review of the literature. *Child Psychology and Psychiatry Review, 6*(4), 172-180.https://doi.org/10.1111/1475-3588.00342

Ornitz, E. M. (1988). Autism: A disorder of directed attention. *Brain Dysfunction, 1*, 309-322.

Panagiotidi, M., Overton, P. G., & Stafford, T. (2018). The Relationship Between ADHD Traits and Sensory Sensitivity in the General Population. *Science Direct, 80,* 179-185.

Parker, J. D. A., Sitarenios, G., & Conners, C. K. (1996). Abbreviated Conners' Rating Scales revisited: A confirmatory factor analytic study. *Journal of Attention Disorders*, *1*(1), 55-62. http://doi.org/10.1016/j.comppsych.2017.10.008

Parush, S., Sohmer, H., Steinberg, A., & Kaitz, M. (1997). Somatosensory functioning in children with attention deficit hyperactivity disorder. *Developmental Medicine & Child Neurology*, *39*(7), 464-468. https://doi.org/10.1177/108705479600100105

Patra, S., & Kar, S. K. (2021). Autism spectrum disorder in India: a scoping review. *International Review of Psychiatry, 33*(1-2), 81-112. http://doi.org/ 10.1080/09540261.2020.1761136.

Patterson, G. R., & Oregon, E. (1982). *A social learning approach,* Volume 3: Coercive family process.

Pelham Jr, W. E., Greenslade, K. E., Vodde-Hamilton, M., Murphy, D. A., Greenstein, J. J., Gnagy, E. M., ... & Dahl, R. E. (1990). Relative efficacy of long-acting stimulants on children with attention deficit-hyperactivity disorder: A comparison of standard methylphenidate, sustained-release

methylphenidate, sustained-release dextroamphetamine, and pemoline. *Pediatrics, 86*(2), 226-237.

Pelham, W. E., & Bender, M. E. (1982). Peer relationships in hyperactive children: Description and treatment. *Advances in Learning & Behavioral Disabilities, 1*, 365-436. http://doi.org/10.1016/j.ambp.2006.04.011

Perera, F. P., Chang, H. W., Tang, D., Roen, E. L., Herbstman, J., Margolis, A., ... & Rauh, V. (2014). Early-life exposure to polycyclic aromatic hydrocarbons and ADHD behavior problems. *PloS One, 9*(11), e111670. http://doi.org/10.1371/journal.pone.0111670

Pezzimenti, F., Han, G. T., Vasa, R. A., & Gotham, K. (2019). Depression in youth with autism spectrum disorder. *Child and Adolescent Psychiatric Clinics*, *28*(3), 397-409. http://doi.org/10.1016/j.chc.2019.02.009

Pfeiffer, B., Kinnealey, M., Reed, C., & Herzberg, G. (2005). Sensory modulation and affective disorder in children with Asperger syndrome. *American Journal of Occupational Therapy, 59*, 335-345. http://doi.org/10.5014/ajot.59.3.335.

Porter, P. (2017). *The Sense of Taste: Gustation.* Retrieved from: http://sinetwork.org/the-sense-of-taste-gustation/. Accessed on 23th February, 2021.

Ptak, A., Miękczyńska, D., Dębiec-Bąk, A., & Stefańska, M. (2022). The Occurrence of the Sensory Processing Disorder in Children Depending on the Type and Time of Delivery: A Pilot Study. *International Journal of Environmental Research and Public Health, 19*(11), 6893. http://doi.org/10.3390/ijerph19116893

Puts, N. A. J., Harris, A. D., Mikkelsen, M., Tommerdahl, M., Edden, R. A. E., & Mostofsky, S. H. (2017). Altered tactile sensitivity in children with attention-

deficit hyperactivity disorder. *Journal of Neurophysiology, 118,* 2568-2578. http://doi.org/10.1152/jn.00087.2017

Raiyani, J. R. (2012). *Research Methodology: Theory and Techniques.* New Delhi: New Century Publications.

Raiyani, J. R. (2012). *Research Methodology: Theory and Techniques.* New Delhi: New Century Publications.

Rapin, I. (1991). Autistic children: Diagnosis and clinical features. *Pediatrics, 87*(5), 751-760.

Reeves, G. D. (2001). From neuron to behavior: Regulation, arousal, and attention as important substrates for the process of sensory integration. In S. S. Roley, E. I. Blanche, & R. C. Schaaf (Eds.), *Understanding the nature of sensory integration with diverse populations* (pp. 89-108). San Antonio, TX: Therapy Skill Builders.

Reimherr, F. W., Marchant, B. K., Gift, T. E., & Steans, T. A. (2017). ADHD and anxiety: clinical significance and treatment implications. *Current Psychiatry Reports, 19,* 1-10. http://doi.org/10.1007/s11920-017-0859-6

Reynolds, S & Lane, S. J. (2009). Sensory Overresponsivity and Anxiety in Children with ADHD. *American Journal of Occupational Therapy, 63,* 433-440. http://doi.org/10.5014/ajot.63.4.433

Riglin, L., Leppert, B., Dardani, C., Thapar, A. K., Rice, F., O'Donovan, M. C., ... & Thapar, A. (2021). ADHD and depression: investigating a causal explanation. *Psychological Medicine, 51*(11), 1890-1897. http://doi.org/10.1017/S0033291720000665.

Rodger, L. (2018). *Sensory Processing Disorder and Autism: Taste and the Picky Eater*. Retrieved from: https://www.aspergers101.com/sensory-differences-taste/. Accessed on 23rd February 2021.

Roeling, M. P. (2010). Functioning is the cornerstone of life-Assessing chronic impairment in social functioning. *Journal of European Psychology Students*, *2*(1), 1-14. http://doi.org/10.5334/jeps.aj

Rogers, S. J., Hepburn, S., & Wehner, E. (2003). Parent Reports of Sensory Symptoms in Toddlers with Autism and Those with Other Developmental Disorders. *Journal of Autism and Developmental Disorders, 33*, 631-642. http://doi.org/10.1023/b:jadd.0000006000.38991.a7

Rossow, T., MacLennan, K., & Tavassoli, T. (2021). The relationship between sensory reactivity differences and mental health symptoms in preschool-age autistic children. *Autism Research, 14*(8), 1645-1657. http://doi.org/10.1002/aur.2525

Rossow, T., MacLennan, K., & Tavassoli, T. (2022). The predictive relationship between sensory reactivity and depressive symptoms in young autistic children with few to no words. *Journal of Autism and Developmental Disorders,* 1-11. http://doi.org/10.1002/aur.2525

Rowe, K. S., & Rowe, K. J. (1997). Norms for parental ratings on Conners' Abbreviated Parent-Teacher Questionnaire: implications for the design of behavioral rating inventories and analyses of data derived from them. *Journal of Abnormal Child Psychology*, *25*, 425-451. http://doi.org/10.1023/a:1022678013979

Rutter, M., Kim-Cohen, J., & Maughan, B. (2006). Continuities and discontinuities in psychopathology between childhood and adult life. *Journal of Child Psychology*

and Psychiatry, and Allied Disciplines, 47(3-4), 276–295. http://doi.org/10.1111/j.1469-7610.2006.01614.x

Salazar, F., Baird, G., Chandler, S., Tseng, E., O'sullivan, T., Howlin, P., ... & Simonoff, E. (2015). Co-occurring psychiatric disorders in preschool and elementary school-aged children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 45*, 2283-2294. http://doi.org/10.1007/s10803-015-2361-5

Schaaf, R. C., Miller, L. J., Seawell, D., & O'Keefe, S. (2003). Children with disturbances in sensory processing: a pilot study examining the role of the parasympathetic nervous system. *American Journal of Occupational Therapy*, *57*, 442-449. http://doi.org/10.5014/ajot.57.4.442

Schoeler, T., Duncan, L., Cecil, C. M., Ploubidis, G. B., & Pingault, J. B. (2018). Quasi-experimental evidence on short- and long-term consequences of bullying victimization: A meta-analysis. *Psychological Bulletin, 144*(12), 1229-1246. http://doi.org/10.1037/bul0000171

Schreiber, C. (2011). Social skills interventions for children with high-functioning autism spectrum disorders. *Journal of Positive Behavior Interventions*, *13*(1), 49-62. https://doi.org/10.1177/1098300709359027

Serafini, G., Gonda, X., Canepa, G., Pompili, M., Rihmer, Z., Amore, M., & Engel-Yeger, B. (2017). Extreme sensory processing patterns show a complex association with depression, and impulsivity, alexithymia, and hopelessness. *Journal of Affective Disorders*, *210*, 249-257. http://doi.org10.1016/j.jad.2016.12.019

Sevincok, D., Ozbay, H. C., Ozbek, M. M., Tunagur, M. T., & Aksu, H. (2020). ADHD symptoms in relation to internalizing and externalizing symptoms in

children: The mediating role of sluggish cognitive tempo. *Nordic Journal of Psychiatry, 74*(4), 265-272. http://doi.org/10.1080/08039488.2019.1697746

Sharma, D., & Sharma, A. J. (2016). Autism spectrum disorder-Impact on parenting and coping strategies. *The International Journal of Indian Psychology, Volume 3*(4), 16-31. http://doi.org/10.25215/0304.003

Shimizu, V. T., Bueno, O. F., & Miranda, M. C. (2014). Sensory processing abilities of children with ADHD. *Brazilian Journal of Physical Therapy, 18*, 343-352. http://doi.org/10.1590/bjpt-rbf.2014.0043

Sicile-Kira, C. (2014). *Autism spectrum disorder (revised): The complete guide to understanding autism*. Tarcher Perigee.

Simonoff, E., Pickles, A., Charman, T., Chandler, S., Loucas, T., & Baird, G. (2008). Psychiatric disorders in children with autism spectrum disorders: Prevalence, comorbidity, and associated factors in a population-derived sample. *Journal of the American Academy of Child & Adolescent Psychiatry, 47*, 921-929. http://doi.org/10.1097/CHI.0b013e318179964f

Singh, S., Roy, D., Sinha, K., Parveen, S., Sharma, G., & Joshi, G. (2020). Impact of COVID-19 and lockdown on mental health of children and adolescents: A narrative review with recommendations. *Psychiatry Research, 293*, 113429. http://doi.org/10.1016/j.psychres.2020.113429

Skirrow, C., & Asherson, P. (2013). Emotional lability, comorbidity and impairment in adults with attention-deficit hyperactivity disorder. *Journal of Affective Disorders, 147*(1-3), 80-86. http://doi.org/10.1016/j.jad.2012.10.011

Smith Roley, S., Mailloux, Z., Miller-Kuhaneck, H. & Glennon, T. (2007). Understanding Ayres' Sensory Integration. *OT Practice 12*(7).

Snz-Cervera. P., Pastor-Cerezuela. G., Fernandez-Andrer, M., & Tarranga- Minguez. R. (2015). Sensory processing in children with autism spectrum disorder: Relationship with non-verbal IQ, autism severity, and attention deficit hyperactive disorder symptomatology. *Science Direct,* 188-201. http://doi.org/10.1016/j.ridd.2015.07.031

South, M., Rodgers, J., & Van Hecke, A. (2017). Anxiety and ASD: Current progress and ongoing challenges. *Journal of Autism and Developmental Disorders*, *47*, 3679-3681. http://doi.org/10.1007/s10803-017-3322-y

Stehli, A. (1991). *The sound of a miracle: A child's triumph over autism*. New York: Doubleday.

Sukhodolsky, D. G., Scahill, L., Gadow, K. D., Arnold, L. E., Aman, M. G., McDougle, C. J., ... & Vitiello, B. (2008). Parent-rated anxiety symptoms in children with pervasive developmental disorders: Frequency and association with core autism symptoms and cognitive functioning. *Journal of Abnormal Child Psychology*, *36*, 117-128. http://doi.org/10.1007/s10802-007-9165-9

Talay-Ongan, A., & Wood, K. (2000). Unusual sensory sensitivity in autism: A possible crossroad. *International Journal of Disability, Development, and Education, 47*, 201-212. https://doi.org/10.1080/713671112

Tengsujaritkul, M., Louthrenoo, O., & Boonchooduang, N. (2020). Emotional/behavioural problems and functional impairment in children with attention-deficit/hyperactivity disorder. *East Asian Archives of Psychiatry*, *30*(3), 79-83. http://doi.org/10.12809/eaap1921

Thapar, A., Collishaw, S., Pine, D. S., & Thapar, A. K. (2012). Depression in adolescence. *The Lancet*, *379*(9820), 1056-1067. https://doi.org/10.1016%2FS0140-6736(11)60871-4

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. https://doi.org/10.1016/j.dcn.2017.04.010

Tomcheck, S. D., & Dunn, W. (2007). Sensory processing in children with and without autism: A comparative study using the short sensory profile. *The American Journal of Occupational Therapy, 61*(2), 190-200. https://doi.org/10.5014/ajot.61.2.190

Tsai, C. H., Chen, K. L., Li, H. J., Chen, K. H., Hsu, C. W., Lu, C. H., ... & Huang, C. Y. (2020). The symptoms of autism including social communication deficits and repetitive and restricted behaviors are associated with different emotional and behavioral problems. *Scientific reports*, *10*(1), 1-8. https://doi.org/10.1038/s41598-020-76292-y

Tseng, M. H., Fu, C. P., Cermak, S. A., Lu, L., & Shieh, J. Y. (2011). Emotional and behavioral problems in preschool children with autism: Relationship with sensory processing dysfunction. *Research in Autism Spectrum Disorders, 5*(4), 1441-1450. https://doi.org/10.1016/j.rasd.2011.02.004

Turgay, A., & Ansari, R. (2006). Major depression with ADHD: In children and adolescents. *Psychiatry (Edgmont)*, *3*(4), 20.

Van Steensel, F. J., Bogels, S. M., & Perrin, S. (2011). Anxiety disorders in children and adolescents with autistic spectrum disorders: A meta-analysis. *Clinical Child and Family Psychology Review*, *14*, 302-317. https://doi.org/10.1007/s10567-011-0097-0

Vasa, R. A., & Mazurek, M. O. (2015). An update on anxiety in youth with autism spectrum disorders. *Current Opinion in Psychiatry*, *28*(2), 83. https://doi.org/10.1097%2FYCO.0000000000000133

Wender, P. H. (1995). *Attention deficit hyperactivity disorder in adults.* University Press, Oxford.

White, S. W., Oswald, D., Ollendick, T., & Scahill, L. (2009). Anxiety in Children and Adolescents with Autism Spectrum Disorders. *Clinal Psychology Review, 29* (3), 216-229. https://doi.org/10.1016/j.cpr.2009.01.003.

Wigham, S., Barton, S., Parr, J. R., & Rodgers, J. (2017). A systematic review of the rates of depression in children and adults with high-functioning autism spectrum disorder. *Journal of Mental Health Research in Intellectual Disabilities*, *10*(4), 267-287. https://doi.org/10.1111/papt.12366

Wigham, S., Rodgers, J., South, M., McConachie, H., & Freeston, M. (2015). The interplay between sensory processing abnormalities, intolerance of uncertainty, anxiety and restricted and repetitive behaviours in autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *45*, 943-952. https://doi.org/10.1007/s10803-014-2248-x

Wilens, T. E., & Spencer, T. J. (2010). Understanding attention-deficit/hyperactivity disorder from childhood to adulthood. *Postgraduate Medicine*, *122*(5), 97-109. https://doi.org/10.3810%2Fpgm.2010.09.2206

Williamson, A. A., Mindell, J. A., Hiscock, H., & Quach, J. (2020). Longitudinal sleep problem trajectories are associated with multiple impairments in child well-being. *Journal of Child Psychology and Psychiatry*, *61*(10), 1092-1103. https://doi.org/10.1111%2Fjcpp.13303

Wilmshurst, L. (2009). Anxiety disorders with likely onset in childhood. *Abnormal Child Psychology: A Developmental Perspective*, 195-222.

Wing, L. (2005). Reflections on opening Pandora's box. *Journal of Autism and Developmental Disorders, 35*(2), 197-203. https://doi.org/10.1007/s10803-004-1998-2

Wolf, M., Van Doorn, G. S., & Weissing, F. J. (2008). Evolutionary emergence of responsive and unresponsive personalities. *Proceedings of the National Academy of Sciences, 105*(41), 15825-15830. https://doi.org/10.1073/pnas.0805473105

Woodard, C. R., Goodwin, M. S., Zelazo, P. R., Aube, D., Scrimgeour, M., Ostholthoff, T., & Brickley, M. (2012). Comparison of autonomic, behavioral, and parent-report measures of sensory sensitivity in young children with autism. *Research in Autism Spectrum Disorder, 6,* 1234-1246. https://doi.org/10.1016/j.rasd.2012.03.012

World Health Organization (WHO) (2017). Depression. Fact sheet. Available online at: http://www.who.int/mediacentre/factsheets/fs369/en/.

World Health Organization. (1992). *The ICD-10 Classification of Mental and Behavioral Disorders: Clinical Descriptions and Diagnostic Guidelines*. Geneva: World Health Organization.

World Health Organization. (2007). *International classification of functioning, disability, and health: Children and youth version.* Geneva: Author.

Xiao, Z., Chen, X., Wang, J., Tang, Y., Zhang, T., Zhang, M., … & Chen, C. (2010). Experimental study on sensory gating in generalized anxiety and obsessive compulsive disorders. *Zhonghua Yi Xue Za Zhi, 90,* 169-172. https://doi.org/10.3760/cma. j.issn.0376-2491.2010.03.007

Yeo, K. J., & Teng, K. T. (2015). Social Skills Deficits in Autism: A Study among Students with Autism Spectrum Disorder in Inclusive Classrooms. *Universal Journal of Educational Research, 3*(12), 1001-1007. https://doi.org/10.13189/ujer.2015.031208

Yochman, A., Parush, S., & Ornoy, A. (2004). Responses of preschool children with and without ADHD to sensory events in daily life. *American Journal of Occupational Therapy, 58,* 294-302. https://doi.org/10.5014/ajot.58.3.294

Zeanah, C. H., Carter, A. S., Cohen, J., Egger, H., Gleason, M. M., Keren, M., ... & Oser, C. (2016). Diagnostic classification of mental health and developmental disorders of infancy and early childhood dc: 0-5: selective reviews from a new nosology for early childhood psychopathology. *Infant Mental Health Journal, 37*(5), 471-475. https://doi.org/10.1002/imhj.21591.

APPENDIX I

Consent Form

I am Sonu Darnal, PhD scholar department of psychology, Sikkim University, Sikkim Gangtok. My research area focuses on sensory processing and psychological correlates in children with ASD, ADHD and typically growing children. The data is collected from the mothers of these three populations. The information thus provided, will be kept confidential and shall be used only for the research purpose.

Kindly sign in the space provided if you wish to participate in the present study.

Signature of the participant

Date:

APPENDIX II

Socio-Demographic Data Sheet

Name:

Age of the child (DOB):

Gender:

Degree of Disorder:

Date of Diagnosis:

Age of the participant:

Gender: male / female

Marital status: married / unmarried/widowed/ separated

Type of Marriage: Arranged/Choice-based/Any other

If separated, the reasons: Specify

Current place of residence: Parents/Husband/Sibling/Any other

Number of children:

Profession: Government employee/ private employee/ self employed/ own business

Type of family: Joined family/ nuclear family

Education Qualification: Illiterate/ primary/ secondary/ higher secondary/ graduate/ post graduate/ technical/ any other

Religion: Hindu/Muslim/Christian/Any Other

Residential address:

District: Jalpaiguri/ Darjeeling

First language/ mother tongue: Nepali/ Bengali/ Hindi/ Any other

APPENDIX III

Kuppuswamy's Socio-Economic Status Scale: Revised (2016)

EDUCATION	SCORES
Professional or honors	7
Graduate or postgraduate	6
Intermediate or post-high school diploma	5
High School Certificate	4
Middle School certificate	3
Primary School certificate	2
Illiterate	1
OCCUPATION	
Professional	10
Semi-Professional	6
Clerical, Shop, Owner, Farmer	5
Skilled Worker	4
Semi-Skilled Worker	3
Unskilled Worker	2
Unemployed	1
Family income per month in Rupees (August 2016 current price index for industrial workers)	
≥ 42,876	12
21,438-42,875	10
16,078-21,437	6
10719-16,077	4
6,431-10,718	3
2,165-6,430	2
≤2164	1

APPENDIX IV

Short Sensory Profile (SPP)

Sl. No.	Tactile sensitivity	Always	Frequently	Occasionally	Seldom	Never
1	Expresses distress during grooming (eg: fights or cries during hair cutting, face washing, finger nail cutting)					
2	Prefers long sleeved clothing when it is warm or short sleeves when it is cold					
3	Avoids going bare foot, especially in sand or grass					
4	Reacts emotionally or aggressively to touch					
5	Withdraws from splashing water					
6	Has difficulty standing in line or close to other people					
7	Rubs or scratches out a spot that has touched					
	Taste smell sensitivity					
8	Avoids certain tastes or food smells that are typically part of children's diets					
9	Will only eat certain tastes (list:……)					
10	Limits self to particular food texture/temperatures (list:……)					
11	Picky eater, especially regarding food textures					
	Movement sensitivity					
12	Becomes anxious or distressed when feet leave the ground					
13	Fears falling or heights					
14	Dislikes activities where head is upside down (eg: somer saults, rough housing)					
	Undersensponsive/ seeks sensation					
15	Enjoys strange noises / seeks to make noise or noise's sake					
16	Seeks all kinds of movements and this interferes with daily routines (eg: can't sit still, fidgets)					
17	Becomes overly excitable during movement activity					
18	Touches people and objects					
19	Does not seem to notice when face and hands are messy					
20	Jumps from one activity to another so that it interferes with play					
21	Leaves clothing twisted on body					
	Auditory filtering					

22	Is distracted or has trouble functioning if there is a lot of noise around					
23	Appears to not hear what you say (eg: does not “tune-in” to what you say, appears to ignore you)					
24	Can’t walk with background noise (eg: fan, refrigerator)					
25	Has trouble completing task when the radio is on					
26	Does not respond when the name is called but you know the child’s hearing is okay					
27	Has difficulty paying attention					
	Low energy/ weak					
28	Seems to have weak muscles					
29	Tries easily, especially when standing or holding particular body position					
30	Has a weak grasp					
31	Can’t lift heavy objects (eg: weak in comparison to same age children)					
32	Props to support self (even during activity)					
33	Poor endurance / tries easily					
	Visual/auditory sensitivity					
34	Responds negatively to unexpected to loud noises (eg: cries or hides at noise from vacuum cleaner/ dog barking/ hair drier)					
35	Holds hands over ears to protect ears from sound					
36	Is bothered by bright lights after others have adapted to the light					
37	Watches every one when they move around the room					
38	Covers eyes or squints to protect eyes from lights					

APPENDIX V

Child Behaviour Check List (CBCL)

Sl No.	*Items*	*Not true*	*sometimes*	*Verytrue*
1.	Acts too young for his/her age			
2.	Allergy			
3.	Argues a lot			
4.	Asthma			
5.	Behaves like opposite sex			
6.	Bowel movement outside toilet			
7.	Bragging, Boasting			
8.	Cannot concentrate or pay attention for long			
9.	Cannot get her/his mind off certain thoughts, obsession			
10.	Cannot sit still/hyper, restless			
11.	Clings to adults or too dependent			
12.	Complains of loneliness			
13.	Confused or seems to be in a fog			
14.	Cries a lot			
15.	Cruel to animals			
16.	Cruelty, bully or meanness to others			
17.	Day-dreaming or gets lost in her/his thoughts			
18.	Deliberately harms self or attempts suicide			
19.	Demands a lot of attention			
20.	Destroys her/his own thoughts			
21.	Destroys things belonging to her/his family or others			
22.	Disobedient at home			
23.	Disobedient at school			
24.	Does not eat well			
25.	Does not get along with other children			
26.	Does not seem to feel guilty about misbehaving			
27.	Easily jealous			
28.	Eats or drinks things that are not food			
29.	Fears certain animals, situations, places other than school (describe)			
30.	Fears going to school			
31.	Fear s/he might do something bad			
32.	Feels s/he has to be perfect			

33.	Feels or complains that one loves her/him			
34.	Feels others are out to get her/him			
35.	Feels worthless/inferior			
36.	Gets hurt a lot, accident-prone			
37.	Gets into many fights			
38.	Gets teased a lot			
39.	Hangs around with children who get into trouble			
40.	Hears things that are not there.			
41.	Impulsive or acts without thinking			
42.	Likes to be alone			
43.	Lying or cheating			
44.	Bites fingernails			
45.	Nervous, high strung or tense			
46.	Nervous movement or twitching (describe…...)			
47.	Nightmare			
48.	Not liked by other children			
49.	Constipated, does not move bowels			
50.	Too fearful or anxious			
51.	Feels dizzy			
52.	Feels too guilty			
53.	Overacting			
54.	Overtired			
55.	Overweight			
56.	Physical problems without known medical cause a. Aches or pains b. Headaches c. Nausea, feels sick d. Problem with eyes e. Rashes or skin problems f. Stomach aches or cramps g. Vomiting or throwing up h. Others (describe)			
57.	Physically attacks people			
58.	Picks nose, skin, or other parts of the body (describe)			
59.	Plays with own sex parts in public			
60.	Plays with own sex part too much			
61.	Poor school work			
62.	Poorly coordinated/ too clumsy			
63.	Prefers playing with older children			

64.	Prefers playing with younger children			
65.	Refuses to talk			
66.	Repeats certain acts over and over, compulsive (describe)			
67.	Runs away from home			
68.	Screams a lot			
69.	Secretive, keeps things to self			
70.	Sees things that are not there (describe)			
71.	Self-conscious or easily embarrassed			
72.	Sets fire			
73.	Sexual problems (describe)			
74.	Showing off or clowning			
75.	Shy or timid			
76.	Sleeps less than most children			
77.	Sleeps more than most children during day/and night			
78.	Smears or plays with bowel movement			
79.	Speech problem (describe)			
80.	Stares blankly			
81.	Steals at home			
82.	Steals outside the home			
83.	Stores up things s/he does not need (describe			
84.	Strange behavior (describe)			
85.	Strange ideas (describe)			
86.	Stubborn, sullen or irritable			
87.	Sudden changes in mood or feelings			
88.	Sulks a lot			
89.	Suspicious			
90.	Swearing or obscene language			
91.	Talks about killing self			
92.	Talks or walks in sleep (describe)			
93.	Talks too much			
94.	Teases a lot			
95.	Temper tantrum or hot temper			
96.	Thinks about sex too much			
97.	Threatens people			
98.	Thumb sucking			
99.	Too concerned with neatness or cleanliness			
100.	Trouble sleeping			
101.	Skips school			

102.	Underactive, slow moving or lacks energy			
103.	Unhappy, sad or depressed			
104.	Unusually loud			
105.	Uses alcohol or drugs			
106.	Vandalism			
107.	Wets self during the day			
108.	Wets in the bed			
109.	Whining			
110.	Wishes to be of the opposite sex			
111.	Withdrawn, does not get involved with others			
112.	Worrying			
113.	Please mention any other problem your child has that has not been mentioned above			

APPENDIX VI

Conners' Abbreviated Parent Questionnaire

		Sometimes	Frequently	Always
1)	The child is restless or overactive			
2)	The child is excitable or impulsive			
3)	The child disturbs other children			
4)	Fails to finish things s/he starts/ short attention span			
5)	Constantly fidgeting			
6)	Inattentive, especially distracted			
7)	Demands must be met immediately, easily frustrated			
8)	Cries easily and often			
9)	Mood changes quickly and drastically			
10)	Temper tantrums, explosive and unpredictive behaviour			

APPENDIX VII

Indian Scalefor Assessment of Autism

Social relationship and reciprocity		Rarely	Sometimes	Frequently	Mostly	Always
1.	has poor eye contact					
2.	lacks social smile					
3.	remains aloof					
4.	does not reach out to others					
5.	Unable to relate to people					
6.	unable to respond to social/environmental cues					
7.	engages in solitary and repetitive play activities					
8.	unable to take turns in social interaction					
9.	does not maintain peer relationships					
Emotional responsiveness						
10.	shows inappropriate emotional response					
11.	shows exaggerated emotions					
12.	engages in self-stimulating emotions					
13.	lacks fear of danger					
14.	excited or agitated for no apparent reason					
Speech-language and communication						
15.	acquired speech and lost it					
16.	has difficulty in using non-verbal language or gestures to communicate					
17.	engages in stereotyped and repetitive use of language					
18.	engages in echolalic speech					
19.	produces infant squeals /unusual noises					
20.	unable to initiate or sustain conversation with others					
21.	uses jargon or meaningless words					
22.	uses pronoun reversals					

23.	unable to grasp pragmatics of communication (real meaning)					
Behaviour patterns						
24.	engages in stereotyped and repetitive motor mannerisms					
25.	shows attatchment to inanimate objects					
26.	shows hyperactivity/restlessness					
27.	exhibits aggressive behaviour					
28.	throws temper tantrums					
29.	engages in self-injurious behaviour					
30.	insists in sameness					
Sensory aspects						
31.	usually sensitive to sensory stimuli					
32.	stares into spaces for long periods of time					
33.	has difficulty in tracking objects					
34.	has unsual vision					
35.	insensitive to pain					
36.	responds to objects/people unusually by smelling ,touching or tasting					
Cognitive component						
37.	inconsistent attention and concentration					
38.	shows delay in responding					
39.	has unusual memory of some kind					
40.	has ‘savant’ ability					

APPENDIX VIII

CERTIFICATE OF PRESENTATION

This is presented to

Sonu Darnal

for participating in the poster presentation titled on Autism: Integration & Diversity at Sammilit, 2020. The Second International Autism Conference was hosted by the India Autism Center at Amity University,Kolkata.

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APPENDIX IX

Sr. No-433

7th International and 9th Indian

Psychological Science Congress

28th -29th November, 2020 @ Virtual Platform

Epidemic and Well Being: The Voices of Psychology

NAPS

Certificate of Honor for Presentation / Participation Awarded to:

This certifies that Ms. SONU DARNAL
Research Scholar, Department of Psychology, Sikkim University, Gangtok, Sikkim -India, has presented her research paper:

ANXIETY AND COPING BEHAVIOUR IN COLLEGE STUDENTS DURING COVID-19: A PILOT STUDY

29th November, 2020 at 1.00-2.30 pm in Session-20

Organizers

National Association of Psychological Science-India

Department of Psychology,
Arba Minch University, Ethiopia

BRICS International Forum

BRICS-International Forum

JAX Foundation
One Word One Family!

Jax Foundation, New Delhi

Dr. Roshan Lal Dahiya
Director-IIPSC-2020

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APPENDIX X

31st Convention of National Academy of Psychology 2021-2022

On

"Psychology and Social Justice at the Time of COVID-19 Pandemic: The State, Community, and Individual Perspectives"

This is to certify that

*Ms./Mr./Dr./Prof. Sonu Darnal has successfully contributed as a participant in Oral Presentation entitled "Psychological Correlates of Sensory Processing in Individuals with Autism Spectrum Disorder and Attention Deficit Hyperactive Disorder"at the **31st convention of National Academy of Psychology 2021-2022** organised by the Psychophysiology Laboratory, Department of Humanities and Social Sciences, Indian Institute of Technology Bombay from 4-6 March, 2022.*

NAOP President (2021-2022)
Prof. Minati Panda
Jawaharlal Nehru University, New Delhi

Organizing Secretary
Prof. Azizuddin Khan
Indian Institute of Technology Bombay, Mumbai

APPENDIX XII

11TH INDIA INTERNATIONAL

PSYCHOLOGICAL SCIENCE CONGRESS

8-9 OCTOBER, 2022

HYBRID MODE

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DEPT OF PSYCHOLOGY PANJAB UNIVERSITY CHANDIGARH
NATIONAL ASSOCIATION OF PSYCHOLOGICAL SCIENCE - INDIA

This Certificate is Presented To

Prof./Dr./Ms./Mr. Sonu Daral Institute SIKKIM UNIVERSITY

Participated/Presented Research Paper Titled Sensory Processing, Anxiety and depression in children with Autism spectrum Disorder and ADHD

Online/Offline in 11TH IIPSC-22, Scientific Session 1

Chaired by Prof./Dr. Rohtash Singh, Payal Kanwar Chandel

OUR PARTNERS:

Department of Psychology
Saurashtra University, Rajkot, Gujrat-INDIA

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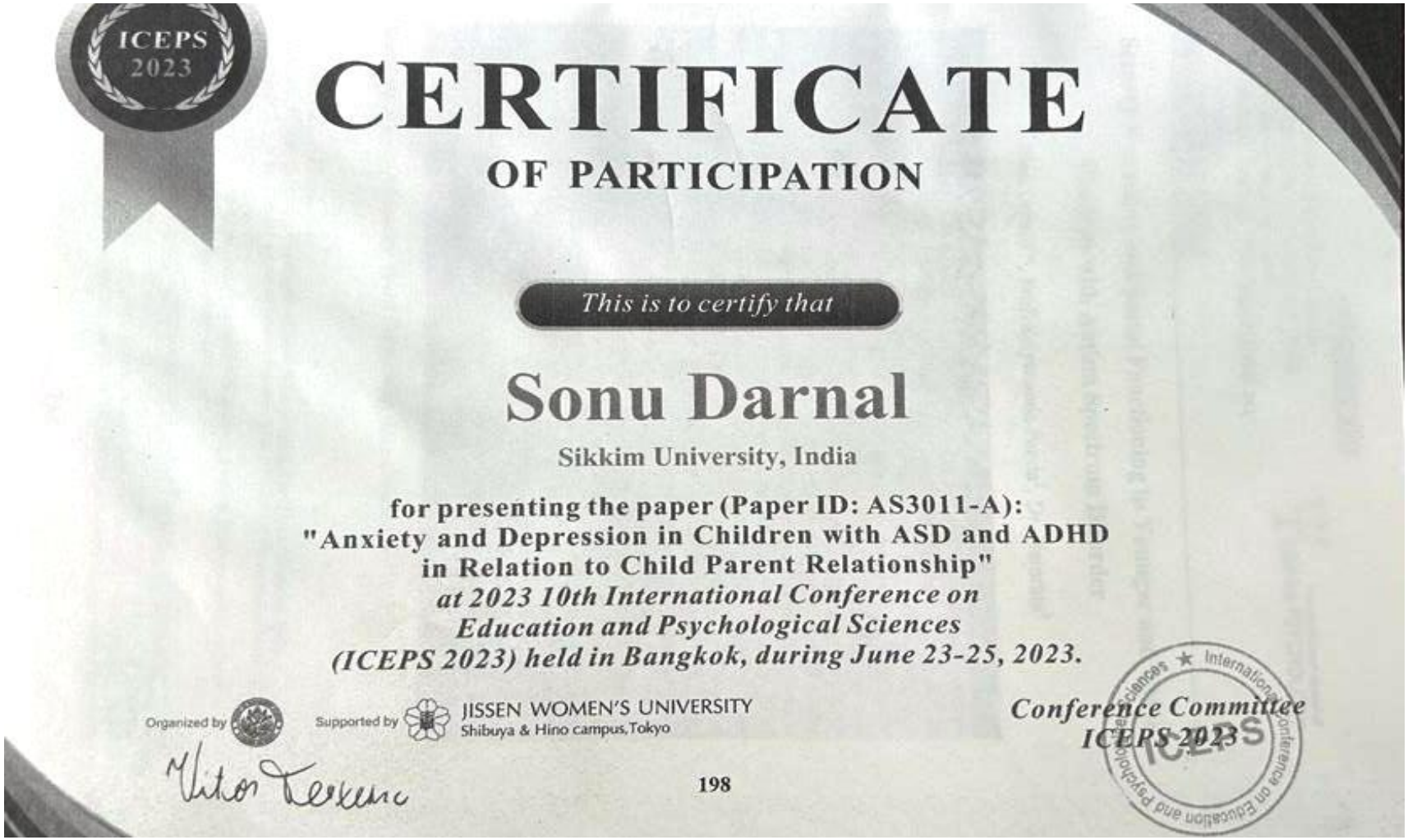
Dhaka, Bangladesh

Eq4 Peace, Worldwide.Inc, USA

Prof. Radhey Shayam
General Secretary
NAPS

Dr. Roshan Lal
Chairperson, Dept. of Psychology
Panjab University, Chandigarh

APPENDIX XI



ICEPS 2023

CERTIFICATE

OF PARTICIPATION

This is to certify that

Sonu Darnal

Sikkim University, India

for presenting the paper (Paper ID: AS3011-A):
"Anxiety and Depression in Children with ASD and ADHD in Relation to Child Parent Relationship"
at 2023 10th International Conference on Education and Psychological Sciences (ICEPS 2023) held in Bangkok, during June 23-25, 2023.

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APPENDIX XII

APPENDIX XIII
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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

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