Sleep Disturbances in Children with Autism Spectrum Disorder and Their Impact on Behavioural and Educational Outcomes

Arnav Gupta[1], Navya Gupta[2], Dr Hemant Gupta[3]

[1]Student Researcher, Wayzata High School, Plymouth, MN, USA, MeritPlus Research Program, Minnesota, USA.
Email ID: arng135@gmail.com

[2]Undergraduate Researcher, University of Minnesota, Minneapolis, MN, USA, MeritPlus Research Program, Minnesota, USA.
Email ID: navg2306@gmail.com

[3]Research Mentor, MeritPlus Research Program, Minnesota, USA.
Email ID: info@themeritplus.com

HOW TO CITE:
Arnav Gupta, Navya Gupta, Hemant Gupta (2026). Sleep Disturbances in Children with Autism Spectrum Disorder and Their Impact on Behavioural and Educational Outcomes. International Journal of Special Education, 41(6s), 750-770.

ABSTRACT:
Sleep-related difficulties are highly prevalent among children diagnosed with autism spectrum disorder (ASD) and are considered a major factor influencing their overall development and daily functioning. Disturbed sleeping patterns not only affect physical health but also influence emotional balance, adaptive behaviour, cognitive efficiency, and school participation. Children with ASD frequently experience irregular sleeping habits that may contribute to frustration, mood instability, reduced tolerance levels, and difficulties in managing social situations. These challenges often intensify existing developmental concerns and create additional stress for caregivers and educators. Educational functioning is also significantly influenced by inadequate sleep. Fatigue and poor sleep quality may reduce a child's ability to remain attentive, process information effectively, participate in classroom activities, and maintain consistent academic performance. Sleep insufficiency may further interfere with language development, executive functioning, problem-solving skills, and peer interaction within educational settings. This review paper focuses on understanding the relationship between sleep disturbances and developmental outcomes in children with ASD. It examines major contributing factors responsible for disrupted sleep and discusses their association with behavioural complications and educational difficulties. The review also presents commonly used assessment tools and evidence-based management approaches aimed at improving sleep quality. Special attention is given to the role of coordinated support from families, schools, clinicians, and therapists in addressing sleep-related concerns. The paper emphasizes that early intervention and appropriate sleep management strategies can positively influence emotional well-being, behavioural adaptation, academic engagement, and overall

quality of life in children with ASD.

Keywords: Autism Spectrum Disorder (ASD), sleep disturbances, insomnia, behavioural outcomes, educational outcomes, aggression

1. Introduction

Autism Spectrum Disorder (ASD) is a developmental condition that impacts a child's perception, processing, and response to the world around them (Yadav, 2020). It is typically linked to difficulties with language, social interaction, flexibility in behaviour, and sensory sensitivity (Crowell et al., 2019). As ASD is increasingly identified in various parts of the world, there can be a greater focus on what can affect the everyday functioning and future development of children with the condition (Gentil-Gutiérrez et al., 2021). Sleep health has also become an important consideration and is related to emotional, behavioural and educational outcomes amongst these factors (Qin et al., 2024).

Children's sleep is important for healthy neurological and psychological functioning. Sleep plays a role in brain maturation, information processing, emotional stability, rest and resilience, and adaptive learning skills (Schlieber & Han, 2021). A lack of sleep or poor sleep can affect children's ability to grow and function during the day. Sleep problems tend to be more common and more severe in children with ASD, and also make it more challenging to address developmental and behavioural needs.

Children with ASD frequently have irregular sleep patterns, long bedtimes, movement during sleep and frequent night-time awakenings (Galli et al., 2022). These problems can be caused by following factors: hypersensitivities to sensory input, biological rhythms, environmental stressors, and emotional regulation issues. Ongoing sleep disturbances can slowly impact the child's social responsiveness, coping skills, and daily functioning.

Impaired sleep behaviors may manifest as frustration, emotional outburst, inattention, repetitive behaviors, and decreased tolerance for change. This can make it more difficult to interact with peers, family, and engage in activities. Educationally, poor sleep may impact readiness for class, comprehension, motivation to learn and ability to finish tasks. Children may struggle to concentrate, attend to instruction, and be engaged in academic tasks (Rey et al., 2020).

Therefore, the link between sleep problems and developmental outcomes is important to comprehend so that supports can be enhanced for children with ASD (Albertini et al., 2025). This review paper highlights the most prominent sleep problems in the ASD community and reviews the impact these sleep problems have on behavioural adjustment and learning in children with ASD.

Children with Autism Spectrum Disorder (ASD) have a high prevalence of sleep disturbances, which have a significant effect on their behavioral, emotional, cognitive, and social function. Insomnia, delayed sleep onset, night awakenings, parasomnias, daytime sleepiness and poor sleep quality are more common in children with ASD as compared to typically developing children. Galli et al., 2022 found that almost 57% of children with ASD had sleep disturbances which were linked to developmental delay, anxiety, aggressive behavior and emotional difficulties. In line with this, Wang et al. (2021) found that preschool children with ASD exhibited higher sleep onset latency and greater night time waking, particularly bedwetting and restlessness were prolific causes of internalizing and externalizing behaviors. There is also preliminary evidence that behavioral sleep interventions can be effective. Papadopoulos et al. (2022) showed that a short-term behavioral sleep intervention effectively decreased sleep issues and enhanced emotional and quality of life outcomes among children with autism. In addition, a systematic review by Whelan et al. (2022) found that sleep quality has a negative impact on social functioning and there is evidence for behavioural problems that further impair sleep quality, and anxiety and sensory sensitivity also contribute to

sleep problems. Lindor et al. (2019) pointed out that sleep problems may aggravate clinically significant behavioral issues, irrespective of the severity of the ASD symptoms, and concluded that sleep problems should be assessed routinely. Furthermore, Kim et al. (2024) conducted a recent meta-analysis which found high correlations between sleep problems, ASD core symptoms, and behavioral disturbances, suggesting that there are distinct types of sleep problems that uniquely affect behavioral outcomes. Together, they highlight the need of early detection and intervention for sleep problems in children with ASD to ensure better behavioral control, emotional well-being, and quality of life.

2. Autism Spectrum Disorder: An Overview

ASD is a neurodevelopmental disorder, which impacts the way one communicates, interacts socially and responds to the environment (Naji et al., 2020). Autism Spectrum Disorder (ASD) is described as a "spectrum" because its characteristics and severity vary considerably among individuals. Clinically, an ASD diagnosis is based on persistent deficits in social communication and social interaction, together with restricted, repetitive patterns of behavior, interests, or activities, as defined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). Symptoms must be present in early developmental periods, cause clinically significant impairment in social, educational, or occupational functioning, and cannot be better explained by intellectual disability alone. The DSM-5 further classifies ASD into three severity levels based on the amount of support required: Level 1 ("requiring support"), Level

2 ("requiring substantial support"), and Level 3 ("requiring very substantial support") (American Psychiatric Association, 2022). Studies indicate that individuals diagnosed with ASD demonstrate significant impairments in social communication and repetitive behaviors that exceed normal developmental variation, with standardized diagnostic tools such as the Autism Diagnostic Observation Schedule (ADOS-2) and Autism Diagnostic Interview-Revised (ADI-R) commonly used to establish diagnostic thresholds. Lord et al. (2020) reported that these instruments show high diagnostic accuracy and remain the gold standard for ASD assessment. Furthermore, a comprehensive review by Zeidan et al. (2022) estimated a global prevalence of approximately 1 in 100 children, highlighting the broad heterogeneity of ASD while emphasizing that diagnosis requires clinically significant symptoms that meet established diagnostic criteria rather than merely exhibiting isolated autistic traits. Some children with ASD can have very good intellectual abilities and functional language skills but for others, there may be challenges with verbal communication, adaptive behaviour and independent functioning. Many people with ASD have the following traits: focusing on limited interests, repetitive behaviors, trouble understanding social signals and reactions to sensory, light, sound, touch and texture (Consoli et al., 2025). These features are likely to affect how the child expresses his emotions, how he relates to others and how he engages in the routines of everyday life.

The exact cause of ASD is not fully understood yet, however, scientific evidence at this time points to a combination of genetic, neurobiological and environmental factors. Studies have shown that the disorder isn't caused by one thing alone, but instead that there are various risk factors that lead to abnormal brain development and function. Genetic factors are thought to play a strong role as twin and family studies have shown that there is a significant genetic component, and many genes linked to the development of the brain, to the way in which neurons communicate with one another, and to the way in which they normally develop have been identified. Moreover, pregnancy and birth-related issues like maternal infections, pregnancy complications, advanced parental age, exposure to environmental pollutants, and prenatal stress have been linked to a higher risk for ASD. Neurobiological research has also demonstrated structural and anatomical, neural connectivity, neurotransmitter, and sensory processing differences in people with ASD. There may be abnormalities in the systems of certain neurotransmitters, such as serotonin, dopamine, gamma-aminobutyric acid (GABA), and

melatonin, which can lead to challenges with social communication, emotional regulation, repetitive behaviours, attention and sleep. In addition, ASD children have been reported to have disrupted circadian rhythms in many cases, and sleep problems are thought to be an important factor in the high rates of sleep problems that are seen in these children (Abdul et al., 2022). All of these biological and environmental exposures occur during development and can have a profound impact on cognitive function, emotional functioning, adaptive behaviour and quality of life of children with ASD.

Children affected by ASD may need more educational and behavioral help to meet their developmental needs. Communication problems, attention issues, emotional regulation and issues with peer interaction can present barriers to learning in the classroom and engaging in social participation (Romero-Ayuso et al., 2022). There are many areas in which children struggle to follow directions, adjust to the changes in routine, or focus on academic work. Concentration, learning abilities and behavioural stability may be additionally affected by co-occurring conditions, especially sleep difficulties. Knowledge of both the developmental and educational aspects of ASD is therefore crucial for developing effective interventions and supportive learning environments that foster the overall well-being and development of children with ASD.

3. Sleep Disturbances in Children with ASD

3.1 Prevalence of Sleep Problems

Children with ASD experience significantly more sleep problems than others in the general pediatric population. Multiple studies have shown that many children with ASD continue to suffer from persistent sleep issues, and that parents report such problems (Chen et al., 2021). These problems can occur at varying severity in different children in relation to their developmental age and capacity, different health issues that they may have, their family environment, and their natural behaviour (Galli et al., 2022). Sleep disturbances are among the most frequently reported co-existing problems in ASD, as these have been linked with emotional and daytime functioning and developmental issues.

In many cases, sleep problems start to appear in the early years in childhood and persist for long periods of time if left untreated. Sleep problems in children with ASD, unlike those found in some other children, are frequently chronic and challenging, and are caused by neurological and sensory dysfunction (Albertini et al., 2025). Persistent sleep disturbances can have detrimental effects on the child's functioning in the family, in school, and in their ability to interact through communication. Long-lasting sleep issues can also hamper therapeutic improvement and education development, highlighting the significance of early recognition and management especially in kids with ASD.

3.2 Types of Sleep Disturbances

Children with ASD experience various forms of sleep disturbances, including:

3.2.1 Insomnia

Insomnia is a common sleep disorder characterized by persistent difficulty initiating sleep, maintaining sleep, or returning to sleep after awakening despite having adequate opportunities for rest. According to clinical diagnostic criteria, insomnia becomes clinically significant when sleep difficulties occur regularly and result in daytime impairment such as fatigue, reduced concentration, mood disturbances, decreased productivity, and impaired social or occupational functioning (Krystal et al., 2019). In the general population, chronic insomnia affects approximately 10–20% of adults and 5–10% of children, making it one of the most prevalent sleep disorders worldwide. Individuals suffering from insomnia frequently experience irritability, anxiety, memory difficulties, emotional instability, reduced cognitive performance, and lower overall quality of life.

The biological mechanisms underlying insomnia involve dysregulation of the sleep–wake cycle, increased physiological arousal, alterations in neurotransmitter activity, and disturbances in circadian rhythm regulation. Hyperactivity of the hypothalamic-pituitary-adrenal (HPA) axis,

elevated cortisol levels, and abnormalities in neurotransmitters such as gamma-aminobutyric acid (GABA), serotonin, dopamine, and melatonin have all been implicated in the development and persistence of insomnia. Psychological factors including stress, anxiety, depression, and emotional dysregulation further contribute to difficulties in initiating and maintaining sleep.

Children with Autism Spectrum Disorder (ASD) exhibit substantially higher rates of insomnia than typically developing children. Research suggests that between 40% and 80% of children with ASD experience clinically significant sleep problems, with insomnia representing the most frequently reported complaint. In contrast, sleep disturbances affect approximately 20–30% of typically developing children (Cortese et al., 2020; Galli et al., 2022). A multicenter study by Chen et al. (2021) reported that sleep difficulties were significantly more prevalent among children with ASD, with many experiencing persistent insomnia symptoms that continued across developmental stages.

Several biological mechanisms explain why insomnia is particularly common and severe in ASD. One of the most significant factors is melatonin dysregulation. Melatonin is a hormone responsible for regulating the body's circadian rhythm and signaling the onset of sleep. Studies have shown that many children with ASD exhibit reduced melatonin production, delayed melatonin secretion, or abnormalities in melatonin-related genes, resulting in delayed sleep onset and fragmented sleep patterns (Ding et al., 2024). In addition, atypical functioning of neurotransmitter systems, including serotonin and GABA pathways, may impair the brain's ability to transition effectively from wakefulness to sleep.

Neurological differences associated with ASD also contribute to insomnia. Neuroimaging studies have identified alterations in brain regions involved in arousal regulation, sensory processing, and emotional control. These differences may create a state of chronic hyperarousal in which the nervous system remains excessively alert even during bedtime. Consequently, many children with ASD experience difficulty relaxing sufficiently to initiate sleep. Furthermore, abnormalities in circadian rhythm regulation, which are frequently observed in ASD, may disrupt normal sleep-wake cycles and contribute to irregular sleep schedules (Abdul et al., 2022).

Sensory processing abnormalities further exacerbate insomnia severity in ASD. Many children demonstrate hypersensitivity to environmental stimuli such as sounds, light, temperature changes, clothing textures, or tactile sensations. While such stimuli may be ignored by typically developing children, they can become overwhelming for children with ASD and significantly interfere with the ability to fall asleep or remain asleep throughout the night. Sensory hypersensitivity therefore acts as both a trigger and maintaining factor for insomnia.

Psychological and behavioral factors also play an important role. Anxiety disorders are highly prevalent in individuals with ASD, with estimates suggesting that up to 40–50% of autistic children experience clinically significant anxiety symptoms. Social stress, difficulties coping with changes in routine, repetitive thinking patterns, and emotional dysregulation can increase bedtime arousal and make it difficult to achieve the relaxation necessary for sleep onset. Children may become preoccupied with repetitive thoughts or experience heightened emotional responses to daily events, prolonging sleep latency and increasing nighttime awakenings.

The consequences of insomnia are often more severe in children with ASD than in typically developing peers. Research has demonstrated that insufficient sleep is associated with increased aggression, irritability, hyperactivity, repetitive behaviors, emotional dysregulation, and reduced adaptive functioning in autistic children (Kim et al., 2024). Sleep deprivation can also worsen core ASD symptoms by impairing social communication, attention, executive functioning, and learning capacity. Educationally, insomnia may contribute to poor classroom engagement, reduced concentration, memory deficits, and lower academic performance. Furthermore, persistent sleep difficulties can increase caregiver stress, negatively affect family functioning, and

reduce the effectiveness of behavioral and educational interventions.

Overall, insomnia represents one of the most prevalent and clinically significant sleep disorders in children with ASD. Its development is influenced by a complex interaction of circadian rhythm abnormalities, neurotransmitter dysregulation, sensory hypersensitivity, neurological differences, and psychological factors. Because insomnia can significantly worsen behavioral, emotional, and educational outcomes, early identification and intervention remain essential components of comprehensive ASD management.

3.2.2 Delayed Sleep Onset

Delayed sleep onset is difficulty getting to sleep in a normal time following the onset of sleep, which leads to a longer sleep latency. In general population, it can be caused by stress, anxiety, insufficient sleep hygiene, excessive screen time, irregular sleep schedules, and circadian rhythm disorders. People with a delayed sleep onset may have a lack of sleep, fatigue during the day, difficulty concentrating, mood swings, and diminished functioning in the daily world (Baranwal et al., 2023). Children with ASD have a higher rate of delayed sleep onset than typically developing children, with 50-80% reporting delayed sleep onset compared to 10-30% of the general pediatric population (Cortese et al., 2020; Galli et al., 2022). From a biological perspective, abnormalities in melatonin production, regulation of the circadian rhythm, neurotransmitter abnormalities, and sensory processing abnormalities are all responsible for sleep initiation difficulties. At the psychological level, anxiety, emotional instability, heightened sensitivity to stimuli, and refusal to accept change in the sleep schedule aggravate the arousal and sleep resistance at bedtime. This means that children with ASD have a more significant and chronic sleep onset issue, and this can result in shorter sleep duration, daytime sleepiness, attention deficits, behavioural issues, and poor academic performance.

3.2.3 Night Awakenings

Repeated interruptions of sleep after a person falls asleep is considered frequent night awakenings. Night awakenings are defined as having trouble maintaining sleep throughout the night, while delayed sleep onset is defined as having trouble getting to sleep in the first place.

Awakening may be a feature of insomnia, but can also be a problem in itself. In the general population, awakenings during the night can be due to stress, anxiety, sleep disordered breathing, environmental disturbances, medical disorders, nightmares, or disturbances of normal sleep architecture. Children with ASD arouse more often from sleep than typically developing children. Research has shown that about 40-60% of children with ASD will have some night waking, whereas typically developing children sleep through the night 10-20% of the time (Cortese et al., 2020; Galli et al., 2022). This is due to several biological factors, such as abnormalities in melatonin secretion, circadian rhythm dysregulation, changes in neurotransmitter activity and abnormal sleep architecture. Children can also wake up when they are more sensitive to sounds, light, temperature, or other environmental factors, such as a person who would not be affected. Anxiety and emotional outbursts, along with problems regulating emotions and coping, can further exacerbate nighttime awakenings in children with ASD. Many children after waking may not be able to go back to sleep alone and will experience more wakefulness and poorer sleep continuity. Disturbed sleep may affect how well you remember what you learn, how you regulate your emotions, how well you pay attention, and how well you function during the day. If night time awakenings last for a long time they can also lead to irritability, behavioral problems, learning challenges and caregiver stress and fatigue.

3.2.4 Reduced Sleep Duration as a Consequence of Sleep Disturbances

Shortened sleep time" is a decrease in the quantity of sleep needed for optimal physical, cognitive and emotional function. Reduced sleep duration is not commonly a primary sleep disorder itself, but is generally a result of other sleep disorders including insomnia, or night awakenings, or circadian rhythm disorders. Children may have shorter sleep times due to extended time taken to fall asleep,

frequent nighttime awakenings, waking too early in the morning or irregular sleep-wake cycles.

Sleep is especially important for children with ASD who often have sleep issues such as insomnia, delayed sleep onset, and circadian rhythm problems. These studies have found children with ASD sleep much less than the typical child and are at a higher risk for chronic sleep insufficiency (Williams Buckley et al., 2020). Biological factors, including reduced melatonin regulation, hyper-sensitivity to senses, and abnormalities in the regulation of circadian rhythm, may also play a role in the decrease of total sleep time.

Sleep deficits may impair attention, memory, emotional control, executive functioning and behavioral control. Consistently poor sleepers might exhibit hyperactivity, impulsivity, low levels of frustration tolerance, and lack of motivation to engage in learning activities. Long-term sleep deprivation can have a negative impact on school performance, social interactions, growth, and quality of life (Schlieber & Han, 2021).

3.2.5 Circadian Rhythm Disorders

Circadian rhythm disorders are a disturbance of the body's internal clock that influences when people fall asleep and get up, when their hormones are released, their body temperature changes, and the timing of other functions during a 24-hour period. These disorders are frequently seen in children with ASD as delayed sleep phase syndrome (DSPS) (difficulty falling asleep until very late at night), irregular sleep-wake rhythm, inconsistent bedtime and wake time, decreased production of melatonin, delayed production of melatonin, and disturbed sleep (Hoshino, 2023). This can lead to late bedtimes, early morning struggles to wake and irregular sleep patterns.

There are multiple biological mechanisms that relate to circadian rhythm disturbances in ASD. The abnormalities in the synthesis and secretion of melatonin, altered expression of circadian clock genes, sleep-wake cycle regulatory neurotransmitter abnormalities and atypical functions of brain regions involved in sleep-wake cycles are found in research (Abdul et al., 2022). In addition, sensory sensitivities and decreased sensitivity to environmental time cues (light exposure, daily activities etc.) can further impair circadian regulation.

Children with ASD are more likely to have circadian rhythm disorders than typically developing children. These are themselves can be accompanied by chronic sleep deprivation, fatigue during the day, less alertness, emotional instability, attention problems, and poor behavioural regulation. Irregular sleep-wake cycle can have adverse effects on school attendance, participation in classes, academic performance and social relations with classmates during the school environment. These ongoing misalignments of the circadian rhythm may therefore have a profound effect on developmental and learning outcomes of children with ASD (Hyndych et al., 2025).

3.2.6 Parasomnias

Unusual behaviours or experiences that occur during sleep, which are also seen in children with ASD. These can be nightmares, night terrors, sleep walking, teeth grinding, movement during sleep or sudden emotional responses (Mughal et al., 2021). These disruptions may disrupt typical sleep cycles and cause fear, confusion, or anxiety. Parasomnias are seen as a result of sensory sensitivities, emotional stress, and neurological irregularities. Children with these conditions may have a troubled or unstable mood when they wake up. The ongoing problem with parasomnias can have a negative impact on emotional control, focus, daytime activities and psychological health, impacting the family and education.

4. Causes of Sleep Disturbances in ASD

Children with Autism Spectrum Disorder have sleep difficulties due to a combination of internal and external factors which interfere with normal sleep patterns (Karthikeyan et al., 2020). These causes may intersect and differ in individual children depending on developmental factors, the environment, and any additional health issues. Irregularities in the body, emotional issues, sensory reactions and lifestyle choices are all potential factors that can disrupt sleep. To create effective interventions and contribute to overall wellness in

children with ASD, it is important to understand these underlying causes.

4.1 Neurological and Genetic Factors

Cognitive differences in the functioning of the brain in children with ASD may relate to sleep regulation. Changes in how the brain works, such as abnormal activity in the neurotransmitters and disruptions in the sleep-wake control areas can disrupt sleep (Dell'Osso et al., 2022). Variations in the genes linked to ASD also can influence their natural sleep cycles. These neurological variations might make it harder for them to sleep, cause them to be more awake at night, and make it harder for them to fall asleep at the same time. Neurological abnormalities have been shown to also significantly affect the quality and length of sleep-in children with ASD, as there is a strong link between brain development and sleep regulation.

4.2 Melatonin Dysregulation

Melatonin is a hormone secreted mainly by the pineal gland which is responsible for the body's circadian rhythm and sleep-wake cycle. In several studies, children with ASD have been shown to have an increased risk of abnormalities in melatonin production, secretion or metabolism compared to typically developing children (Ding et al., 2024). But not everyone with ASD has some form of melatonin dysfunction and it does not define ASD; it is only a contributing factor.

Studies indicate that some people with ASD may have reduced levels of the hormone melatonin during nighttime, the timing of melatonin release may be delayed, or they may have changes in the genes responsible for melatonin production. These irregularities can affect a person's internal clock, making it harder to fall and stay asleep. This leads to children having problems with falling asleep, waking up during the night, irregular sleep-wake cycles and poor sleeping quality.

Even though there is a strong association with melatonin abnormalities and ASD, at this time there is no direct evidence that shows that autism is a direct cause of melatonin abnormalities. Rather, melatonin dysfunction is believed to be a contributing factor to greater sleep problems in children with ASD among several neurobiological factors. The difficulties with sleep that often follow such emotional or behavioral disturbances may then lead to further emotional and behavioral problems, and to poorer attention, learning, and functioning during the day.

4.3 Sensory Sensitivities

Children with ASD are very likely to have sensory processing problems, which can profoundly influence sleep patterns. Some kids are hyper-sensitive to sound, lighting, fabrics, temperature or touch. Any stimulus to the environment, even if it does not bother other children, can cause discomfort and make relaxation difficult (Asher, 2022). A sensory hypersensitivity can lead to greater night time restlessness (at bedtime) and sleep continuity problems (at night). Children also may be upset by a change in sleeping schedule or by new environments. Sensory related reactions can make it hard for the child to have a quiet and settled sleep required for optimal development.

4.4 Anxiety and Emotional Dysregulation

Many emotional challenges that are common in children with ASD can disrupt their sleep patterns, causing them to have trouble getting to bed and sleeping soundly (Asher, 2022). High anxiety and worry, social stress, and emotional reactivity can cause mental arousal at bedtime. Some children with difficulty controlling their emotions may have trouble settling down before bedtime, resulting in staying awake longer and not sleeping as well. Emotional distress can also cause nightmares or fears, re-waking or repeated awakenings. This can then lead to poor sleep patterns and poor sleep quality, and on a long-term basis, have an impact on emotional well-being, behaviour and functioning during the day.

4.5 Behavioural Factors

Common factors for sleep problems in general and in people with an ASD include behavioural and lifestyle factors. The sleep initiation and maintenance are disrupted by irregular bedtime schedules, inconsistent sleep routines, excessive use of electronic devices before sleep, stimulating activities at night, and poor sleep hygiene (Wang et al., 2021). These behaviors can disrupt normal

circadian rhythms, delay release of melatonin, raise physiological arousal and decrease the quality of sleep. Eventually, these behaviors can become ingrained and lead to persistent sleep problems.

These factors can impact on many children, but can have a greater impact in children with ASD. Poor sleep habits can exacerbate symptoms of ASD such as sensory hyper-sensitivity, anxiety, emotional dysregulation, hyperactivity, repetitive behaviours and a preference for routine. For instance, any disruption in bedtime routine can be more distressing for a child with ASD than for a typical child, increasing resistance at bedtime and time to sleep. Likewise, having a repetitive interest or challenges with calming down could lead to an increased cognitive and emotional arousal at bed time, which may make it harder to fall asleep. This suggests that in addition to being a potential cause of sleep problems in children with ASD, behavioural and lifestyle factors can also worsen sleep difficulties and make them more chronic and intense, underscoring the need for behavioral interventions and for children with ASD and their families to maintain good sleep hygiene.

4.6 Medication Side Effects

Some medications taken to control behavioral, emotional and attention problems in children with ASD can cause sleep problems. While there are no medicines that directly affect the main symptoms of ASD, there are some medicines that are used to control associated symptoms like hyperactivity, attention-deficit/hyperactivity disorder (ADHD), irritability, aggression, and anxiety (Esposito et al., 2020).

Medications that are used for attention and hyperactivity symptoms (such as stimulants like methylphenidate (Ritalin®, Concerta®) and amphetamine based medications (Adderall®) may have side effects that include insomnia, difficulty falling asleep, and waking up at night. Some children may experience sleep disturbances, restlessness or vivid dreams while taking selective serotonin reuptake inhibitors (SSRIs), such as fluoxetine (Prozac®) and sertraline (Zoloft®), which are sometimes prescribed for anxiety and repetitive behaviour.

Some of the most frequently prescribed drugs to treat irritability and aggressive behaviors in children with ASD include atypical antipsychotic medications, especially risperidone (Risperdal®) and aripiprazole (Abilify®). These may be associated with behavioural improvements and on occasion can induce drowsiness, but some can also alter sleep architecture, increase daytime drowsiness, or cause weight gain which can have indirect effects on sleep quality. Some other drugs, such as those prescribed for anxiety, mood disorders or behavioral control, may also affect sleep depending on dose, length of time on the drug and response.

Sleep effects from medication should be closely monitored given that sleep problems are already prevalent among children with ASD. Disturbed sleep can also have implications for behaviour, emotional functioning, attention, learning, and daytime functioning. Thus, ongoing evaluation of sleep habits should be an integral part of the management of medication in children who have an ASD.

5. Impact of Sleep Disturbances on Behavioural Outcomes

Good sleep helps regulate emotions, behavior and adaptive functioning in children with autism spectrum disorder. If sleep is disturbed or inadequate, children may have severe behavioural problems which affect their daily functioning and relationships (Galli et al., 2022). Poor sleep is associated with poor emotional control, decreased coping, and increased behavioural instability. Children with ASD may thus experience worsening developmental difficulties and have a detrimental impact on their social, emotional and psychological functioning as a result of persistent sleep issues.

5.1 Aggression, Irritability, Hyperactivity, and Impulsivity

Children with ASD have been reported to experience sleep disturbances that can have a significant impact on their behavioural regulation, including more aggression, irritability, hyperactivity and impulsivity. Sleep plays a critical role in emotional regulation, executive functioning

and emotional control. Children's emotional responses to sleep loss or sleep deprivation can increase, they may be less tolerant of frustration, and can be more likely to experience behavioral outbursts (Carter Leno et al., 2021).

Children may find it harder to control their reactions towards normal challenges in life because sleep deprivation affects brain areas that play a part in emotional control and inhibitory control. As a result, minor frustrations can cause tearfulness, shouting, aggression or other outbursts. Some children might also show higher levels of restlessness, excessive activity, fidgeting, trouble sitting still, and impulsivity that disrupts functioning (Bruni et al., 2021).

These effects can be more prominent in children with ASD as many children with the disorder have already challenges in emotional regulation, behavioural flexibility and self-control. Poor sleep can also make hyperactivity, repetitive behavior and impulsive reactions more extreme, and make it more difficult to follow rules, join in on organized activities and adjust to changes in routine. This behavioral problem can have a negative impact on family, teachers, and peers' relationships and may limit participation in learning and socializing activities.

There are several reports that indicated that children with ASD who have sleep disturbances also have higher rates of behavioural issues, including aggression, irritability, hyperactivity and impulsive behaviour, suggesting that better sleep quality could lead to improvements in emotional and behavioural functioning.

5.3 Repetitive Behaviours

Often individuals with ASD engage in repetitive actions and have a limited pattern of behaviour, and sleep difficulties can exacerbate these actions. When a child is not getting adequate sleep, he or she may engage in repetitive movements, rigid behaviors or self-stimulatory behaviors as a way to cope with fatigue or emotional discomfort (MacDuffie et al., 2020). Children's behavioural rigidity may also be heightened when they are physically tired or emotionally stressed. Stressful situations or changes in routine may make repetitive behaviors more obvious, which can make daily living and behaviour management more difficult for child care workers, teachers, and therapists caring for children with ASD.

5.4 Social Withdrawal

Children may be less inclined and able to engage in social interaction if they experience sleep disturbances. Emotional exhaustion and fatigue during the day can make it harder to listen and interact socially, or even to play. Children might seem unfriendly, unresponsive or withdrawn from other children and adults around them (Bowker et al., 2023). Limited social interaction may restrict communication skills, friendships and adaptive social behaviour development. Chronic withdrawal symptoms can also impact confidence and emotional health, which can make it challenging for children to be involved in educational and recreational settings and come up with social cooperation and interaction.

5.5 Anxiety and Emotional Distress

Children with ASD face heightened emotions, and an irregular sleep pattern can exacerbate anxiety and psychological strain on them. Lack of sleep can intensify fear, nervousness, emotional sensitivity and emotional imbalance. Children may be overly anxious, overwhelmed or not be able to cope with stress. Emotional exhaustion can also occur during the day due to fears at night and disruptions to sleep (Albertini et al., 2025). Emotional resilience can be negatively impacted by increased anxiety, which can also impact communication and behavior to affect adaptive functioning. The on-going emotional upset can have a substantial impact on the child's mental well-being and quality of life over time.

5.6 Attention Deficits

Good sleep is necessary for concentration, mental alertness and cognitive control. Children with ASD who do not sleep enough may have a poor ability to concentrate on tasks and activities. May be distractible, forget directions, have trouble in class assignments, or be unable to perform daily tasks. Poor executive functioning abilities (planning, organization, problem solving, and decision making) can also be impacted by sleep

deprivation (Aidman et al., 2019). Such attention impairments can impact behavioural efficiency and affect participation in education. Home and school are both places where children, parents and teachers can experience frustration and be limited in learning opportunities due to lack of concentration.

6. Impact of Sleep Disturbances on Educational Outcomes

Children's sleep is strongly related to their learning, engagement in classroom activities, and adjustment to the classroom. Adequate sleep is particularly important for children with ASD, as optimal cognitive, behavioural, emotional, and communicative functioning depends heavily on healthy sleep patterns (Tomaso et al., 2021). Consequently, sleep disturbances may significantly impair educational performance and classroom engagement. Inadequate sleep is associated with sub-optimal cognitive performance, emotional regulation, classroom involvement and general participation in the school-learning process. This can result in children struggling to reach their educational potential and their school's performance may not be consistent.

6.1 Reduced Academic Performance

Not getting enough sleep can have a negative effect on a child's academic skills and his or her educational progress. If a child has ASD and sleeps poorly, he or she might have a hard time grasping new ideas, recalling previous lessons, and being able to do schoolwork well. When the brain fails to get restorative sleep, cognitive functions like reasoning, comprehension in reading and problem-solving capabilities weaken (Alfonsi et al., 2020). It can also cause decreased mental alertness, which can impact learning speed and decrease productivity in classroom activities. Chronic sleep deprivation can impact test results, homework completion and academic success, which may hinder children from performing at the level of their developmental and educational abilities.

6.2 Impaired Attention and Concentration

Childhood poor sleepers frequently have trouble sustaining attention in school or formal learning activities. May be distracted by what is happening around them, may have a short attention span or may not be able to focus for a long time. Decreased concentration may impair listening abilities, task completion, and inability to follow multi-step instructions (Clemente-Suárez et al., 2024). In educational environments, inattention can result in problems finishing assignments, not understanding what is being taught, and not participating in class discussions. Sleep deprivation can also make a child less alert and responsive, and affect their capacity to absorb or process information presented in the classroom during the course of the school day.

6.3 Poor Classroom Behaviour

Disruptions in sleep can have a profound impact on behaviour in the classroom. Physically tired and emotionally drained children can become irritable, restless, frustrated and unable to adhere to classroom rules. These behaviours may be disruptive of teaching and limit the child's capacity to playfully engage in group learning experiences (Liu et al., 2024). Emotional outbursts and difficulties in responding to teachers due to poor sleep, can also lead to conflict with peers. Disruptions in behaviour can cause further learning and social difficulties, impacting learning opportunities and classroom dynamics. Persistent behavioral issues could also impact self-confidence, motivation, and engagement in classroom learning.

6.4 Learning Difficulties

Good sleep is crucial to brain function, memory and cognition. During the night, the brain filters and sorts out the information that has been gained throughout the day; this enhances memory and learning ability. Children may not learn new skills well or remember what they have learned in the classroom when they don't get enough or quality sleep (Sharma, 2026). ASD children may have an even greater challenge to acquire language, reasoning and adaptive learning abilities if sleep is sub-optimal. Students might struggle to comprehend lessons, to remember instructions and/or to use what they have learned, which can slowly impact on learning growth. Ongoing learning difficulties in sleep may also impact long-

term academic success and developmental outcomes.

6.5 Communication Challenges

Children with ASD often struggle to communicate and sleep deprivation could make this even harder. When people do not sleep well, verbal fluency, listening, emotional expression and social responsiveness are lowered during class discussions. Children might have difficulties in joining in with conversations, answering questions and responding to verbal and nonverbal cues (Camden & Silva, 2021). Another consequence of fatigue could be a diminished interest in interacting with peers and teachers, affecting social learning and collaborative experiences. The lack of communication, due to sleep disorders, may then impact on the learning process in an educational setting, and on social integration.

6.6 Reduced School Attendance

Interruptions in sleep patterns could be associated with absenteeism and decreased engagement in school-related activities. Chronic fatigue may make it hard for children to get up in the morning; stay alert during the school day; or adjust to scheduled school-based routines. For some, sleep deprivation and associated emotional distress and behavioural issues can result in school avoidance or refusal behaviours (Brigden et al., 2021). Students who miss classes often have difficulty maintaining flow of learning, engage less in classroom activities, and perform poorly on academic work. A lower attendance rate can also create less social interaction, skill development and less participation in extracurricular activities that are key components of overall education and personal growth.

7. Assessment and Diagnosis of Sleep Disturbances

The key to an accurate assessment of sleep disturbances is to understand the nature, severity and etiology of sleep problems in children with ASD. Many of the symptoms of sleep disorders are common to core ASD symptoms, behavioural problems, anxiety, attention problems, or medication side effects and a thorough assessment is needed to understand the causes of sleep difficulties. It is especially significant to identify sleep disturbances early because sleep disturbances, if not treated, can exacerbate behavioural regulation, emotional functioning, cognitive functioning and educational outcomes (McCarthy, 2021).

The assessment process usually includes clinical interviews, parent/caregiver reports, sleep diaries, standardised questionnaires, behavioural observations, and objective sleep measures. These methods can assist clinicians in differentiating sleep disorders, assessing the severity of symptoms, understanding the role of other biological and environmental factors, and determining if there are other medical or psychological conditions. A correct diagnosis is essential to determining the most effective interventions and to evaluating treatment over the course of time.

Considering that sleep issues are highly common in children with ASD, it is recommended to incorporate sleep screening into the routine clinical evaluation and developmental care of children with this condition.

7.1 Clinical Interviews

Clinical interviews are frequently employed as a first step to the assessment of sleep problems in children with ASD. In these interviews, health professionals gather a comprehensive set of information from parents or carers about the child's sleep patterns, bedtime rituals, sleeping time, night-time waking, and daytime behavior (Shanahan et al., 2021). Questions may also cover emotional issues, over-sensitivities to senses, surroundings and medical history that may affect sleep quality. Clinical interviews can assist healthcare providers in gaining insight into the type and prevalence of sleep-related issues and uncover any recurring themes that could warrant further investigation. This approach also provides a basis for the development of treatment and behaviour management plan for individuals.

7.2 Sleep Diaries

Sleep diaries can be helpful to document and track a child's sleep patterns on a day-to-day basis for a set time (Pina et al., 2020). Parents/carers usually

report on bedtimes, how long it takes to fall asleep, how many times they awaken during the night, how much sleep children get, and whether they feel tired during the day (Alamoudi et al., 2024). These records are useful for recognising abnormal sleeping habits, behaviours that may disrupt sleep, environmental conditions that can impact sleep. Information gained from sleep diaries can be used to obtain long-term data which may not be apparent at short clinical evaluations (Carlson et al., 2021). They can also be used by professionals to compare sleep behaviour pre and post intervention to assess and evaluate the effectiveness of treatment and where further behavioural or medical support is needed.

7.3 Questionnaires and Rating Scales

Common questionnaires and rating scales include standardized measures of sleep disturbance in children with ASD. These assessment instruments measure how often, how intensely, and how much problems with sleep interfere with functioning in daily life (Romeo et al., 2021). Parents, teachers or carers can fill in questionnaires regarding resistance to bedtime, anxiety about sleep, waking up during the night, daytime sleepiness and behaviour problems related to sleep (Galli et al., 2022). These tools offer systematic and dependable information which helps clinical assessment and research studies. Standardized tests also facilitate comparison of symptoms across ages and assist health and other professionals in identifying children that might benefit from specialized testing or therapeutic interventions.

7.4 Polysomnography

Polysomnography (PSG) is a full sleep study, which evaluates physiological activity during sleep. It can measure several biological parameters including brain activity (EEG), eye movements, muscle activity, heart rate, breathing patterns, oxygen saturation and body movements (Boulos et al., 2019). PSG is regarded as the gold standard in sleep diagnosis due to its objective and detailed sleep architecture and physiological information.

Polysomnography has been employed to study sleep disturbances in children with ASD with the aim of elucidating their prevalence and mechanisms. Children with ASD have been found to have differences in their sleep architecture, such as decreased total sleep time, sleep onset latency, sleep efficiency, and increases in the number of sleep arousals during sleep, alongside abnormalities in rapid eye movement (REM) sleep, compared with typical children (Cortese et al., 2020). PSG is also useful for detecting co-occurring sleep problems which can be important for behaviour and cognition, including OSA, PLMS and other sleep related breathing disorders.

The application of PSG in studies of ASD has yielded important findings on the underlying mechanisms of sleep disturbances, which indicate abnormalities in neural regulation, circadian rhythms and organization of sleep stages, which could be responsible for the high prevalence of sleep problems in this population. From a clinical standpoint, PSG can assist in distinguishing behavioural sleep problems from true physiological sleep disorders, thus providing health care professionals with more precise and effective treatment. Laboratory based PSG can be a difficult procedure for some children with ASD due to sensory sensitivities and unfamiliar environments, however it is an important test if complex or medically significant sleep disturbances are suspected (Qian et al., 2021).

7.5 Actigraphy

Actigraphy is an objective means of sleep-wake assessment that uses movement recording devices to monitor sleep-wake patterns over periods of time. Child will usually wear a small, like a wristwatch, that will track the child's movements during the day and night. Activity records can be used to estimate sleep duration, sleep interruptions and circadian rhythm patterns. This is especially valuable in children with ASD as it enables sleep monitoring in the natural home environment, not in clinical setting (Hunt, 2022). The method allows for objective sleep data on daily sleep habits and is able to establish if irregular sleep patterns are contributing to behavioural, emotional and educational issues.

8. Intervention Strategies

If sleep disturbance has been diagnosed and the

factors that contribute to it are determined, then interventions can be implemented to enhance sleep and daytime functioning for children with ASD. Sleep issues can result from a variety of factors, both behavioural, sensory, emotional and physiological, which means treatment needs to be a multidisciplinary and individualized approach (Cortese et al., 2020). Interventions that have been shown to be effective have been linked to emotional regulation, behavioural stability, cognitive functioning, academic engagement and quality of life (Chen et al., 2021). Effective management often requires cooperation between parents, health care providers, therapists and educators to ensure consistency in the home environment, clinical setting and educational environment.

8.1 Behavioural Interventions

When sleep hygiene measures alone are insufficient, behavioural interventions are often recommended to address persistent sleep difficulties in children with ASD. These interventions focus on modifying behaviours that interfere with healthy sleep and strengthening behaviours that promote consistent sleep patterns. Common approaches include establishing predictable bedtime routines, reducing bedtime resistance, promoting independent sleep initiation, and using positive reinforcement to encourage appropriate sleep behaviours (Chung et al., 2024).

Behavioural interventions are particularly important for children with ASD because difficulties with transitions, anxiety, sensory sensitivities, and strong preferences for routine may contribute to sleep problems. Structured behavioural strategies can help children develop consistent sleep habits while reducing bedtime stress for both children and caregivers. Studies have shown that behavioural sleep interventions can improve sleep onset, reduce night awakenings, increase total sleep duration, and enhance daytime functioning and quality of life (van Deurs et al., 2019; Papadopoulos et al., 2022).

8.3 Cognitive Behavioural Therapy

Children that are having anxiety related sleep problems may benefit from evidence-based psychological therapy, Cognitive Behavioural Therapy (CBT). This intervention is about recognizing negative thoughts, emotional stress and sleep-disruptive behaviors (Espie et al., 2019). Children could be taught relaxation techniques, emotional management skills and coping mechanisms with guided therapeutic approaches to reduce worry and psychological stress at bedtime. CBT can also help to modify unhealthy sleep behaviours and emotions that are linked to sleep routines. CBT can be adapted to the developmental and communication skills of the child and could be a component in improving sleep patterns and emotional distress.

8.4 Melatonin Supplementation

When the behavioural and environmental strategies do not result in sufficient alleviation of sleep problems, melatonin is often recommended as an addition (Palagini et al., 2021). In children diagnosed with ASD, melatonin may improve sleep onset and sleep maintenance, and help synchronize the body's internal sleep-wake cycle. Although melatonin has been shown to improve sleep onset and sleep duration in many children with ASD, uncertainty remains regarding the optimal dosage, timing of administration, long-term effectiveness, and individual variability in treatment response. Consequently, melatonin supplementation should only be considered following a thorough clinical evaluation to identify the specific causes of the child's sleep difficulties and to ensure that treatment is appropriate for their individual needs. Dosage and timing are crucial for desired effects and to preclude unwanted side-effects (Bjørklund et al., 2025). For some children, a combination of melatonin and supportive behavioural approaches will be more effective than medication alone, and will be able to help them sleep more restfully and in a more stable way.

9. Role of Parents, Teachers, and Healthcare Professionals

Treating sleep problems in children with ASD takes the cooperation of several people that are close to the child's daily activities. A co-ordinated support system is necessary to enhance overall functioning, as sleep issues can affect any of the

following areas: emotional behaviour, social interaction, communication and educational performance (Vlcek et al., 2020). Unique observations and interventions from parents, teachers, healthcare professionals, therapists and psychologists all work towards addressing sleep-related issues (Shi et al., 2025). This collaborative approach enables the child to get continuous guidance and support in a variety of places such as home, school, and clinical.

Parents are usually the first to observe changes in the child's sleeping behaviour and nighttime routines. They are one of the important factors in detecting symptoms like trouble falling asleep, waking up many times at night, irregular sleep patterns or daytime tiredness. Having a routine and keeping track of children's sleep schedules helps to provide a predictable environment that fosters healthy sleep habits (Tiwari & Talreja, 2020). They also play an important part in the use of behavioural strategies that professionals recommend, such as relaxing activities at bedtime and minimising environmental disturbances. Parents also give the professional useful information about how the child is emotionally reacting, sensitivities, habits, and why he or she has a sleep problem.

Teachers also play an important role in helping children with ASD and supporting their sleep. Sleep problems can impact your interest in participating in class, focus, emotional management and social exchange with peers (Galli et al., 2022). Teachers might observe symptoms like inattention, irritability, restlessness, loss of motivation and/or academic difficulty. When children are sleep-deprived, their learning and behaviour are affected, and educators can do much to minimize stress and enhance engagement in their classrooms through supportive teaching strategies (Albertini et al., 2025). Depending on the individual child, flexible approaches to teaching, predictable schedules, brief activity periods and rewards for positive behavior can assist them to manage through tiredness and emotional uncertainty during the day. Regular correspondence from teachers to parents can also provide a mechanism for communicating about changes in behaviour or achievement at school (Karthikeyan et al., 2020).

Sleep specialists, neurologists, psychologists, and paediatricians will all be involved in conducting a full assessment and determining if there are any medical, neurological, or psychological issues that may be responsible for the child's sleep problems. They might conduct clinical assessments, sleep tests, behavioural observations and standardized tests to identify the extent and frequency of the child's sleep problems (Corkum et al., 2019). Based on the results, individual interventions are suggested, which can range from behavioral therapy, sleep hygiene, counselling or medical intervention if needed. Therapists and counsellors might also help regulate emotions, manage anxiety, and provide effective coping strategies that can enhance sleep quality.

Communication between all support providers is key to ensuring consistency of interventions. Therefore, a collaborative approach between parents, teachers and health care professionals will increase their ability to track progress, identify triggers and adjust interventions as the child's needs evolve (Williams Buckley et al., 2020). This partnership contributes to the emotional support, behaviour and educational engagement. A multi-disciplinary support system thus has great importance in helping to encourage better sleeping habits and enhance children's quality of life with ASD.

9.1 Parent Training Programs

Education for parents is a key component of intervention planning as they are central to managing their child's sleep issues with ASD. Parent training programs offer information on bedtime management, behavioral strategies, sleep monitoring and environmental changes that promote sleep hygiene (Deb et al., 2020). These programs can educate caregivers about what can cause sleep issues and show them ways to improve sleep problems. Increased parent awareness and consistency can decrease family stress and enhance effectiveness of intervention. Education and training also give parents an opportunity to identify early signs of sleep-related problems and

to get professional help when needed.

9.2 Educational Support

Schools and education professionals can play a vital role in helping children with ASD to sleep. Students may show symptoms of tiredness, inattention, emotional instability or decreased participation in school activities due to poor sleep (MacDonald et al., 2021). Fatigue, inattention, emotional instability, or decreased engagement in classroom activities may be observed by teachers and school personnel. Academic stress and student engagement can be minimized through individualized educational accommodations, flexible learning strategies and classroom environments. School can also work with parents, and health professionals, to track changes in behaviour and learning resulting from sleep issues (Papadopoulos et al., 2022). Emotional supports, routine and learning supports provided in the educational environment have a positive impact on academic outcomes and can enhance overall functioning.

10. Future Research Directions

There has been considerable progress in the understanding of sleep disturbances in children with Autism Spectrum Disorder (ASD), but a number of areas are active research interests. In recent years, the multidimensional nature of sleep has started to be acknowledged in the literature, affecting their behaviours, emotions, cognitions and education. Thus, the long-term consequences of sleep disturbances throughout the lifespan are becoming a focus of research. Longitudinal studies are emerging as an important area of research with studies looking at the sleep patterns across childhood and into adolescence and adulthood and how these patterns relate to adaptive functioning, social participation, educational attainment and quality of life.

Another significant focus of scientific research is the neurologic mechanisms that underlie sleep disturbances in ASD. Scientists are now looking into how brain connectivity, neurotransmitter systems, circadian rhythm control, genetic mechanisms, and hormonal mechanisms that regulate sleep work. New methodologies in neuroimaging, molecular genetic and biomarker research have facilitated more nuanced examination of the neurobiological mechanisms which may underlie atypical sleep across ASD. This work is part of a larger ongoing effort to gain a better understanding of the diversity of sleep symptoms and their association with other core ASD features and comorbid conditions.

Sleep disturbances and other frequent problems in ASD have also garnered close attention in present studies. There have been recent studies looking at correlations between sleep and anxiety issues, Sensory Processing differences, attention problems, hyperactivity, emotional regulation and repetitive behaviours. It's not just sleep, but sleep and these other factors, and how they might affect each other over time.

There is also growing interest in culturally responsive and family-oriented methods of sleep management. It has been observed that sleep-related practices, parenting behaviours, family routines and environmental influences are significantly different in varying cultural and socioeconomic settings. Consequently, a search for more flexible models of intervention that take into account these contextual differences and increase the applicability of sleep-related interventions in diverse populations is emerging.

Schools are also a focus in the literature, though not as much as the other settings mentioned. In recent years, the link between sleep quality and education outcomes (e.g. academic achievement, in-school behavior, attention, and social involvement) has been investigated. School-based strategies like sleep awareness programs, teacher training and educational supports to support students with sleep challenges are also being investigated.

Another segment of research is the field of technological innovations. Wearable sleep monitoring devices, actigraphy, mobile health apps and digital behavioural monitoring systems have opened up new avenues to gain real-time sleep information in the natural environment. More and more of these technologies are being assessed for their accuracy, feasibility and clinical and research

applications. These developments can help to make more objective and ongoing sleep evaluations of children with ASD.

Lastly, scientists are still working to determine how sleep quality affects cognition. Ongoing research is investigating the role sleep plays in the consolidation of memory, in attentional and executive functions, in language acquisition, in emotional regulation, in learning potential and in academic performance. The more evidence that accumulates, sleep is coming to be seen as not just an associated problem in ASD but as a potential important factor affecting overall developmental trajectories and functional outcomes.

11. Conclusion

Sleep disturbances are among the most prevalent and clinically significant comorbidities associated with ASD, affecting multiple domains of functioning, including physical, emotional, behavioural, and educational outcomes. Children with ASD who have ongoing sleep problems are at risk for worsening their developmental issues as they become even less able to manage their emotions, pay attention, communicate and engage in everyday tasks. Sleep disturbances can also lead to behavioural instability, emotional sensitivity, and social problems, and have a negative impact on both family and school relationships. In the context of education, poor sleep is associated with a variety of problems in children that can negatively impact their ability to be present in class, understand and process information, maintain consistent academic productivity, or learn adaptations, all of which reduce the options available for intellectual and social development. The quality of sleep is associated with brain function and developmental progress, so early detection of sleep-related issues is of paramount importance.

Using appropriate assessment and interventions that are individualized can help determine underlying causes and better sleep outcomes. Behaviours, behavioural change, modifications to the environment, psychological support and medical advice can all play a role in improving sleep habits and daytime functioning. Consistency and continuity in intervention planning requires the involvement of parents, educators, clinicians and therapists. Supportive environments can be developed through a coordinated and multidisciplinary approach to promote emotional stability, behavioural improvement and academic participation. Additionally, better sleep could lessen stress levels in caregivers and improve family health. Despite rising awareness of sleep disturbances in individuals with ASD, ongoing research is needed to increase understanding of the biological, psychological, and environmental factors that impact sleep disturbances. Advances in scientific knowledge can help identify the most promising, readily available and tailored treatments. In general, addressing problems with sleep is an integral part of comprehensive developmental care for children with ASD, as they are shown to have a significant impact on their functioning, education and quality of life.

References

Abdul, F., Sreenivas, N., Kommu, J. V. S., Banerjee, M., Berk, M., Maes, M., ... & Debnath, M. (2022). Disruption of circadian rhythm and risk of autism spectrum disorder: role of immune-inflammatory, oxidative stress, metabolic and neurotransmitter pathways. *Reviews in the Neurosciences*, *33*(1), 93-109.

Aidman, E., Jackson, S. A., & Kleitman, S. (2019). Effects of sleep deprivation on executive functioning, cognitive abilities, metacognitive confidence, and decision making. *Applied cognitive psychology*, *33*(2), 188-200.

Alamoudi, D., Nabney, I., & Crawley, E. (2024). Evaluating the effectiveness of the SleepTracker app for detecting anxiety-and depression-related sleep disturbances. *Sensors*, *24*(3), 722.

Albertini, M. L., Spoto, G., Ceraolo, G., Fichera, M. F., Consoli, C., Nicotera, A. G., & Di Rosa, G. (2025).

Sleep disorders in children with autism spectrum disorder: developmental impact and intervention strategies. *Brain Sciences*, *15*(9), 983.

Alfonsi, V., Scarpelli, S., D'Atri, A., Stella, G., & De Gennaro, L. (2020). Later school start time: the impact of sleep on academic performance and health in the adolescent population. *International journal of environmental research and public health*, *17*(7), 2574.

Asher, A. D. (2022). The Influence of Classroom Design on Problem Behaviors and Educational Growth Indicators for Children with Autism Spectrum Disorder (ASD).

Baranwal, N., Phoebe, K. Y., & Siegel, N. S. (2023). Sleep physiology, pathophysiology, and sleep hygiene. *Progress in cardiovascular diseases*, *77*, 59-69.

Bjørklund, G., Oleshchuk, O., Ivankiv, Y., Venger, O., Liuta, O., Mocherniuk, K., ... & Shanaida, M. (2025). Melatonin interventions in autism spectrum disorder: sleep regulation, behavioral outcomes, and challenges across the lifespan. *Molecular Neurobiology*, *62*(8), 9710-9732.

Boulos, M. I., Jairam, T., Kendzerska, T., Im, J., Mekhael, A., & Murray, B. J. (2019). Normal polysomnography parameters in healthy adults: a systematic review and meta-analysis. *The Lancet Respiratory Medicine*, *7*(6), 533-543.

Bowker, J. C., Gurbacki, J. N., Richard, C. L., & Rubin, K. H. (2023). Anxious-withdrawal and sleep problems during adolescence: the moderating role of peer difficulties. *Behavioral Sciences*, *13*(9), 740.

Brigden, A., Shaw, A., & Crawley, E. (2021). "it'sa medical condition… you need to support as much as possible": a qualitative analysis of teachers' experiences of chronic fatigue syndrome/myalgic encephalomyelitis (CFS/ME). *BMC pediatrics*, *21*(1), 6.

Bruni, O., Breda, M., Ferri, R., & Melegari, M. G. (2021). Changes in sleep patterns and disorders in children and adolescents with attention deficit hyperactivity disorders and autism spectrum disorders during the COVID-19 lockdown. *Brain Sciences*, *11*(9), 1139.

Camden, C., & Silva, M. (2021). Pediatric teleheath: opportunities created by the COVID-

19 and suggestions to sustain its use to support families of children with disabilities. *Physical & occupational therapy in pediatrics*, *41*(1), 1-17.

Carlson, J. A., Tuz-Zahra, F., Bellettiere, J., Ridgers, N. D., Steel, C., Bejarano, C., ... & Natarajan, L. (2021). Validity of two awake wear-time classification algorithms for activPAL in youth, adults, and older adults. *Journal for the measurement of physical behaviour*, *4*(2), 151-162.

Carter Leno, V., Forth, G., Chandler, S., White, P., Yorke, I., Charman, T., ... & Simonoff,

E. (2021). Behavioural and physiological response to frustration in autistic youth: associations with irritability. *Journal of neurodevelopmental disorders*, *13*(1), 27.

Chen, H., Yang, T., Chen, J., Chen, L., Dai, Y., Zhang, J., ... & Li, T. (2021). Sleep problems in children with autism spectrum disorder: a multicenter survey. *BMC psychiatry*, *21*(1), 406.

Chung, K. M., Chung, E., & Lee, H. (2024). Behavioral interventions for autism spectrum disorder: a brief review and guidelines with a specific focus on applied behavior analysis. *Journal of the Korean Academy of Child and Adolescent Psychiatry*, *35*(1), 29.

Clemente-Suárez, V. J., Beltrán-Velasco, A. I., Herrero-Roldán, S., Rodriguez-Besteiro, S., Martínez-Guardado, I., Martín-Rodríguez, A., & Tornero-Aguilera, J. F. (2024). Digital device usage and childhood cognitive development: Exploring effects on cognitive abilities. *Children*, *11*(11), 1299.

Consoli, C., Turriziani, L., Antoci, M., Lo Monaco, M., Ceraolo, G., Spoto, G., ... & Di Rosa, G. (2025). Sensory Phenotypes in Autism Spectrum Disorder Associated with Distinct Patterns of Social Communication, Repetitive and Restrictive Behaviors or Interests, and Comorbidities: A State-of-the-Art Review. *Brain Sciences*, *16*(1), 53.

Corkum, P., Weiss, S., Hall, W., Brown, C., Chambers, C., Constantin, E., ... & Witmans,

M. (2019). Assessment and treatment of pediatric behavioral sleep disorders in Canada. Sleep medicine, 56, 29-37.

Cortese, S., Wang, F., Angriman, M., Masi, G., & Bruni, O. (2020). Sleep disorders in children and adolescents with autism spectrum disorder: diagnosis, epidemiology, and management. *CNS drugs*, *34*(4), 415-423.

Crowell, J. A., Keluskar, J., & Gorecki, A. (2019). Parenting behavior and the development of children with autism spectrum disorder. *Comprehensive psychiatry*, *90*, 21-29.

Deb, S., Retzer, A., Roy, M., Acharya, R., Limbu, B., & Roy, A. (2020). The effectiveness of parent training for children with autism spectrum disorder: a systematic review and meta-analyses. *BMC psychiatry*, *20*(1), 583.

Dell'Osso, L., Massoni, L., Battaglini, S., Cremone, I. M., Carmassi, C., & Carpita, B. (2022). Biological correlates of altered circadian rhythms, autonomic functions and sleep problems in autism spectrum disorder. *Annals of General Psychiatry*, *21*(1), 13.

Ding, W., Xu, Y., Ding, W., Tang, Q., Zhang, B., Yuan, Y., & Jin, J. (2024). Research progress on melatonin, 5-HT, and orexin in sleep disorders of children with autism spectrum disorder. *Biomolecules and Biomedicine*, *25*(3), 525.

Espie, C. A., Emsley, R., Kyle, S. D., Gordon, C., Drake, C. L., Siriwardena, A. N., ... & Luik, A. I. (2019). Effect of digital cognitive behavioral therapy for insomnia on health, psychological well-being, and sleep-related quality of life: a randomized clinical trial. *JAMA psychiatry*, *76*(1), 21-30.

Esposito, D., Belli, A., Ferri, R., & Bruni, O. (2020). Sleeping without prescription: management of sleep disorders in children with autism with non-pharmacological interventions and over-the-counter treatments. *Brain sciences*, *10*(7), 441.

Galli, J., Loi, E., Visconti, L. M., Mattei, P., Eusebi, A., Calza, S., ... & ASD Collaborative Group. (2022). Sleep disturbances in children affected by autism spectrum disorder. *Frontiers in psychiatry*, *13*, 736696.

Gentil-Gutiérrez, A., Cuesta-Gómez, J. L., Rodríguez-Fernández, P., & González-Bernal, J.

J. (2021). Implication of the sensory environment in children with autism spectrum disorder: Perspectives from school. *International Journal of Environmental Research and Public Health*, *18*(14), 7670.

Hoshino, K. (2023). Problems in the development of the sleep–wake rhythm influence neurodevelopmental disorders in children. *Diagnostics*, *13*(11), 1859.

Hunt, N. (2022). *The Feasibility of Actigraphy and Care Journals to Examine Sleep-Wake Patterns of Preterm Infants in the NICU* (Doctoral dissertation, University of Maryland, Baltimore).

Hyndych, A., El-Abassi, R., & Mader Jr, E. C. (2025). The role of sleep and the effects of sleep loss on cognitive, affective, and behavioral processes. *Cureus*, *17*(5).

Karthikeyan, R., Cardinali, D. P., Shakunthala, V., Spence, D. W., Brown, G. M., & Pandi-Perumal, S. R. (2020). Understanding the role of sleep and its disturbances in Autism spectrum disorder. *International Journal of Neuroscience*, *130*(10), 1033-1046.

Kim, H., Kim, J. H., Yi, J. H., Kim, J. Y., Solmi, M., Cortese, S., ... & Fusar-Poli, P. (2024). Correlations between sleep problems, core symptoms, and behavioral problems in children and adolescents with autism spectrum disorder: a systematic review and meta-analysis. European Child & Adolescent Psychiatry, 33(5), 1539-1549.

Krystal, A. D., Prather, A. A., & Ashbrook, L. H. (2019). The assessment and management of insomnia: an update. *World Psychiatry*, *18*(3), 337-352.

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.

Liu, J., Ji, X., Pitt, S., Wang, G., Rovit, E., Lipman, T., & Jiang, F. (2024). Childhood sleep: physical, cognitive, and behavioral consequences and implications. *World Journal of Pediatrics*, *20*(2), 122-132.

Luiselli, J. K., Harper, J. M., Shlesinger, A., Murphy, K. J., & Luke, K. (2020). Faded bedtime intervention for delayed sleep onset in an adolescent with autism spectrum disorder. *Clinical Case Studies*, *19*(3),

180-188.

MacDonald, L. L., Gray, L., Loring, W., Wyatt, A., Bonnet, K., Schlund, D., ... & Malow,

B. A. (2021). A community-based sleep educational intervention for children with autism spectrum disorder. *Research in Autism Spectrum Disorders*, *81*, 101719.

MacDuffie, K. E., Munson, J., Greenson, J., Ward, T. M., Rogers, S. J., Dawson, G., & Estes,

A. (2020). Sleep problems and trajectories of restricted and repetitive behaviors in children with neurodevelopmental disabilities. *Journal of autism and developmental disorders*, *50*(11), 3844-3856.

Mc Carthy, C. E. (2021). Sleep disturbance, sleep disorders and co-morbidities in the care of the older person. *Medical Sciences*, *9*(2), 31.

Mughal, R., Wong, S. S., Dimitriou, D., & Halstead, E. (2021). Nightmares in children with foetal alcohol spectrum disorders, autism spectrum disorders, and their typically developing peers. *Clocks & sleep*, *3*(3), 465-481.

Naji, W. A., Waheeb, M. Q., & Hamza, D. H. (2020). Autism spectrum disorder. *Medico-legal Update*, *20*(2), 321.

Palagini, L., Manni, R., Aguglia, E., Amore, M., Brugnoli, R., Bioulac, S., ... & Geoffroy, P.

A. (2021). International expert opinions and recommendations on the use of melatonin in the treatment of insomnia and circadian sleep disturbances in adult neuropsychiatric disorders. *Frontiers in psychiatry*, *12*, 688890.

Paone, A., Logrieco, M. G., Guerrera, S., Fucà, E., Casula, L., Minutolo, A., ... & Valeri, G. (2026). Sleep problems in autistic children and adolescents: an age-stratified approach. *Frontiers in Psychology*, *17*, 1715093.

Papadopoulos, N., Sciberras, E., Hiscock, H., Williams, K., McGillivray, J., Mihalopoulos, C., ... & Rinehart, N. (2022). Sleeping Sound Autism Spectrum Disorder (ASD): A randomised controlled trial of a brief behavioural sleep intervention in primary school-aged autistic children. *Journal of Child Psychology and Psychiatry*, *63*(11), 1423-1433.

Pina, L., Sien, S. W., Song, C., Ward, T. M., Fogarty, J., Munson, S. A., & Kientz, J. A. (2020). DreamCatcher: exploring how parents and school-age children can track and review sleep information together. Proceedings of the ACM on Human-computer Interaction, 4(CSCW1), 1-25.

Qian, X., Qiu, Y., He, Q., Lu, Y., Lin, H., Xu, F., ... & Shuai, J. (2021). A review of methods for sleep arousal detection using polysomnographic signals. *Brain sciences*, *11*(10), 1274.

Qin, L., Wang, H., Ning, W., Cui, M., & Wang, Q. (2024). New advances in the diagnosis and treatment of autism spectrum disorders. *European Journal of Medical Research*, *29*(1), 322.

Rey, A. E., Guignard-Perret, A., Imler-Weber, F., Garcia-Larrea, L., & Mazza, S. (2020). Improving sleep, cognitive functioning and academic performance with sleep education at school in children. *Learning and Instruction*, *65*, 101270.

Romeo, D. M., Brogna, C., Belli, A., Lucibello, S., Cutrona, C., Apicella, M., ... & Mariotti,

P. (2021). Sleep disorders in autism spectrum disorder pre-school children: an evaluation using the sleep disturbance scale for children. *Medicina*, *57*(2), 95.

Romero-Ayuso, D., Espinosa-García, B., Gómez-Marín, E., Gómez-Jara, N., Cuevas-Delgado, C., Álvarez-Benítez, I., & Triviño-Juárez, J. M. (2022). A pilot study of improving self-regulation and social interaction with peers: An “exciting school”. *Children*, *9*(6), 829.

Schlieber, M., & Han, J. (2021). The role of sleep in young children’s development: a review. *The Journal of genetic psychology*, *182*(4), 205-217.

Shanahan, P. J., Isaac, M., & Blackwell, J. E. (2021). Sleep disorders in attention-deficit hyperactivity disorder and autism spectrum disorder: a pragmatic approach to assessment and management. *BJPsych Advances*, *27*(5), 320-332.

Sharma, S. (2026). Sleep and Cognition. *Cognition in Neurological Disorders and Other Diseases*, 108.

Shi, F., He, M., Li, J., Wang, X., & Zhang, D. (2025). Parents' experience with the management of sleep disorders in children with autism: A qualitative study. *Research in Developmental Disabilities*, *162*, 105027.

Song, S., Mehrab, M., Tahir, Z., Garrison, K. A., & Ziskind, S. (2025). Sensory-Based Sleep Interventions: Light, Sound, and Temperature as Therapeutic Tools.

Tiwari, S., & Talreja, S. (2020). Insomnia: A study on sleeping disorder with the reference of ayurvedic herbs. *Journal of Pharmaceutical Sciences and Research*, *12*(11), 1375-1379.

Tomaso, C. C., James, T., Nelson, J. M., Espy, K. A., & Nelson, T. D. (2021). Associations between preschool sleep problems and observed dimensions of elementary classroom engagement. *Early childhood research quarterly*, *57*, 251-259.

van Deurs, J. R., McLay, L. K., France, K. G., Blampied, N. M., Lang, R. B., & Hunter, J.

E. (2019). Behavioral sleep intervention for adolescents with autism spectrum disorder: A pilot study. *Advances in Neurodevelopmental disorders*, *3*(4), 397-410.

Vlcek, S., Somerton, M., & Rayner, C. (2020). Collaborative teams: Teachers, parents, and allied health professionals supporting students with autism spectrum disorder in mainstream Australian schools. Australasian Journal of Special and Inclusive Education, 44(2), 102-115.

Wang, Y., Lin, J., Zeng, Y., Liu, Y., Li, Y., Xia, K., ... & Ou, J. (2021). Effects of sleep disturbances on behavioral problems in preschool children with autism spectrum disorder. *Frontiers in psychiatry*, *11*, 559694.

Whelan, S., Mannion, A., Madden, A., Berger, F., Costello, R., Ghadiri, S., & Leader, G. (2022). Examining the relationship between sleep quality, social functioning, and behavior problems in children with autism spectrum disorder: A systematic review. Nature and science of sleep, 675-695.

Williams Buckley, A., Hirtz, D., Oskoui, M., Armstrong, M. J., Batra, A., Bridgemohan, C.,

... & Ashwal, S. (2020). Practice guideline: Treatment for insomnia and disrupted sleep behavior in children and adolescents with autism spectrum disorder: Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology. *Neurology*, *94*(9), 392-404.

Yadav, B. (2020). Autism spectrum disorder (ASD) in children: a brief review. *Autism*, *1*(1).