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A Brief Review of the Latest Intervention Methods for Sleep Disorders in Children with Autism Spectrum Disorder

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ABSTRACT

Up to 80% of children with autism spectrum disorders (ASD) experience sleep disorders, which can manifest in five predominant forms. Although the causes of sleep disorders in these children remain unclear, the relationship between autism—considered a neurodevelopmental disorder—and the critical role of sleep in neurodevelopment has prompted significant interest among researchers and clinicians. Over the past decade, numerous trials have explored both non-pharmacological and pharmacological interventions to improve sleep in children with autism. A review of numerous randomized controlled trials on sleep in children with autism has shown that, while no definitive conclusions have been reached regarding the most effective intervention, melatonin appears to be the most promising option based on its widespread use in studies. Recent experimental evidence also addresses concerns from earlier research about the long-term efficacy and safety of melatonin. However, further exploration is needed to determine the most effective doses of melatonin for different severities of sleep disorders.

KEYWORDS

Sleep disorders; Autism spectrum disorder; Insomnia; Night wakings; Morning Wakings; Sleep quality

1. INTRODUCTION

Autism spectrum disorder (ASD) is a prevalent neurodevelopmental disorder characterized by social and communication difficulties, along with restrictive or repetitive behaviors (American Psychiatric Association, 2013). Recent research indicates that approximately 1 in 100 children worldwide are diagnosed with ASD, accounting for regional, racial, and cultural differences (Zeidan et al., 2022). As diagnostic delays and underdiagnosis improve in women, the male-to-female prevalence gap for ASD is smaller than previously reported (Ochoa-Lubinoff et al., 2023).

Sleep disorders are particularly common among children with ASD, affecting more than 50% and potentially up to 80% of this population—almost double the rate observed in typically developing (TD) children (Ballester et al., 2020; Cohen et al., 2014; Valicenti-McDermott et al., 2019). Furthermore, sleep problems in children with ASD tend to be more persistent compared to those in TD children, whose sleep disturbances often diminish with age (Hodge et al., 2014).

Sleep disorders in children with autism manifest in various ways, often co-occurring. Common symptoms include difficulty falling asleep, frequent night awakenings, early morning awakenings, irregular sleep patterns, poor sleep quality, and sleep-related anxiety or sensory sensitivities (Johnson & Zarrinnegar, 2021; Martínez-Cayuelas et al., 2022). Females with autism exhibit increased bedtime

resistance, sleep anxiety, daytime sleepiness, and shorter sleep duration. However, there are no significant differences in delayed sleep onset, night wakings, heteromorphic sleep, or respiratory disturbances when compared to males with autism (Estes et al., 2023).

Sleep problems can exacerbate core symptoms of autism, including irritability, social difficulties, and communication issues. Additionally, these disturbances can interfere with daily functioning, learning, and overall well-being (Kim et al., 2024; Mazurek & Sohl, 2016; Mazzone et al., 2018). Given their significant impact on behavioral functioning, emotional regulation, and quality of life, there is growing interest in developing and evaluating various intervention strategies to address these sleep issues.

Developing targeted interventions to improve both sleep quality and overall well-being for these children is essential. This review will summary the different manifestations of sleep disorders and the effectiveness of various intervention methods for sleep disorders in children with autism, drawing on research from the past decade.

2. MANIFESTATIONS OF SLEEP DISORDERS IN CHILDREN WITH AUTISM

The manifestations of sleep disorders in children with autism spectrum disorder (ASD) can vary significantly and often differ from the typical sleep challenges experienced by neurotypical children due to the unique characteristics of autism. Here are five common types of sleep disorders in children with autism and their manifestations:

2.1. Sleep Onset Insomnia

Children with ASD frequently struggle with falling asleep at bedtime. The prevalence of insomnia in children with ASD ranges from 60% to 86%. (Posar & Visconti, 2020). This may be due to a variety of factors, including anxiety, sensory sensitivities, or difficulty with transitioning from the day's activities to a state of rest (Lane et al., 2022). Manifestations of Difficulty Falling Asleep include resistance to bedtime or bedtime routines(Ahmadian et al., 2024), increased levels of anxiety or arousal in the evening (Muscatello & Corbett, 2018), repetitive behaviors or rituals (Kanney et al., 2020) that interfere with settling down to sleep.

2.2. Frequent Night Wakings and Early Morning Wakings

Children with ASD often experience frequent awakenings throughout the night, which may be accompanied by difficulty returning to sleep (Hausman et al., 2023). This can lead to disrupted sleep cycles and insufficient restorative sleep. Another common "waking" sleep issue in children with autism is waking up very early in the morning, often well before the desired wake time(Hausman et al., 2023). This can lead to insufficient sleep duration and early morning behavior problems due to sleep deprivation. Manifestations of these two issues include waking up multiple times during the night and suffering from a hard time to back asleep (De Laet et al., 2022); nighttime anxiety or fear of the dark, nightmares, or separation anxiety (MacLennan et al., 2020); difficulty self-soothing or self-regulating during the night (Garfinkel et al., 2016); waking up at dawn or earlier, sometimes as early as 4 a.m; parents report feeling that their child is "ready to start the day" much earlier than typical, which disrupts family routines (Reilly et al., 2022).

2.3. Circadian Rhythm Disorders

Children with autism may experience disruptions in their circadian rhythm (the body's internal clock that regulates the sleep-wake cycle) (Pinato et al., 2019). Manifestations of circadian rhythm disorders include inconsistent sleep schedules, with wide variations in bedtimes and wake-up times from day

to day; difficulty transitioning between different sleep-wake cycles, leading to irregular sleep onset and duration; in some cases, a delayed sleep-wake cycle(Richdale & Schreck, 2009) (where the child stays up late and wakes up late) or an advanced sleep-wake cycle(Hirata et al., 2016) (where the child goes to sleep very early and wakes up early) is evident.

2.4. Poor Sleep Quality

Children with autism may experience poor sleep quality, which includes restless or fragmented sleep that is not restorative (Tse et al., 2020). They may wake frequently without fully awakening, or they may struggle to enter deep stages of sleep. Manifestations of poor sleep quality include tossing and turning throughout the night, frequent movement during sleep; signs of distress or discomfort while sleeping (e.g., body twitching, moaning, or grinding teeth); unexplained night awakenings without obvious external causes; behavioral problems during the day, such as irritability, difficulty concentrating, or hyperactivity, which may be related to poor sleep quality (Whelan et al., 2022).

2.5. Sensory Sensitivities Impacting Sleep

Children with ASD often have heightened sensory sensitivities that can interfere with their ability to fall asleep or stay asleep (Whelan et al., 2022). These sensitivities may include sensitivity to noise, light, textures, or even the feeling of bedding (Mazurek & Petroski, 2015). Manifestations of it include being easily disturbed by light, noise, or temperature, which may require specialized sleep environments such as blackout curtains, white noise machines, or special bedding; fidgeting or discomfort due to certain textures (e.g., certain fabrics or blankets) that prevent restful sleep; seeking specific sensory input to calm down, such as the need for weighted blankets(Yu et al., 2024) or particular types of touch (e.g., rocking or deep pressure).

3. NON-PHARMACOLOGICAL INTERVENTIONS

Although the causes of sleep disorders in children with autism have not yet been clearly established (Schröder et al., 2022), research on non-pharmacological interventions for sleep problems in this population has become increasingly diverse over the last decade. From a Western medical perspective, studies have explored various behavioral interventions, innovative sound systems specifically designed to help children with autism sleep, and the efficacy of physical exercise. From a Chinese medical perspective, researchers have investigated the application of techniques such as Chinese massage and acupuncture to address sleep problems in children with autism. Additionally, recent studies suggest that training parents can also improve their children's sleep.

3.1. Cognitive Behavioral Therapy and Brief Behavioral Intervention

McCrae and the research team conducted a pre-post study on 17 children with autism and insomnia (M±SD=8.76±1.99years) by obtaining their objective and subjective sleep situation parameters (including sleep onset latency (SOL), total sleep/wake times (TST/TWT), and sleep efficiency (SE)) (McCrae et al., 2020). After completing all 2-week sessions and a one-month follow-up, outcomes showed significant improvements in subjects' sleep quality after completing the short-term intervention, and benefits could be sustained for up to one month.

Papadopoulos and the research team conducted a randomized controlled trial on 66 children with ADHD and comorbid Autism Spectrum Disorder aged 5-13 years old (Papadopoulos et al., 2019). 28 children were randomly assigned to the observation group (brief behavioral intervention) and 33 children were randomly assigned to the control group (usual clinical care). The researchers used Child Sleep Habits Questionnaire (CSHQ) to asses the sleep problems of children at 3rd month and 6th

month after starting the trial. The results of the trial showed greater improvements in sleep problems at 3 and 6 months after randomization for children who received the intervention.

3.2. Parent-Child Sandplay Therapy

Liu and the research team selected 50 preschool children with mild to moderate autism spectrum disorder (ASD) and randomly divided them into two equal groups: an experimental group that received progressively integrated sandplay therapy and a control group that participated in teaching and auditory integration training (AIT) for a six-month intervention trial in China (Liu et al., 2019). To assess sleep improvement, changes in the Children's Sleep Habits Questionnaire (CSHQ) were measured before the intervention and again after six months. The results showed that the experimental group had significantly lower scores in bedtime resistance, sleep onset, sleep duration, night waking, daytime sleepiness, and total CSHQ compared to the control group.

3.3. Sound-To-Sleep (STS) system

Pattison and the research team recruited 247 autistic children aged between 5 and 13 years who had sleep problems (Pattison et al., 2024). The children were randomly assigned to two groups: 123 to the intervention group (Sleeping Sound) and 124 to the treatment-as-usual (TAU) group. Sleep problems for all subjects were assessed by using the Children’s Sleep Habit Questionnaire. The final results indicated that, despite some missing data, caregivers of children in the intervention group reported greater reductions in sleep problems at the 3rd, 6th, and 12th months of follow-up compared to those in the TAU group.

3.4. Physical Activity

Wang and the research team conducted a systematic review and meta-analysis of the effects of physical activity intervention on sleep in children and adolescents diagnosed with neurodevelopmental disorders (Wang et al., 2024). They analyzed data from nine high-quality studies (most of the subjects are autistic children). That made the final cut and concluded that physical activity interventions had a significant effect on sleep efficiency, wake-after-sleep onset and sleep duration.

3.5. Scalp Acupuncture Stimulation

Jiaand the research team recruited 60 children aged 3 to 6 years with SAD and randomized them equally into a control group (music education rehabilitation) and an observation group (scalp acupuncture + music education rehabilitation) for a six-month intervention trial in China (Jia et al., 2021). Subjects' sleep improvement was responded to by obtaining changes in the Children's Sleep Habits Questionnaire (CSHQ) at the 3rd month and 6th month. Unfortunately, the results of the study showed the scores of the subscale for night waking and sleep disordered breathing did not change noticeably.

3.6. Parent Training and Psychoeducation

Johnson and the research team conducted a 10-week-long randomized controlled trial (Johnson et al., 2023)and a trial for follow-up of it (Johnson et al., 2024). A total of 77 parents of young children aged 2-7 years with autism and associated sleep disorders participated, with 36 participants randomly assigned to sleep parent training (SPT) and 38 participants randomly assigned to one sleep-focused session (SPE). Modified Simonds & Parraga Sleep Questionnaire-Composite Sleep Index (MSPSQ - CSI) was used to evaluate changes in sleep quality at 5th week and 10th week for children. The results of the study showed significant improvements in sleep outcome indicators in the SPT group.

4. PHARMACOLOGICAL INTERVENTIONS

When non-pharmacological interventions alone are insufficient to improve sleep disorders in children with autism spectrum disorder (ASD), pharmacological treatments are often considered in clinical practice. Medications are typically prescribed for children experiencing more severe or persistent sleep disturbances, especially when other strategies have failed. Melatonin is currently the only compound with sufficient evidence to support its use; however, clinicians often select medications based on firsthand experiences of psychiatrists and pediatricians, as well as expert opinion. Other potential options include clonidine, antihistamines, trazodone, ramelteon, gabapentin, and suvorexant (Mammarella et al., 2023).

Research on pharmacological treatments in the last decade has focused on melatonin, but there have also been many trials of different medications and supplements exploring their effects on improving sleep disorders in children with autism, although many of these trials have shown that they do not help children with autism with sleep disorders, including ferrous sulfate (Reynolds et al., 2020), extended-release guanfacine (Politte et al., 2018), combined donepezil and choline reatment (Gabis et al., 2019), Omega-3-6-9 fatty acid supplementation (Boone et al., 2022)

4.1. Melatonin

Melatonin, a hormone that regulates the sleep-wake cycle, is the most widely studied pharmacological intervention for sleep disorders in children with autism spectrum disorder (ASD). It is particularly effective for addressing sleep onset latency in children with delayed sleep phases or those who struggle to fall asleep at typical bedtimes. Numerous studies over the past decade have demonstrated that melatonin can effectively reduce sleep onset latency and improve sleep duration in children with ASD (Nogueira et al., 2023). It is especially helpful for children with delayed sleep-wake rhythms (Richdale & Schreck, 2009). Some studies have also found that melatonin can improve sleep quality and reduce the frequency of night awakenings (Gringras et al., 2017). Not only is short-term use of melatonin safe, but long-term safety, especially with regard to effects on puberty and hormonal development, is not a concern. A 2-year trial has demonstrated that long-term treatment of children and adolescents with autism spectrum disorders is safe and effective, and no harmful effects on child growth or pubertal development have been observed, and there have been no withdrawal or safety concerns associated with use or discontinuation of the drug (Malow et al., 2021).

4.2. l-Carnosine Supplementation

L-carnosine is a naturally occurring dipeptide composed of the amino acids beta-alanine and histidine. It is present in various tissues throughout the body, particularly in the brain, muscles, and heart, and is known for its antioxidant and anti-inflammatory properties. L-carnosine has been studied for its potential therapeutic effects in various conditions, including autism spectrum disorder (ASD). Although L-carnosine has not been extensively researched regarding sleep disturbances in ASD, a study (Mehrazad-Saber et al., 2018) was conducted to investigate its effects. In this 2-month study, 43 children aged 4 to 16 years with autism were randomly assigned to either a treatment group, which received 500 mg of carnosine, or a control group, which received 500 mg of a placebo. The Children's Sleep Habits Questionnaire (CSHQ) was used to assess the severity and improvement of sleep disorders. The results indicated statistically significant positive changes in sleep duration, parasomnias, and the total sleep disorders score in the carnosine group.

5. CONCLUSION

Over the past decade, various intervention methods have been evaluated for managing sleep problems in children with autism. Most of these trials have utilized the Children's Sleep Habits Questionnaire

(CSHQ) to assess sleep. However, it remains unclear which intervention is most effective for sleep disorders in this population, particularly among non-pharmacological options.

From a pharmacological perspective, several trials indicate that melatonin is beneficial for addressing sleep disorders in children with autism. Nevertheless, there are limited studies comparing the effectiveness of non-pharmacological interventions to pharmacological treatments. One study found that physical activity was equally effective as melatonin, and the combination of both methods did not yield better results than either alone (Tse et al., 2024).

It is important to note that there is no one-size-fits-all approach; interventions must be individualized to meet the specific sleep challenges and needs of each child with autism spectrum disorder (ASD). Furthermore, more research is needed to explore various melatonin dosages for different levels of sleep disorders. Additional studies should also aim to refine existing interventions, investigate new treatments, and develop comprehensive, integrative approaches that can be broadly implemented across diverse populations of children with autism.

REFERENCES

[1] Ahmadian, P., Cardy, R. E., De Luca, G., & Kushki, A. (2024). Usability of an augmented reality bedtime routine application for autistic children. Assist Technol, 1-10. https://doi.org/10.1080/10400435.2024.2338277

[2] Ballester, P., Richdale, A. L., Baker, E. K., & Peiró, A. M. (2020). Sleep in autism: A biomolecular approach to aetiology and treatment. Sleep Med Rev, 54, 101357. https://doi.org/10.1016/j.smrv.2020.101357

[3] Boone, K. M., Klebanoff, M. A., Rogers, L. K., Rausch, J., Coury, D. L., & Keim, S. A. (2022). Effects of Omega-3-6-9 fatty acid supplementation on behavior and sleep in preterm toddlers with autism symptomatology: Secondary analysis of a randomized clinical trial. Early Hum Dev, 169, 105588. https://doi.org/10.1016/j.earlhumdev.2022.105588

[4] Cohen, S., Conduit, R., Lockley, S. W., Rajaratnam, S. M., & Cornish, K. M. (2014). The relationship between sleep and behavior in autism spectrum disorder (ASD): a review. J Neurodev Disord, 6(1), 44. https://doi.org/10.1186/1866-1955-6-44

[5] De Laet, A., Piccardi, E. S., Begum-Ali, J., Charman, T., Johnson, M. H., Jones, E. J. H., Bedford, R., & Gliga, T. (2022). Neuronal gating of tactile input and sleep in 10-month-old infants at typical and elevated likelihood for autism spectrum disorder. Sci Rep, 12(1), 14188. https://doi.org/10.1038/s41598-022-18018-w

[6] Estes, A., Munson, J., St John, T., Finlayson, R., Pandey, J., Gottlieb, B., Herrington, J., & Schultz, R. T. (2023). Sleep problems in autism: Sex differences in the school-age population. Autism Res, 16(1), 164-173. https://doi.org/10.1002/aur.2848

[7] Gabis, L. V., Ben-Hur, R., Shefer, S., Jokel, A., & Shalom, D. B. (2019). Improvement of Language in Children with Autism with Combined Donepezil and Choline Treatment. J Mol Neurosci, 69(2), 224-234. https://doi.org/10.1007/s12031-019-01351-7

[8] Garfinkel, S. N., Tiley, C., O'Keeffe, S., Harrison, N. A., Seth, A. K., & Critchley, H. D. (2016). Discrepancies between dimensions of interoception in autism: Implications for emotion and anxiety. Biol Psychol, 114, 117-126. https://doi.org/10.1016/j.biopsycho.2015.12.003

[9] Gringras, P., Nir, T., Breddy, J., Frydman-Marom, A., & Findling, R. L. (2017). Efficacy and Safety of Pediatric Prolonged-Release Melatonin for Insomnia in Children With Autism Spectrum Disorder. J Am Acad Child Adolesc Psychiatry, 56(11), 948-957.e944. https://doi.org/10.1016/j.jaac.2017.09.414

[10] Hausman, N. L., Falligant, J. M., Bednar, M. K., Carver, A. N., & Connaughton, K. (2023). Behavioral Treatment of Sleep Problems using Wake-Time Fading with Individuals with Autism: A Brief Report. Dev Neurorehabil, 26(2), 130-133. https://doi.org/10.1080/17518423.2022.2152119

[11] Hirata, I., Mohri, I., Kato-Nishimura, K., Tachibana, M., Kuwada, A., Kagitani-Shimono, K., Ohno, Y., Ozono, K., & Taniike, M. (2016). Sleep problems are more frequent and associated with problematic behaviors in preschoolers with autism spectrum disorder. Res Dev Disabil, 49-50, 86-99. https://doi.org/10.1016/j.ridd.2015.11.002

[12] Hodge, D., Carollo, T. M., Lewin, M., Hoffman, C. D., & Sweeney, D. P. (2014). Sleep patterns in children with and without autism spectrum disorders: developmental comparisons. Res Dev Disabil, 35(7), 1631-1638. https://doi.org/10.1016/j.ridd.2014.03.037

[13] Jia, Y. N., Gu, J. H., Wei, Q. L., Jing, Y. Z., Gan, X. Y., & Du, X. Z. (2021). [Effect of scalp acupuncture stimulation on mood and sleep in children with autism spectrum disorder]. Zhen Ci Yan Jiu, 46(11), 948-952. https://doi.org/10.13702/j.1000-0607.20210276

[14] Johnson, C. R., Barto, L., Worley, S., Rothstein, R., & Alder, M. L. (2023). Telehealth parent training for sleep disturbances in young children with autism spectrum disorder: A randomized controlled trial. Sleep Med, 111, 208-219. https://doi.org/10.1016/j.sleep.2023.08.033

[15] Johnson, C. R., Barto, L., Worley, S., Rothstein, R., & Wenzell, M. L. (2024). Follow-up of telehealth parent training for sleep disturbances in young children with autism spectrum disorder. Sleep Med, 119, 114-117. https://doi.org/10.1016/j.sleep.2024.04.022

[16] Johnson, K. P., & Zarrinnegar, P. (2021). Autism Spectrum Disorder and Sleep. Child Adolesc Psychiatr Clin N Am, 30(1), 195-208. https://doi.org/10.1016/j.chc.2020.08.012

[17] Kanney, M. L., Durmer, J. S., Trotti, L. M., & Leu, R. (2020). Rethinking bedtime resistance in children with autism: is restless legs syndrome to blame? J Clin Sleep Med, 16(12), 2029-2035. https://doi.org/10.5664/jcsm.8756

[18] Kim, H., Kim, J. H., Yi, J. H., Kim, J. Y., Solmi, M., Cortese, S., Smith, L., Koyanagi, A., Shin, J. I., Cheon, K. A., & 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. Eur Child Adolesc Psychiatry, 33(5), 1539-1549. https://doi.org/10.1007/s00787-023-02253-1

[19] Lane, S. J., Leão, M. A., & Spielmann, V. (2022). Sleep, Sensory Integration/Processing, and Autism: A Scoping Review. Front Psychol, 13, 877527. https://doi.org/10.3389/fpsyg.2022.877527

[20] Liu, G. H., Huang, L. S., Qian, Q. F., Wang, Y. X., & Ge, P. (2019). [Curative effect of progressively integrated sandplay therapy on core symptoms and sleep management in preschool children with mild-to-moderate autism spectrum disorder]. Zhongguo Dang Dai Er Ke Za Zhi, 21(8), 743-748. https://doi.org/10.7499/j.issn.1008-8830.2019.08.002

[21] MacLennan, K., Roach, L., & Tavassoli, T. (2020). The Relationship Between Sensory Reactivity Differences and Anxiety Subtypes in Autistic Children. Autism Res, 13(5), 785-795. https://doi.org/10.1002/aur.2259

[22] Malow, B. A., Findling, R. L., Schroder, C. M., Maras, A., Breddy, J., Nir, T., Zisapel, N., & Gringras, P. (2021). Sleep, Growth, and Puberty After 2 Years of Prolonged-Release Melatonin in Children With Autism Spectrum Disorder. J Am Acad Child Adolesc Psychiatry, 60(2), 252-261.e253. https://doi.org/10.1016/j.jaac.2019.12.007

[23] Mammarella, V., Orecchio, S., Cameli, N., Occhipinti, S., Marcucci, L., De Meo, G., Innocenti, A., Ferri, R., & Bruni, O. (2023). Using pharmacotherapy to address sleep disturbances in autism spectrum disorders. Expert Rev Neurother, 23(12), 1261-1276. https://doi.org/10.1080/14737175.2023.2267761

[24] Martínez-Cayuelas, E., Rodríguez-Morilla, B., Soriano-Guillén, L., Merino-Andreu, M., Moreno-Vinués, B., & Gavela-Pérez, T. (2022). Sleep Problems and Circadian Functioning in Children and Adolescents With Autism Spectrum Disorder. Pediatr Neurol, 126, 57-64. https://doi.org/10.1016/j.pediatrneurol.2021.09.009

[25] Mazurek, M. O., & Petroski, G. F. (2015). Sleep problems in children with autism spectrum disorder: examining the contributions of sensory over-responsivity and anxiety. Sleep Med, 16(2), 270-279. https://doi.org/10.1016/j.sleep.2014.11.006

[26] Mazurek, M. O., & Sohl, K. (2016). Sleep and Behavioral Problems in Children with Autism Spectrum Disorder. J Autism Dev Disord, 46(6), 1906-1915. https://doi.org/10.1007/s10803-016-2723-7

[27] Mazzone, L., Postorino, V., Siracusano, M., Riccioni, A., & Curatolo, P. (2018). The Relationship between Sleep Problems, Neurobiological Alterations, Core Symptoms of Autism Spectrum Disorder, and Psychiatric Comorbidities. J Clin Med, 7(5). https://doi.org/10.3390/jcm7050102

[28] McCrae, C. S., Chan, W. S., Curtis, A. F., Deroche, C. B., Munoz, M., Takamatsu, S., Muckerman, J. E., Takahashi, N., McCann, D., McGovney, K., Sahota, P., & Mazurek, M. O. (2020). Cognitive behavioral treatment of insomnia in school-aged children with autism spectrum disorder: A pilot feasibility study. Autism Res, 13(1), 167-176. https://doi.org/10.1002/aur.2204

[29] Mehrazad-Saber, Z., Kheirouri, S., & Noorazar, S. G. (2018). Effects of l-Carnosine Supplementation on Sleep Disorders and Disease Severity in Autistic Children: A Randomized, Controlled Clinical Trial. Basic Clin Pharmacol Toxicol, 123(1), 72-77. https://doi.org/10.1111/bcpt.12979

[30] Muscatello, R. A., & Corbett, B. A. (2018). Comparing the effects of age, pubertal development, and symptom profile on cortisol rhythm in children and adolescents with autism spectrum disorder. Autism Res, 11(1), 110-120. https://doi.org/10.1002/aur.1879

[31] Nogueira, H. A., de Castro, C. T., da Silva, D. C. G., & Pereira, M. (2023). Melatonin for sleep disorders in people with autism: Systematic review and meta-analysis. Prog Neuropsychopharmacol Biol Psychiatry, 123, 110695. https://doi.org/10.1016/j.pnpbp.2022.110695

[32] Ochoa-Lubinoff, C., Makol, B. A., & Dillon, E. F. (2023). Autism in Women. Neurol Clin, 41(2), 381-397. https://doi.org/10.1016/j.ncl.2022.10.006

[33] Papadopoulos, N., Sciberras, E., Hiscock, H., Mulraney, M., McGillivray, J., & Rinehart, N. (2019). The Efficacy of a Brief Behavioral Sleep Intervention in School-Aged Children With ADHD and Comorbid Autism Spectrum Disorder. J Atten Disord, 23(4), 341-350. https://doi.org/10.1177/1087054714568565

[34] Pattison, E., Papadopoulos, N., Fuller-Tyszkiewicz, M., Sciberras, E., Hiscock, H., Williams, K., McGillivray, J., Mihalopoulos, C., Bellows, S. T., Marks, D., Howlin, P., & Rinehart, N. (2024). Randomised Controlled Trial of a Behavioural Sleep Intervention, 'Sleeping Sound', for Autistic Children: 12-Month Outcomes and Moderators of Treatment. J Autism Dev Disord, 54(2), 442-457. https://doi.org/10.1007/s10803-022-05809-3

[35] Pinato, L., Galina Spilla, C. S., Markus, R. P., & da Silveira Cruz-Machado, S. (2019). Dysregulation of Circadian Rhythms in Autism Spectrum Disorders. Curr Pharm Des, 25(41), 4379-4393. https://doi.org/10.2174/1381612825666191102170450

[36] Politte, L. C., Scahill, L., Figueroa, J., McCracken, J. T., King, B., & McDougle, C. J. (2018). A randomized, placebo-controlled trial of extended-release guanfacine in children with autism spectrum disorder and ADHD symptoms: an analysis of secondary outcome measures. Neuropsychopharmacology, 43(8), 1772-1778. https://doi.org/10.1038/s41386-018-0039-3

[37] Posar, A., & Visconti, P. (2020). Sleep Problems in Children with Autism Spectrum Disorder. Pediatr Ann, 49(6), e278-e282. https://doi.org/10.3928/19382359-20200511-01

[38] Reilly, M., McGivney, C., Christiansen, A., & Augustyn, M. (2022). Raising the Question: Medication Mix-Up or Diversion. J Dev Behav Pediatr, 43(6), 373-374. https://doi.org/10.1097/dbp.0000000000001101

[39] Reynolds, A. M., Connolly, H. V., Katz, T., Goldman, S. E., Weiss, S. K., Halbower, A. C., Shui, A. M., Macklin, E. A., Hyman, S. L., & Malow, B. A. (2020). Randomized, Placebo-Controlled Trial of Ferrous Sulfate to Treat Insomnia in Children With Autism Spectrum Disorders. Pediatr Neurol, 104, 30-39. https://doi.org/10.1016/j.pediatrneurol.2019.07.015

[40] Richdale, A. L., & Schreck, K. A. (2009). Sleep problems in autism spectrum disorders: prevalence, nature, & possible biopsychosocial aetiologies. Sleep Med Rev, 13(6), 403-411. https://doi.org/10.1016/j.smrv.2009.02.003

[41] Schröder, C. M., Broquère, M. A., Claustrat, B., Delorme, R., Franco, P., Lecendreux, M., & Tordjman, S. (2022). [Therapeutic approaches for sleep and rhythms disorders in children with ASD]. Encephale, 48(3), 294-303. https://doi.org/10.1016/j.encep.2021.08.005 (Approches thérapeutiques des troubles du sommeil et des rythmes chez l'enfant avec TSA.)

[42] Tse, A. C., Yu, C., & Lee, P. H. (2020). Comparing sleep patterns between children with autism spectrum disorder and children with typical development: A matched case-control study. Autism, 24(8), 2298-2303. https://doi.org/10.1177/1362361320936827

[43] Tse, A. C. Y., Lee, P. H., Sit, C. H. P., Poon, E. T., Sun, F., Pang, C. L., & Cheng, J. C. H. (2024). Comparing the Effectiveness of Physical Exercise Intervention and Melatonin Supplement in Improving Sleep Quality in Children with ASD. J Autism Dev Disord, 54(12), 4456-4464. https://doi.org/10.1007/s10803-023-06172-7

[44] Valicenti-McDermott, M., Lawson, K., Hottinger, K., Seijo, R., Schechtman, M., Shulman, L., & Shinnar, S. (2019). Sleep Problems in Children With Autism and Other Developmental Disabilities: A Brief Report. J Child Neurol, 34(7), 387-393. https://doi.org/10.1177/0883073819836541

[45] Wang, T., Li, W., Deng, J., Zhang, Q., Liu, Y., & Zheng, H. (2024). The impact of the physical activity intervention on sleep in children and adolescents with neurodevelopmental disorders: a systematic review and meta-analysis. Front Neurol, 15, 1438786. https://doi.org/10.3389/fneur.2024.1438786

[46] 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. Nat Sci Sleep, 14, 675-695. https://doi.org/10.2147/nss.S239622

[47] Yu, J., Yang, Z., Sun, S., Sun, K., Chen, W., Zhang, L., Xu, J., Xu, Q., Liu, Z., Ke, J., Zhang, L., & Zhu, Y. (2024). The effect of weighted blankets on sleep and related disorders: a brief review. Front Psychiatry, 15, 1333015. https://doi.org/10.3389/fpsyt.2024.1333015

[48] Zeidan, J., Fombonne, E., Scorah, J., Ibrahim, A., Durkin, M. S., Saxena, S., Yusuf, A., Shih, A., & Elsabbagh, M. (2022). Global prevalence of autism: A systematic review update. Autism Res, 15(5), 778-790. https://doi.org/10.1002/aur.2696