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Investigating the Effect of Enhancing Understanding of Embodied Metaphors on Sleep Status in Children with Autism and Sleep Problems

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Abstract

Background and Objective: Children with autism spectrum disorder (ASD) often suffer from language disorders; however, those who experience sleep problems usually have more severe impairments in various domains of language and communication. Given the essential role of language in communication, this study aimed to investigate the effect of enhancing understanding of embodied conceptual metaphors on the sleep status of children with autism experiencing sleep problems.

Materials and Methods: This study employed a within-subjects design. The study population consisted of boys with autism aged 7-12 years. A total of 34 children with sleep disorders were selected using purposive sampling. Pre-test data were obtained using the Children's Sleep Habits Questionnaire (CSHQ), which includes items related to the cognitive, emotional, and communication difficulties in children with autism, such as sleep anxiety, sleep onset delay, bedtime resistance, and daytime sleepiness. Participants then underwent 20 sessions designed to enhance their understanding of conceptual metaphors. The CSHQ was re-administered as a post-test and follow-up to evaluate the effect of language-based intervention on sleep problems.

Results: Repeated-measures analysis of variance (ANOVA) demonstrated a significant positive effect of enhancing understanding of embodied conceptual metaphors on sleep improvement in children with autism experiencing sleep problems ($P < 0.0001$).

Conclusion: Enhancing understanding of embodied conceptual metaphors may be effective in improving sleep problems in children with autism, potentially through reducing sleep anxiety and increasing communication abilities.

Keywords: Autism; Sleep disorders; Metaphor; Children

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Introduction

Autism is a communicative-cognitive disorder that belongs to the pervasive developmental disorders spectrum. Core features include communication deficits, social skills difficulties, and stereotyped behaviors that emerge within the first three years of life and persist across the person's life (1). In recent years, extensive research has focused on the biological and genetic factors associated with the etiology of autism. However, relatively few studies have examined intervention and treatment approaches aimed at supporting children with autism. Evidence indicates that early diagnosis and treatment can improve outcomes in this population. To develop effective educational and treatment programs, appropriate assessment, accurate diagnosis, and early identification play an important role (2).

Children with autism are often reluctant to communicate with others and experience signifi-

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cant difficulties in social interaction, including speech and language disorders manifested as a complete absence of language or developmental delay in language acquisition and production (3). Studies over the past two decades have reported a rising prevalence of autism for multiple reasons. The disorder occurs 3-5 times more frequently in boys than in girls; however, symptoms tend to be more severe in girls (4). Many children with autism fail to develop functional language, and among those who do, speech is often atypical. Their speech may be excessively soft or loud, unusually rapid, repetitive, or contextually irrelevant, and it usually fails to meet the listener's informational needs. Moreover, individuals with autism often have difficulty understanding the speaker's communicative intent beyond the literal meaning of words (5). For example, children with autism show impairments in understanding various types of metaphors (6-8).

A large part of human abstract thinking is expressed through metaphors. From this perspective, metaphors arise from the human need to understand and represent new, unfamiliar abstract concepts by relying on objective meanings and prior knowledge. Many abstract conceptual categories are formed through metaphors, and numerous concepts, particularly abstract concepts, are structured through metaphorical adaptation of information and the transfer of knowledge from one context to another (9). Similarly, Lakoff and Johnson in "Metaphors We Live By" state that metaphors are grounded in human experience and involve understanding an "abstract conceptual domain" based on another objective conceptual domain (10).

Research indicates that, like adults, children can map information from a source domain to a target domain. They can engage in metaphorical imitation and understand metaphors based on context. Thus, they can think metaphorically, and this type of thinking is not an intrinsic feature of the mind but derives from the child's physical experiences, expressing the concept of embodied metaphor (11). Studies have shown that children learn motor metaphors and metaphors related to the primary senses, such as vision, more rapidly (6). Individuals with autism often interpret implicit language literally and concretely; therefore, they experience difficulty in understanding abstract language, including metaphors, allusions, and jokes (12). Abstract expressions are frequently interpreted literally, and these people have difficulty combining metaphorical concepts (13). Moreover, syntactic, phonological, and semantic impairments associated with autism spectrum disorder (ASD) limit an individual's capacity for effective social interaction (14).

Many problems in children with autism are attributed to fundamental impairments in executive functions associated with abnormalities of the nervous system. People with autism are more likely than the general population to have macrocephaly, epilepsy, cerebral palsy (CP), hydrocephalus, migraines or headaches, and inherited abnormalities of the nervous system, with reported prevalence rates ranging from 1.1% for hydrocephalus to 14.2% for epilepsy. In addition, the prevalence of sleep disorders in children with autism has been reported to range from 40% to 86% (15). These sleep disorders are associated with impairments in executive function and language.

Sleep disorders represent a concern in children with autism, as they affect cognitive functions such as attention, concentration, perception, memory, and language (16). Sleep disorders and daytime sleepiness may exacerbate the symptoms and behavioral problems of a child with autism (17). In pediatric populations, sleep disorders are defined as changes in sleep duration, abnormalities in sleep architecture, atypical behaviors, or the occurrence of abnormal events during sleep (18). These disorders can negatively affect children's health, behavior, cognitive functioning, and long-term abilities (19). In addition to their physical consequences, sleep disorders impair the process of language and memory learning, reduce attention span, and diminish overall performance (20).

Goldman et al. have demonstrated that sleep problems in ASD are relatively stable and vary with age (21). In a sample of 1859 children with ASD aged 3-18 years, sleep problems were reported from early childhood to adolescence, with specific sleep problems increasing with age. Parental reports of young children were more likely to include sleep disturbances, parasomnias, nighttime awakenings, and sleep resistance. However, parental reports of adolescents were more likely to include problems with sleep duration and sleep onset (22). Studies that have examined the association between sleep problems in children and clinical features of ASD (e.g., epilepsy and cognitive function) have reported conflicting findings (23).

Taylor et al. also reported that lower overall intellectual functioning was associated with shorter nighttime sleep duration in children with ASD (23). In contrast, other studies have shown that sleep problems occur in individuals with ASD regardless of their cognitive level (24, 25). Because of shared neurological mechanisms between sleep regulation and autism, sleep disorders are commonly seen in children with autism (17). Furthermore, these disorders and daytime sleepiness may exacerbate the symptoms and behavioral difficulties in this population (18). In pediatric populations, sleep disorders are defined as changes in sleep duration associated with age, abnormal sleep patterns, atypical behaviors, or abnormal events during sleep (26). Such disorders can negatively affect the cognitive function, long-term abilities, behavior, and physical health of children with autism (19). Sleep disorders are among the most serious challenges in these children, often accompanied by depression, anxiety, and cognitive deficits (18).

Sleep disorders in children with autism are often overlooked due to the presence of overlapping behavioral comorbidities, leaving these sleep issues untreated (27). Considering the types of sleep disorders in children with autism, environmental factors, family-based education, behavioral interventions, such as various types of sleep hygiene interventions, and rehabilitation approaches are considered first-line treatments (28). To date, relatively little attention has been paid to the linguistic aspect of rehabilitation in children with autism. The intervention examined in this study is based on language application. It targets one of the most critical language weaknesses in these children, which is essential for effective communication with this population. Applied language studies focus on the use of language in social contexts and examine the reasons for communication, principles of conversation, and variations in speech across different situations (29).

Children's ability to acquire the social and psychological components of communicative situations is the basis of cognitive skills development. The emergence of verbal and nonverbal behaviors in the field of linguistic application occurs in early childhood; while some of these behaviors are innate, others are learned through social interactions. Children with autism rarely use language as a means of communication; instead, they tend to use it only for specific needs, such as making requests or expressing objections. This cognitive limitation in language use contributes to difficulties in social interaction (30).

Accordingly, the present study aimed to examine the effect of linguistic rehabilitation, specifically enhancing understanding of embodied conceptual metaphor, on sleep disorders in children with autism. This approach was expected to improve their linguistic understanding and, consequently, reduce communication deficits and sleep-related anxiety.

To date, research has not addressed whether language-based interventions can effectively mitigate sleep problems in children with autism. Therefore, this study represents one of the first attempts to investigate this issue. Notably, this research incorporates ‘embodied conceptual metaphors’, which represent specific linguistic-perceptual difficulties in children with autism, as a component of language rehabilitation. Accordingly, the primary aim of this study was to examine the impact of linguistic rehabilitation by enhancing understanding of embodied conceptual metaphors on the sleep status of boys with autism experiencing sleep problems.

Materials and Methods

Participants: The present study employed a within-subjects design. The study sample consisted of 34 boys with autism aged 7-12 years who were studying in special schools or were receiving services at rehabilitation centers of Khorasan Razavi Province, Iran. All participating children had been diagnosed with autism by a psychiatrist. Children who exhibited sleep problems were additionally diagnosed by a psychologist using the Children's Sleep Habits Questionnaire (CSHQ). Inclusion criteria were having a low level of ASD, absence of epilepsy or certain physical diseases, and not taking sleep medications that could interfere with the assessment process. Accordingly, children with physical or mental conditions that could affect test performance, as well as those who were unwilling or unable to continue participation due to discomfort, were excluded.

Ethical approval was obtained from Tarbiat Modares University, Tehran, Iran (Ethics ID: IR.MODARES.REC.1399.199). Following parental review and completion of written informed consent, all assessments were conducted individually.

Parents of 39 children initially expressed willingness to participate in the study. Five chil-

dren were excluded for failing to meet the inclusion criteria.

After obtaining parental consent, the children were evaluated through clinical interviews conducted in accordance with the criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5).

Tools

CSHQ: The CSHQ is a standardized tool for assessing children's sleep over the previous week and is completed through an interview with the child and his/her parents. The questionnaire comprises 33 items across eight subscales. A score above 41 indicates poor sleep quality, with higher scores reflecting poorer sleep quality (31). In a study by Wang et al., Cronbach's alpha for this questionnaire was 0.80 (32). This standard index, as shown in previous studies, demonstrated acceptable consistency in sleep studies using polysomnography (PSG) (33). In the present study, the CSHQ reliability was 0.78, as calculated using Cronbach's alpha. Shoghy et al. evaluated the Persian version of the CSHQ using content validity, and its reliability was determined to be 0.97 via a two-week test-retest design in a sample of 10 children aged 6-11 years (34). The responses are aggregated into eight subscales reflecting common pediatric sleep problems: sleep onset delay, bedtime resistance, night wakings, sleep duration, sleep anxiety, daytime sleepiness, sleep-disordered breathing (SDB), and parasomnias. Each subscale yields an independent score, with higher scores indicating greater severity of the corresponding sleep disturbance.

Bedtime resistance refers to the tendency to remain awake. It includes behaviors that indicate refusal to sleep, such as verbal resistance, crying, and leaving the bed, often aimed at attracting attention.

Sleep onset delay refers to the prolonged time required to fall asleep after going to bed, usually more than 30 minutes and sometimes more than 3 hours.

Sleep duration encompasses both the quantitative and qualitative aspects of sleep, such as the short, normal, or variable sleep duration across different nights (sleep regularity). In some cases, the individual falls asleep but awakens before sleep needs are met and is unable to return to sleep.

Night wakings are episodes of waking during the sleep period and are often associated with conditions such as night terrors, sleepwalking, and confusional arousals. Most of these events occur within the first one to three hours after sleep onset.

Parasomnia refers to undesirable events, abnormal behaviors, or physiological phenomena that occur mainly during sleep, specific sleep stages, or the transition between sleep and wakefulness. In parasomnias, the primary problem is not the sleep itself but events that disrupt the sleep process.

SDB involves ineffective breathing during sleep and may result from complete or partial airway obstruction or impaired regulation by the respiratory control center. Daytime sleepiness refers to falling asleep while doing daily activities and experiencing irresistible sleep attacks, leading to inappropriate sleep episodes. This disorder significantly impairs the affected individual's ability to perform daily activities (35).

One of the key components of this questionnaire, which plays an essential role in the results of this research and is related to sleep and language problems in children with autism, is sleep anxiety. Sleep anxiety is defined as a feeling of worry or stress about the ability to fall asleep, a state of tension during sleep, such as fear of sleeping alone or fear of darkness. Excessive concern regarding sleep quantity and quality may itself interfere with the duration and efficiency of sleep, resulting in a never-ending cycle of anxiety and sleep disturbance (35).

Metaphor Comprehension Test: The Metaphor Comprehension Test consists of a set of embodied conceptual metaphors (In cognitive linguistics, conceptual metaphor, or cognitive metaphor, refers to the understanding of one idea, or conceptual domain, in terms of another. An example of this is the understanding of quantity in terms of directionality (e.g., "the prices are rising") or time in terms of money (e.g., "I spent time at work today") and includes two components: visual and auditory. The visual component comprises 20 body-related conceptual metaphors**.** For each metaphor, three binary sets of metaphorical sentences are defined: one representing the abstract concept of metaphor, one reflecting the literal understanding of metaphor, and one unrelated to the metaphor. For each metaphor, six images were used, presented as paired images on a single card. Each metaphor was administered to participants using three cards in a random order, identical for all participants. For example, for the metaphor "to sew one's eye to the door", three paired sets were designed, each including an image of a door. In the set reflecting the literal,

word-for-word meaning, an eye is sewn onto the door with a needle and thread. In the set representing the abstract meaning, a child is shown looking toward the door, conveying the sense of waiting or anticipation. In the unrelated set, a child is shown cleaning the door, which has no metaphorical or literal association with the expression (Figure 1).

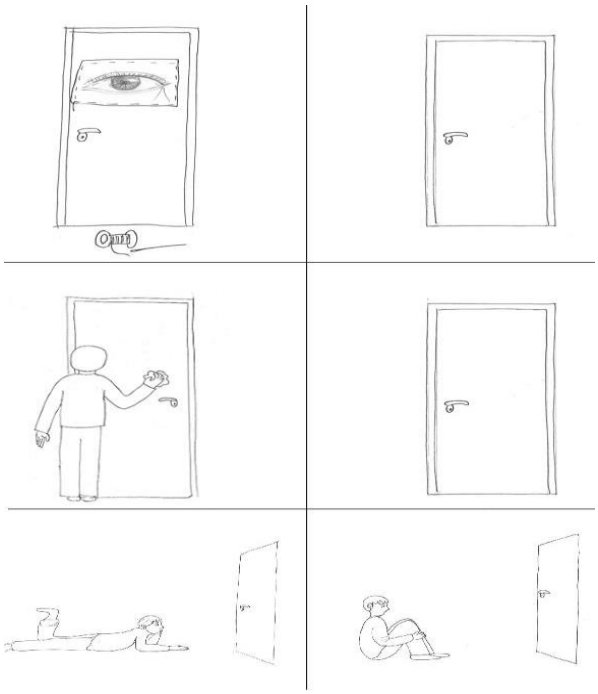


Figure 1. An example of the visual part of the test of understanding the abstract concept of embodied conceptual metaphors

To reduce the likelihood that participants would guess the test's process and purpose, 10 non-metaphorical filler image sets were randomly distributed across the 20 test questions. In the auditory component of the test, metaphors were selected evenly across body-related concepts (organs), as in the visual component.

In the auditory section, a short story was designed for each metaphor, with emphasis on its abstract meaning. As in the visual section, each question included three response options: one representing the abstract metaphorical meaning, one reflecting the literal sense, and one completely unrelated to the metaphor. The order of options was randomized for each question. In addition, 10 filler questions with accompanying stories that did not contain any metaphors were included (36).

An example from the auditory section involves the conceptual metaphor "empty-handed". In this item, the participant is presented with a scenario where Mohammad has run out of medication and is unable to purchase more because he is empty-handed. The children were also asked to choose the correct interpretation of this phrase from the following options**:**

- He does not have one hand.
- He has nothing in his hands.
- He has no money.

In this example, the first option is unrelated to the metaphor, the second is its literal meaning, and the third is the metaphorical meaning.

Procedure

To facilitate access to special schools for the assessment of children with autism, a letter of introduction was issued by the Deputy of Exceptional Education of Khorasan Razavi. Participant selection within schools was conducted purposively and based on childrens' date of birth. Before testing, each child's expressive language and comprehension were informally assessed in approximately 10 minutes using the Language Evaluation Profile Monitoring Package for Children. The test procedure was then explained to the participants, and all assessments were conducted individually.

First, a short story consisting of two to three brief sentences was read aloud clearly to the child, followed by the presentation of response options. The child was required to choose the option that best reflected the meaning of the story. Since the primary focus in each story was an embodied conceptual metaphor, the options were designed to correspond to the concept of metaphor. Upon completion of the auditory part, participants were given a 5-minute rest period, during which they were provided with a snack. If the child was ready to continue, the visual part of the test was then administered. In this section, the images related to each question were presented to the child, and the examiner clearly read the sentence related to that metaphor. The child was asked to select the card that best represented the meaning of the metaphorical expression and hand it to the examiner.

An individual answer sheet was used for each participant to record the participant's demographic information and responses. For each item, three cards were labeled a, b, and c, and the letter corresponding to the selected card was recorded next to the number of each question**.**

The conceptual metaphors used in the rehabilitation program were related to the tongue. This

organ was selected because of the high frequency of tongue-related conceptual metaphors in everyday language and the marked difficulties children with autism experience in face-to-face communication. All rehabilitation sessions were designed as games and storytelling.

The rehabilitation sessions were designed to be implementable in clinics with minimal facilities. Given the specific needs and limitations of children with autism and the game-based format of the sessions, children showed good cooperation. Accordingly, sessions were held in two separate sessions per day. If a child was unwilling or unable to continue at any point for any reason, the session was discontinued and rescheduled. All sessions were held individually, three days per week, with two sessions per day (six sessions per week). Completion of the whole program required four weeks.

Statistical considerations: Considering that the same group of participants was evaluated at multiple time points [pre-intervention (pre-test), post-intervention (post-test), and follow-up], repeated-measures analysis of variance (ANOVA) was used to assess the effect of the intervention and the persistence of its effects.

Results

A group of 34 boys with autism (mean age: 9.82 ± 2.52 years) participated in this study. Table 1 shows the mean values of sleep-related variables across three assessment time points.

Before the primary analysis, Mauchly's sphericity test was conducted to assess the assumption of sphericity.

Mauchly's test was significant for all variables at the 0.05 level, indicating that the assumption of sphericity was violated and that the variances of the differences between levels of the dependent variables were significantly different. Because violation of sphericity can bias F-statistics, degrees of freedom (df) were corrected using the Greenhouse-Geisser and Huynh-Feldt methods. As epsilon values were less than 0.75, the Greenhouse-Geisser index was used.

Table 1. The mean and standard deviation (SD) of sleep-related variables (n = 34)

Variables	Time measurement	Mean ± SD
Bedtime resistance	Pre-test	14.73 ± 1.28
	Post-test	10.14 ± 1.07
	Follow-up	11.00 ± 0.98
Daytime sleepiness	Pre-test	13.02 ± 1.50
	Post-test	12.79 ± 1.12
	Follow-up	13.11 ± 1.06
Night wakings	Pre-test	5.58 ± 0.89
	Post-test	4.55 ± 0.95
	Follow-up	4.67 ± 0.97
Sleep duration	Pre-test	6.17 ± 0.86
	Post-test	5.20 ± 0.97
	Follow-up	5.55 ± 0.89
Sleep-disordered breathing	Pre-test	3.79 ± 0.68
	Post-test	3.64 ± 0.59
	Follow-up	3.64 ± 0.59
Sleep anxiety	Pre-test	8.97 ± 1.24
	Post-test	6.91 ± 1.08
	Follow-up	7.02 ± 1.08
Sleep onset delay	Pre-test	2.55 ± 0.66
	Post-test	2.17 ± 0.62
	Follow-up	2.29 ± 0.57
Parasomnia	Pre-test	14.72 ± 1.98
	Post-test	12.61 ± 1.80
	Follow-up	12.94 ± 1.51
Total CSHQ score	Pre-test	69.38 ± 2.93
	Post-test	58.02 ± 3.12
	Follow-up	59.82 ± 3.21

CSHQ: Children's Sleep Habits Questionnaire; SD: Standard deviation

As shown in table 2, a repeated-measures ANOVA revealed a significant effect of time on total CSHQ scores ($F = 227$, $\eta^2 = 0.87$, $P = 0.0001$), indicating that 87% of the variance in total CSHQ scores was explained by measurement time.

Pairwise comparisons using the Bonferroni post hoc test are reported in table 3.

Table 2. Results of repeated-measures analysis of variance (ANOVA) to examine the differences in the study group at different time points of evaluation

Variables	SS	df	MS	F	P-value	η^2
Bedtime resistance	404.96	1.18	343.06	189.90	0.0001	0.85
Daytime sleepiness	1.90	1.20	1.57	1.28	0.2700	0.04
Night wakings	21.58	1.37	15.66	54.47	0.0001	0.62
Sleep duration	16.41	1.50	10.92	29.67	0.0001	0.47
Sleep-disordered breathing	0.49	1.00	0.49	0.75	0.3900	0.02
Sleep anxiety	90.90	1.27	71.56	103.01	0.0001	0.76
Sleep onset delay	2.60	1.40	1.85	10.67	0.0010	0.24
Parasomnia	78.40	1.33	58.90	30.40	0.0001	0.48
Total CSHQ score	2532.70	1.40	1762.00	227.00	0.0001	0.87

CSHQ: Children's Sleep Habits Questionnaire; SS: Sum of squares; df: Degree of freedom; MS: Mean square

Table 3. Pair comparison of Children's Sleep Habits Questionnaire (CSHQ) scores at different time points

Variables	Stages	Mean difference	SE	P-value
Bedtime resistance	Pre-test vs. post-test	4.58	0.31	0.0001
	Pre-test vs. follow-up	3.73	0.28	0.0001
	Post-test vs. follow-up	0.85	0.11	0.0001
Night wakings	Pre-test vs. post-test	1.03	0.11	0.0001
	Pre-test vs. follow-up	0.09	0.14	0.0001
Sleep-disordered breathing	Pre-test vs. post-test	0.97	0.14	0.0001
	Pre-test vs. follow-up	0.61	0.14	0.0001
	Post-test vs. follow-up	0.35	0.08	0.0010
Sleep anxiety	Pre-test vs. post-test	2.06	0.18	0.0001
	Pre-test vs. follow-up	1.94	0.19	0.0001
Sleep onset delay	Pre-test vs. post-test	0.38	0.08	0.0001
Parasomnia	Pre-test vs. post-test	2.00	0.31	0.0001
	Pre-test vs. follow-up	1.67	0.33	0.0001
Total CSHQ score	Pre-test vs. post-test	11.35	0.57	0.0001
	Pre-test vs. follow-up	9.55	0.71	0.0001
	Post-test vs. follow-up	1.79	0.38	0.0001

SE: Standard error; CSHQ: Children's Sleep Habits Questionnaire

Significant differences across time points were observed for the subscales of bedtime resistance ($F = 189.90$, $P = 0.0001$), night waking ($F = 54.47$, $P = 0.0001$), sleep duration ($F = 29.67$, $P = 0.0001$), sleep anxiety ($F = 103.01$, $P = 0.0001$), sleep onset delay ($F = 10.67$, $P = 0.001$), and parasomnia ($F = 30.04$, $P = 0.0001$). The corresponding eta-squared values were 0.62, 0.47, 0.76, 0.24, and 0.48, respectively, indicating that 62%, 47%, 76%, 24%, and 48% of the variance in these dependent variables was explained by the measurement time.

According to table 3, the mean total CSHQ score at pre-test (69.38) was significantly higher than that at post-test (69.38 vs. 58.02, $P < 0.0001$) and at follow-up test (69.38 vs. 59.82, $P < 0.0001$). These findings indicate that enhancing understanding of embodied conceptual metaphors had a significant positive effect on sleep problems in children with autism. To ensure the long-term effectiveness of rehabilitation, the metaphorical perception test was re-administered 45 days after the intervention. Follow-up results confirmed the persistence of the beneficial effects of enhancing understanding of embodied conceptual metaphors.

Discussion

This study aimed to investigate the effect of enhancing understanding of embodied conceptual metaphors on sleep problems in children with autism who experience sleep problems. The findings indicated that this intervention had a significant positive effect on the sleep status of children with ASD.

Sleep onset delay and insufficient sleep duration were among the obvious sleep problems in children with autism. Consistent with these findings, Tudor et al. reported a direct positive relationship between sleep onset delay and reduced sleep duration with autism symptoms, identifying sleep onset delay as the strongest predictor of communication deficits, stereotyped behaviors, and the severity of autism (37). Similarly, Khazaei et al. identified sleep behavior disorders, particularly bedtime resistance, as the most inappropriate sleep habit in children (38). Sleep onset delay and bedtime resistance can lead to insufficient sleep, clumsiness, and fatigue during the day, thus impairing language learning and cognitive readiness required to acquire language. In addition, delayed sleep onset and bedtime resistance may lead to discomfort and conflict within the family, which can eventually lead to behavioral problems.

The present study found that children with autism exhibited daytime sleepiness. These findings align with those of Adams et al. (39) and Van Litsenburg et al. (40), reporting that daytime sleepiness is common in children with autism and sleep problems can have a substantial effect on the severity of symptoms and negatively affect the daily functioning of these children. In this study, daytime sleepiness was identified as one of the most prominent sleep problems reported in children with autism. Daytime sleepiness is associated with reduced cognitive functions, including attention and memory, which are essential for proper conscious functioning and learning. Consequently, language acquisition becomes more difficult, and children may show poor performance in so-

cial and communicative tasks, as well as reduced motivation to engage in language learning.

Another sleep problem observed in this study was SDB, problems with oxygen delivery to the brain, and frequent night wakings. These findings are supported by several neurological studies that emphasize the role of sleep in memory and its underlying neurological mechanisms. Several studies have shown that sleep problems can alter the neurotransmitter system that is critical for amplifying and stabilizing information during rapid eye movement (REM) sleep. For example, Verma et al. highlighted the effect of dopamine, serotonin, gamma-aminobutyric acid (GABA), and norepinephrine in sleep regulation in individuals with autism (41). Deuschle et al. also demonstrated an association between serotonin and insomnia, and the role of serotonin in melatonin production, with its sedative effect promoting sleep (42). GABA is also involved in the cognitive inhibition processes in individuals with autism and sleep disorders **(**43). Disruption in breathing during sleep may therefore lead to frequent awakenings, which in turn interrup the sleep cycle, resulting in impaired consolidation of language-related information during sleep, and subsequent fatigue, distraction, and confusion during the day.

Anxiety is a common problem in children with autism that exacerbates a variety of sleep disorders (44). One of the key findings of this study was the reduction in sleep anxiety by enhancing understanding of embodied conceptual metaphors, which had a positive effect on a variety of sleep disorders in children with autism. Tudor et al. mentioned that communication difficulties could be predicted by sleep anxiety. They also found that social interaction deficits, stereotyped behaviors, and autism severity could be predicted by sleep onset delay (37). Additionally, Hollway et al. demonstrated a relationship between sleep anxiety and abnormal smell and taste perception (45). Sleep anxiety, as a subscale of CSHQ, refers to fears of sleeping in the dark, sleeping alone, difficulty sleeping away from home, and needing a parent in the room at bedtime. However, sleep anxiety in children with autism is a complex and multidimensional phenomenon that may not be fully captured by these items alone (46).

Botting and Baraka reported that sleep anxiety and language skills were closely intertwined in children with autism, whereby poorer sleep was associated with weaker language abilities. Although there is no direct causal relationship, it is possible that improved language skills may be related to improved sleep patterns in these children. Their research also showed that sleep problems were experienced more frequently in children with communication disorders than in their typically developing peers, predicting sleep behaviors and expressive, receptive, and social language deficits in both groups, as well as receptive communication problems in children with communication disorders (47). Enhancing understanding of embodied conceptual metaphors may therefore facilitate metaphor comprehension, improve communication, increase the desire for social interaction, promote relaxation, and ultimately reduce sleep-related problems in children with autism.

Limitations and suggestions: A limitation of this study was the limited access to children with autism for matching purposes, including age, gender, educability, language ability, underlying diseases, and medication use. Future studies should include larger samples and incorporate female participants, as access to girls with autism was limited in this study. Additionally, children with autism may respond differently to interventions depending on educational, cultural, and social contexts; therefore, participants in this study may not be representative of all children with autism in the broader community.

Conclusion

Considering that autism is a communication disorder, establishing effective communication with others is essential. Since the language rehabilitation program in this study improved linguistic communication, the findings suggest that enhancing understanding of embodied conceptual metaphors contributes to improvements in multiple aspects of sleep disorders, especially sleep anxiety.

Furthermore, in light of severe emotional and communication difficulties experienced by children with autism, reducing sleep anxiety may play an essential role in improving communication abilities, cognitive functioning, and other sleep disorders in this population.

Conflict of Interests

Authors have no conflict of interests.

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