

Effectiveness of Sleep-Based Cognitive Behavioral Interventions on Emotion Regulation and Sleep Quality in Children Aged 7 to 12 with Combined Type Attention-Deficit/Hyperactivity Disorder

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ABSTRACT

Purpose: The present study aimed to investigate the effect of sleep-based cognitive behavioral interventions on children aged 7 to 12 with combined type attention-deficit/hyperactivity disorder (ADHD) regarding emotion regulation and sleep quality. This study examined the impact of these interventions on two primary domains: emotion regulation and ADHD/hyperactivity symptoms.

Methods and Materials: This experimental study employed a pretest-posttest design. Participants included 34 children diagnosed with ADHD (17 per group) who received sleep-based cognitive behavioral interventions. Data were collected using standardized instruments, including the Emotion Regulation Checklist – Parent Form (Shields & Cicchetti, 1995), the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989), and the Conners' Rating Scale (Conners, 2008). Analyses were conducted using analysis of covariance (ANCOVA) in SPSS version 26.

Findings: Findings indicated that sleep-based cognitive behavioral interventions improved overall sleep quality and its associated components, enhanced satisfaction with sleep, and positively affected daytime functioning ($p < 0.01$). Additionally, these interventions contributed to improved emotion regulation performance and reduced emotional negativity/lability among the children.

Conclusion: The study demonstrated that sleep-based cognitive behavioral interventions can enhance emotion regulation processes in children with ADHD, while also increasing sleep quality and overall daily functioning.

Keywords: Sleep quality, attention-deficit/hyperactivity disorder, emotion regulation

1. Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most prevalent neurodevelopmental disorders of childhood and adolescence, characterized by persistent patterns of inattention, hyperactivity, and impulsivity that interfere with academic, social, emotional, and family functioning (American Psychiatric, 2022). The disorder typically emerges during childhood and often persists into adolescence and adulthood, resulting in substantial impairments across multiple domains of life. Beyond the core symptoms of inattention and hyperactivity, children with ADHD frequently experience difficulties in emotional functioning, interpersonal relationships, sleep regulation, and adaptive behavior. Contemporary research increasingly recognizes that ADHD is a multidimensional disorder involving deficits in cognitive, behavioral, and emotional self-regulation rather than merely a condition of attention impairment (Babinski & Sibley, 2022; Surman & Walsh, 2022). Consequently, researchers and clinicians have expanded their focus beyond symptom reduction toward understanding associated difficulties that significantly influence long-term functioning and quality of life among affected children.

One of the most important associated features of ADHD is emotional dysregulation. Emotional dysregulation refers to difficulties in monitoring, evaluating, and modifying emotional responses in ways that facilitate adaptive functioning. Children with ADHD often exhibit heightened emotional reactivity, emotional lability, irritability, frustration intolerance, and difficulties in recovering from negative emotional experiences. These difficulties frequently contribute to social rejection, family conflict, academic challenges, and reduced psychological well-being. Studies have demonstrated that impairments in emotion recognition and emotion regulation predict social and interpersonal difficulties among adolescents with ADHD, highlighting the central role of emotional functioning in the developmental course of the disorder (McKay et al., 2023). Furthermore, systematic reviews have indicated that psychosocial interventions targeting emotional dysregulation may significantly improve functional outcomes in children with ADHD, emphasizing the clinical relevance of emotion regulation as a treatment target (Vacher et al., 2020). Research has also suggested that effective ADHD treatments can produce meaningful improvements in emotional behavior, supporting the notion that emotional regulation difficulties represent a modifiable

component of the disorder rather than a fixed characteristic (Surman & Walsh, 2022).

In recent years, increasing attention has been directed toward sleep disturbances as another critical but often underrecognized aspect of ADHD. Sleep plays a fundamental role in cognitive development, emotional functioning, learning, attention, memory consolidation, and behavioral regulation. Insufficient or poor-quality sleep can adversely affect virtually every domain of child development. Children with ADHD experience significantly higher rates of sleep disturbances compared with their typically developing peers, including difficulties initiating sleep, maintaining sleep, delayed sleep onset, reduced sleep efficiency, and daytime sleepiness (Arias-Mera et al., 2023; Miniksar & Özdemir, 2021). These sleep difficulties may exacerbate ADHD symptoms, contribute to emotional dysregulation, and create additional burdens for children and their families. Sleep disorders are now recognized as highly prevalent across the lifespan among individuals with ADHD, with evidence suggesting that both ADHD symptom severity and comorbid conditions influence the manifestation of sleep-related problems (Adamis et al., 2026). Sleep quality has also been identified as an important predictor of overall psychological well-being, cognitive performance, and mental health outcomes in diverse populations (Sepehrmanesh et al., 2022).

The relationship between ADHD and sleep disturbances appears to be complex and bidirectional. On one hand, core ADHD symptoms may interfere with healthy sleep routines through increased motor activity, difficulty disengaging from stimulating activities, and challenges in establishing consistent bedtime behaviors. On the other hand, sleep deprivation and sleep disturbances can worsen attention deficits, impulsivity, emotional instability, and executive functioning difficulties. Emerging evidence suggests that sleep problems may not merely coexist with ADHD but may actively contribute to symptom expression and functional impairment (Owens et al., 2019). Recent investigations of sleep physiology have further demonstrated associations between sleep characteristics and cognitive-behavioral symptoms in youth with ADHD, suggesting that neurophysiological mechanisms underlying sleep may play a significant role in attentional and emotional functioning (Lunsford-Avery et al., 2026). Such findings highlight the need for interventions that specifically target sleep disturbances as part of comprehensive ADHD management.

The association between sleep disturbances and emotional dysregulation has received growing empirical

attention. Sleep deprivation affects brain regions involved in emotional processing and regulation, including the prefrontal cortex and limbic system, thereby reducing emotional control and increasing emotional reactivity. Children who experience chronic sleep problems are more likely to demonstrate irritability, mood instability, anxiety, and behavioral difficulties. Within ADHD populations, this relationship appears particularly pronounced. Evidence indicates that sleep difficulties are significantly associated with deficient emotional self-regulation among children and adolescents with ADHD, regardless of pharmacological treatment status (Sanabra et al., 2022). Similarly, recent research protocols and reviews have identified the relationship between emotion dysregulation and sleep as a critical area of investigation, emphasizing the possibility that sleep interventions may produce benefits extending beyond sleep outcomes to emotional functioning and behavioral adjustment (Sørensen et al., 2025). Therefore, interventions designed to improve sleep may simultaneously enhance emotional regulation capacities among children with ADHD.

Traditional ADHD treatments have primarily focused on pharmacological management. Although stimulant and non-stimulant medications have demonstrated effectiveness in reducing core ADHD symptoms, concerns remain regarding residual impairments in emotional functioning, sleep quality, and family life. Pharmacological treatments may also produce sleep-related side effects in some children, potentially complicating the management of sleep difficulties (Groom & Cortese, 2022). Consequently, increasing emphasis has been placed on behavioral and psychosocial interventions that address broader aspects of functioning. Family-based interventions, for example, have demonstrated positive effects on family functioning and child outcomes by addressing parenting practices, behavioral management strategies, and environmental factors that contribute to symptom maintenance (Babinski & Sibley, 2022). Given the significant influence of family routines and parental behavior on children's sleep habits, family involvement represents an especially important component of sleep-focused interventions.

Behavioral sleep interventions have emerged as promising non-pharmacological approaches for improving sleep quality among children with ADHD. These interventions typically include sleep hygiene education, bedtime routine management, stimulus control, relaxation training, cognitive restructuring, and parental guidance. Research has demonstrated that behavioral sleep

interventions can effectively reduce sleep problems and improve overall functioning in children with ADHD. A cluster-randomized trial conducted by Hiscock and colleagues found that behavioral interventions delivered by pediatricians or psychologists produced significant improvements in sleep outcomes among children with ADHD (Hiscock et al., 2019). Similarly, sleep-focused behavioral training has been shown to improve sleep-related outcomes in children with ADHD within diverse cultural contexts, highlighting the adaptability and effectiveness of such approaches (Singh et al., 2022). Pilot investigations have further suggested that behavioral sleep interventions are feasible, acceptable, and potentially effective in improving sleep quality and ADHD-related symptoms among adolescents (Becker et al., 2022).

The growing body of evidence supporting sleep interventions has led to the development of increasingly sophisticated treatment models integrating cognitive and behavioral components. Cognitive-behavioral approaches address both maladaptive sleep-related behaviors and dysfunctional beliefs that interfere with healthy sleep patterns. Recent intervention protocols have specifically targeted sleep as a mechanism for reducing ADHD symptoms and related impairments. For example, the Sleep Intervention as Symptom Treatment for ADHD (SIESTA) protocol was developed to improve sleep, ADHD symptoms, and associated difficulties through blended cognitive-behavioral techniques (Keuppens et al., 2023). Meta-analytic evidence further supports the effectiveness of sleep-focused interventions, indicating that existing treatments can significantly improve sleep outcomes among youth with ADHD and potentially contribute to broader improvements in functioning (Fang et al., 2026). Additional research among adults with ADHD has shown that sleep treatment can reduce ADHD symptoms while improving sleep quality, fatigue, and psychological well-being, suggesting that sleep may represent a transdiagnostic treatment target across developmental stages (van der Ham et al., 2026).

The impact of sleep difficulties extends beyond the affected child and significantly influences family functioning. Parents of children with ADHD frequently report elevated stress, disrupted family routines, and concerns related to their child's sleep behavior. Qualitative investigations have revealed that sleep difficulties in children with ADHD affect parental well-being, family relationships, and household functioning, creating a cycle of stress that may further reinforce sleep and behavioral problems (French et al., 2023). Moreover, parental

acceptance of behavioral interventions for insomnia and sleep disturbances has generally been favorable, indicating that families recognize the importance of addressing sleep difficulties and are willing to engage in non-pharmacological treatment approaches (Goodday et al., 2014). These findings underscore the value of incorporating parents into sleep intervention programs and support the implementation of family-centered treatment models.

Despite growing recognition of the importance of sleep in ADHD, several gaps remain in the existing literature. Many studies have focused primarily on sleep outcomes without simultaneously examining emotional functioning. Likewise, research investigating emotional regulation has often overlooked sleep as a potential mechanism of change. Given the strong associations among sleep quality, emotional regulation, and ADHD symptomatology, there is a need for integrated intervention studies that evaluate multiple outcomes simultaneously. Furthermore, much of the available evidence has been generated in adolescent or adult populations, while relatively fewer studies have focused specifically on school-aged children. Considering the developmental significance of middle childhood for emotional, cognitive, and behavioral growth, identifying effective interventions during this period may have important long-term implications for psychological adjustment and academic success.

Therefore, the present study aimed to investigate the effectiveness of sleep-based cognitive behavioral interventions on emotion regulation and sleep quality among children aged 7 to 12 years with Combined Type Attention-Deficit/Hyperactivity Disorder (ADHD).

2. Methods and Materials

2.1. Study Design and Participants

This study employed a quasi-experimental design using a pretest–posttest framework with a control group. The target population consisted of all children aged 7 to 12 years who had been diagnosed with Combined Type Attention-Deficit/Hyperactivity Disorder (ADHD) and who attended specialized and subspecialized psychiatric clinics in Tehran, Iran, during 2025. Participants were selected through purposive sampling based on predefined inclusion criteria. A total of 34 children who met the eligibility requirements were recruited and randomly assigned to either the experimental group ($n = 17$) or the control group ($n = 17$). Inclusion criteria consisted of a confirmed diagnosis of Combined Type ADHD by a psychiatrist, an age range

between 7 and 12 years, parental reports indicating the presence of sleep-related difficulties, and parental informed consent for participation in the intervention sessions. Exclusion criteria included concurrent participation in other psychological interventions and any changes in psychotropic medication dosage during the intervention period. The experimental group participated in an eight-session sleep-based cognitive behavioral intervention program, whereas the control group received no intervention during the study period. Ethical principles, including confidentiality, voluntary participation, and the right to withdraw from the study at any stage, were observed throughout the research process.

2.2. Measures

Symptoms of attention-deficit/hyperactivity disorder were assessed using the Conners' Parent Rating Scale (CPRS) developed by Conners (2008). The Conners scales are among the most widely used instruments for evaluating ADHD-related behavioral symptoms in children and adolescents. The parent version used in the present study consists of approximately 25–30 items scored on a four-point Likert scale ranging from 0 (Never) to 3 (Very Often). The scale measures six major domains, including inattention, hyperactivity, impulsivity, cognitive problems, oppositional behaviors, and anxiety. Raw scores are converted into standardized T-scores based on normative data adjusted for the child's age and gender, allowing for accurate interpretation of symptom severity. Higher scores indicate greater behavioral difficulties and more severe ADHD-related symptoms. Previous studies have reported satisfactory psychometric properties for the scale, including strong reliability and validity across clinical and non-clinical populations. The Persian version of the Conners' Scale has also demonstrated acceptable validity and reliability among Iranian samples. In the present study, Cronbach's alpha coefficients were 0.85 for the Hyperactivity subscale and 0.87 for the Inattention subscale, indicating good internal consistency.

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), developed by Buysse et al. (1989). The PSQI is one of the most extensively used self-report measures for evaluating sleep quality during the previous month. The instrument consists of 19 self-rated items and 5 additional items completed by a roommate or bed partner when available; however, only the 19 self-rated items contribute to the final score. The questionnaire evaluates

seven dimensions of sleep, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction related to sleep problems. Each component is scored on a scale ranging from 0 to 3, resulting in a global score ranging from 0 to 21. Higher scores indicate poorer sleep quality, and a global score above 5 is generally considered indicative of significant sleep disturbances. The PSQI has been widely validated across diverse clinical and community populations and has demonstrated strong psychometric properties. The Persian version has been translated and validated in Iran, showing satisfactory reliability and construct validity. In the current study, the Cronbach's alpha coefficient for the overall scale was 0.79, indicating acceptable internal consistency.

Children's emotional regulation abilities were evaluated using the Emotion Regulation Checklist (ERC) developed by Shields and Cicchetti (1995). The checklist was specifically designed to assess emotion regulation capacities among school-aged children between 6 and 12 years of age and can be completed by either parents or teachers. The original version consists of 24 items rated on a four-point Likert scale ranging from 1 (Never) to 4 (Almost Always). The instrument measures two primary dimensions: Emotion Regulation and Emotional Lability/Negativity. Higher scores on the Emotion Regulation dimension reflect better emotional self-regulation abilities, whereas higher scores on the Emotional Lability/Negativity dimension indicate greater emotional instability and negative emotional responses. A revised 22-item Persian version has been developed and validated in Iranian populations, demonstrating satisfactory psychometric properties. Previous validation studies reported Cronbach's alpha coefficients of 0.76 for the Emotion Regulation subscale and 0.69 for the Emotional Lability/Negativity subscale, while evidence for construct validity was also confirmed. The ERC has been widely used in developmental and clinical research involving children with emotional and behavioral difficulties, making it an appropriate measure for evaluating intervention outcomes in children with ADHD.

2.3. Intervention

The intervention consisted of eight structured sessions of sleep-based cognitive behavioral therapy delivered to the experimental group. The program focused on improving sleep quality and establishing healthy sleep behaviors through psychoeducation, behavioral modification,

cognitive strategies, and parental involvement. The first session introduced participants and their parents to fundamental sleep concepts, sleep hygiene principles, and the objectives of the intervention. The second session provided comprehensive psychoeducation regarding sleep hygiene practices, physiological factors affecting sleep quality, dietary influences such as caffeine consumption, and environmental conditions conducive to healthy sleep. During the third session, children were trained in relaxation techniques and strategies for preparing the body and mind for sleep. The fourth session emphasized parental understanding of healthy sleep patterns in children and encouraged the sharing of experiences related to sleep difficulties. Techniques aimed at reducing cognitive attachment to daily concerns before bedtime were also introduced. The fifth session focused on functional analysis of sleep problems, identification of sleep-related difficulties, and development of individualized sleep plans tailored to each child's specific needs. The sixth session addressed maladaptive cognitive processes such as rumination, ineffective planning, circadian rhythm disruptions, and motivational difficulties that contribute to sleep disturbances. Cognitive and behavioral strategies for managing these processes were taught. During the seventh session, participants finalized personalized sleep schedules and behavioral plans designed to fit their individual lifestyles and family circumstances. The final session reviewed the consequences of untreated sleep problems, reinforced learned strategies, addressed ongoing sleep-related challenges, and provided a comprehensive summary of the intervention. Throughout the program, parents were actively involved and received training to support the maintenance of healthy sleep habits and the consistent implementation of behavioral recommendations at home.

2.4. Data Analysis

Data analysis was conducted using IBM SPSS Statistics version 26. Descriptive statistics, including means and standard deviations, were calculated to summarize participant characteristics and study variables. Prior to hypothesis testing, assumptions underlying parametric analyses, including normality of distribution, homogeneity of variances, and homogeneity of regression slopes, were evaluated. To determine the effectiveness of the sleep-based cognitive behavioral intervention, analysis of covariance (ANCOVA) was employed. Posttest scores of sleep quality, emotion regulation, and emotional lability/negativity served

as dependent variables, while corresponding pretest scores were entered as covariates to control for baseline differences between groups. Statistical significance was determined at the 0.05 level, and effect sizes were examined to evaluate the magnitude of intervention effects on the outcome variables.

3. Findings and Results

The findings indicated that the mean age of participants in the experimental group was 8.35 years (SD = 0.93), whereas the mean age of the control group was 8.23 years (SD = 0.90). In the experimental group, 14 participants were

boys and 3 were girls, while the control group consisted of 13 boys and 4 girls. Approximately 65% of participants in the experimental group and 76% of those in the control group had a documented history of ADHD. Regarding socioeconomic status, 47% of the experimental group and 64% of the control group were classified as having a moderate socioeconomic status. Preliminary analyses confirmed that the assumptions required for analysis of covariance, including normality of score distributions, homogeneity of variances, and homogeneity of regression slopes, were adequately satisfied.

Table 1

Means and Standard Deviations of Sleep Quality and Emotion Regulation Variables at Pretest and Posttest

Research Variables	Group	Pretest M	Pretest SD	Posttest M	Posttest SD
Subjective Sleep Quality	Experimental	1.57	0.70	0.70	0.46
	Control	1.29	0.77	1.23	0.66
Sleep Latency	Experimental	1.77	0.44	0.52	0.51
	Control	1.82	0.39	1.47	0.52
Sleep Duration	Experimental	1.17	0.80	0.58	0.61
	Control	1.05	0.74	1.22	0.65
Sleep Efficiency	Experimental	1.48	0.73	0.58	0.50
	Control	1.42	0.88	1.19	0.75
Sleep Disturbances	Experimental	1.48	0.81	0.76	0.66
	Control	1.42	0.88	1.48	0.73
Use of Sleep Medication	Experimental	0.65	0.69	0.29	0.58
	Control	0.70	0.68	0.58	0.61
Daytime Dysfunction	Experimental	1.28	0.84	0.47	0.51
	Control	1.23	0.90	1.23	0.90
Global Sleep Quality	Experimental	9.43	3.70	3.94	1.81
	Control	9.08	3.32	8.44	2.92
Emotional Lability/Negativity	Experimental	31.94	3.61	25.11	3.27
	Control	32.23	3.63	31.58	4.52
Emotion Regulation	Experimental	12.52	1.77	15.35	1.69
	Control	12.41	2.03	12.88	1.79

As shown in Table 1, the mean global sleep quality score at posttest was 3.94 in the experimental group compared with 8.44 in the control group. Furthermore, the mean score for Emotional Lability/Negativity at posttest was 25.11 in

the experimental group and 31.58 in the control group, indicating favorable changes among participants who received the sleep-based cognitive behavioral intervention.

Table 2

One-Way Analysis of Covariance for Sleep Quality Components and Emotion Regulation Variables

Dependent Variable	SS	df	MS	F	p	η ²
Subjective Sleep Quality	3.60	1	3.60	15.70	.010	.38
Sleep Latency	6.14	1	6.14	24.45	<.001	.49
Sleep Duration	3.31	1	3.31	11.62	.002	.31
Sleep Efficiency	2.14	1	2.14	7.35	.010	.22
Sleep Disturbances	4.09	1	4.09	9.61	.005	.27
Use of Sleep Medication	0.56	1	0.56	1.74	.190	.06
Daytime Dysfunction	5.00	1	5.00	13.17	.001	.34
Emotional Lability/Negativity	50.17	1	50.17	18.21	<.001	.47
Emotion Regulation	335.93	1	335.93	26.83	<.001	.37

The results presented in Table 2 demonstrate significant differences between the experimental and control groups on Subjective Sleep Quality, $F(1, 31) = 15.70$, $p = .010$, Sleep Latency, $F(1, 31) = 24.45$, $p < .001$, Sleep Duration, $F(1, 31) = 11.62$, $p = .002$, Sleep Efficiency, $F(1, 31) = 7.35$, $p = .010$, Sleep Disturbances, $F(1, 31) = 9.61$, $p = .005$, Daytime Dysfunction, $F(1, 31) = 13.17$, $p = .001$, Emotional Lability/Negativity, $F(1, 31) = 18.21$, $p < .001$, and Emotion Regulation, $F(1, 31) = 26.83$, $p < .001$. However, no statistically significant difference was observed between the groups regarding the Use of Sleep Medication, $F(1, 31) = 1.74$, $p = .190$. As indicated in Table 1, the experimental group exhibited substantial improvements from pretest to posttest across most sleep quality components as well as emotion regulation outcomes, supporting the effectiveness of the sleep-based cognitive behavioral intervention.

4. Discussion and Conclusion

The present study examined the effectiveness of sleep-based cognitive behavioral interventions on sleep quality and emotion regulation among children aged 7 to 12 years with Combined Type Attention-Deficit/Hyperactivity Disorder (ADHD). The findings demonstrated that participation in the intervention program resulted in significant improvements in several components of sleep quality, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, and daytime functioning. In addition, significant improvements were observed in emotion regulation and reductions in emotional lability/negativity among children in the experimental group compared with those in the control group. However, no significant difference was found between the groups regarding the use of sleep medication. Overall, these findings indicate that sleep-based cognitive behavioral interventions can effectively improve both sleep-related outcomes and emotional functioning in children with ADHD.

One of the most important findings of the present study was the significant improvement in overall sleep quality among children who participated in the intervention program. This finding is consistent with a growing body of evidence indicating that behavioral and cognitive-behavioral sleep interventions are effective in addressing sleep-related difficulties in individuals with ADHD. Previous studies have consistently reported that children and adolescents with ADHD experience substantial impairments in sleep quality,

including difficulties initiating sleep, poor sleep efficiency, sleep fragmentation, and daytime fatigue (Arias-Mera et al., 2023; Miniksar & Özdemir, 2021). The improvements observed in the current study suggest that interventions targeting sleep hygiene, bedtime routines, relaxation skills, and parental support can successfully address many of these difficulties. Similar findings have been reported by Hiscock and colleagues, who demonstrated that behavioral sleep interventions significantly reduced sleep problems in children with ADHD (Hiscock et al., 2019). Likewise, Singh and colleagues found that sleep-focused behavioral training improved sleep outcomes among children diagnosed with ADHD (Singh et al., 2022). More recently, meta-analytic evidence has shown that behavioral and cognitive-behavioral sleep interventions produce meaningful improvements in sleep outcomes across youth populations with ADHD (Fang et al., 2026). Therefore, the present findings further strengthen the evidence supporting sleep-focused interventions as an effective component of ADHD management.

The observed improvements in subjective sleep quality may be explained by the emphasis placed on sleep hygiene education and environmental modifications throughout the intervention process. Children and parents were taught strategies designed to establish consistent sleep schedules, reduce exposure to sleep-disrupting stimuli, and create sleep-supportive routines. Such strategies likely reduced physiological and psychological arousal at bedtime, thereby facilitating healthier sleep patterns. Previous research has emphasized that sleep disturbances in ADHD are frequently maintained by maladaptive behavioral habits and inconsistent routines rather than solely by biological factors (Owens et al., 2019). Consequently, interventions that target these behavioral contributors may substantially improve sleep quality. The positive changes observed in sleep latency and sleep duration further support this interpretation, suggesting that participants were better able to initiate and maintain sleep following the intervention.

Another important finding of the study was the significant reduction in sleep disturbances and improvement in sleep efficiency. Sleep efficiency reflects the proportion of time spent asleep relative to the total time spent in bed and is considered a key indicator of healthy sleep functioning. Children with ADHD often exhibit prolonged periods of wakefulness, restless sleep, and frequent nighttime awakenings (Adamis et al., 2026; Arias-Mera et al., 2023).

The intervention's focus on bedtime relaxation, cognitive disengagement from daily concerns, and individualized sleep planning may have contributed to greater sleep consolidation and fewer nighttime disruptions. These findings are consistent with the work of Becker and colleagues, who reported improvements in sleep functioning following behavioral sleep interventions among adolescents with ADHD (Becker et al., 2022). Furthermore, the SIESTA protocol proposed by Keuppens and colleagues was specifically designed on the premise that improving sleep can alleviate a range of ADHD-related impairments, including sleep fragmentation and daytime dysfunction (Keuppens et al., 2023). The current results provide empirical support for this theoretical framework.

The significant improvement in daytime functioning observed among participants in the experimental group represents another meaningful outcome. Sleep disturbances often result in fatigue, impaired concentration, emotional irritability, and diminished academic performance during waking hours. By improving sleep quality, the intervention likely enhanced children's cognitive and behavioral functioning throughout the day. Research has consistently demonstrated that inadequate sleep negatively affects executive functioning, attention, learning, and behavioral self-control in children (Owens et al., 2019). Because children with ADHD already experience challenges in these domains, sleep problems may further compound their difficulties. Therefore, improving sleep quality may create a cascade of positive effects that extend beyond nighttime functioning. Similar conclusions have been reported in adult populations with ADHD, where sleep treatment was associated with improvements not only in sleep quality but also in fatigue and broader psychological outcomes (van der Ham et al., 2026).

A particularly noteworthy finding of the present study was the significant reduction in emotional lability/negativity and the corresponding improvement in emotion regulation. This outcome is highly important because emotional dysregulation has increasingly been recognized as a central feature of ADHD rather than a secondary consequence of the disorder (Surman & Walsh, 2022). Children with ADHD frequently experience difficulties managing frustration, controlling emotional reactions, and recovering from negative emotional experiences. These challenges contribute substantially to social difficulties, family conflict, and reduced quality of life. The current findings indicate that improving sleep may be an effective pathway for enhancing emotional functioning in this population.

Several mechanisms may explain the relationship between improved sleep and enhanced emotion regulation. Sleep plays a critical role in regulating neural systems involved in emotional processing, including the prefrontal cortex and limbic structures. Insufficient or poor-quality sleep compromises executive control over emotional responses, increasing emotional reactivity and reducing the capacity for adaptive regulation. When sleep quality improves, these regulatory systems may function more effectively, resulting in greater emotional stability. This explanation is supported by findings demonstrating significant associations between sleep problems and deficient emotional self-regulation among children with ADHD (Sanabra et al., 2022). Similarly, the systematic review protocol proposed by Sørensen and colleagues emphasized the growing evidence linking sleep disturbances with emotion dysregulation in children and adolescents with ADHD (Sørensen et al., 2025). The present findings provide empirical support for this relationship by demonstrating that interventions targeting sleep can produce meaningful improvements in emotional functioning.

The observed improvements in emotion regulation are also consistent with broader literature indicating that psychosocial interventions can effectively address emotional difficulties among children with ADHD. Vacher and colleagues concluded that psychosocial interventions targeting emotional and behavioral functioning can reduce emotional dysregulation and improve adaptive outcomes in this population (Vacher et al., 2020). Likewise, McKay and colleagues found that deficits in emotion regulation contribute significantly to social difficulties among adolescents with ADHD (McKay et al., 2023). By improving emotional regulation, sleep-based interventions may therefore produce downstream benefits in peer relationships, family interactions, and academic adjustment. This possibility is particularly important because emotional difficulties often persist even when core ADHD symptoms improve.

The role of parents within the intervention may have further contributed to the observed outcomes. Parents were actively involved in learning about sleep hygiene, bedtime routines, and strategies for supporting healthy sleep behaviors. Family involvement is especially relevant because parents play a central role in establishing and maintaining children's sleep habits. Previous studies have demonstrated that family-centered interventions can improve both child outcomes and family functioning among children with ADHD (Babinski & Sibley, 2022). Moreover,

qualitative research has shown that sleep difficulties in children with ADHD affect the entire family system, increasing parental stress and disrupting household routines (French et al., 2023). Consequently, involving parents in treatment may strengthen intervention effects by promoting consistency and reinforcing behavioral changes across settings. The favorable outcomes observed in the present study are therefore likely attributable not only to child-focused strategies but also to parental engagement throughout the intervention process.

An additional finding worthy of discussion is the absence of a significant difference between the experimental and control groups regarding the use of sleep medication. This result is not entirely surprising given that the intervention was designed to improve sleep through behavioral and cognitive strategies rather than pharmacological means. Behavioral interventions often aim to reduce dependence on sleep medications by addressing the underlying behavioral and environmental factors contributing to sleep problems. The lack of significant change in medication use may reflect the relatively short duration of the intervention or the possibility that medication-related decisions remained under the supervision of healthcare providers and were not directly influenced by the intervention. Nevertheless, the fact that substantial improvements in sleep quality occurred without significant changes in medication use highlights the effectiveness of non-pharmacological approaches for managing sleep difficulties in children with ADHD.

The present findings also contribute to the broader literature examining the relationship between ADHD treatment and emotional functioning. While pharmacological treatments remain a cornerstone of ADHD management, evidence suggests that medication alone may not fully address emotional dysregulation and sleep-related difficulties (Groom & Cortese, 2022). Recent reviews have highlighted the importance of considering emotional outcomes when evaluating ADHD treatments (Surman & Walsh, 2022). The current study supports this perspective by demonstrating that a targeted behavioral intervention can simultaneously improve sleep quality and emotional functioning. These findings align with contemporary models of ADHD that emphasize the interconnected nature of sleep, emotion regulation, cognitive functioning, and behavioral symptoms (American Psychiatric, 2022). Future treatment approaches may therefore benefit from adopting a more integrated perspective that addresses these interrelated domains simultaneously.

Overall, the findings of the present study suggest that sleep-based cognitive behavioral interventions represent a promising, practical, and family-centered approach for improving both sleep quality and emotion regulation among children with Combined Type ADHD. By targeting sleep-related difficulties, the intervention appears to have produced broad benefits extending beyond sleep itself, including improvements in emotional stability and daytime functioning. Given the high prevalence of sleep disturbances among children with ADHD and the strong association between sleep and emotional functioning, integrating sleep-focused interventions into routine clinical practice may enhance treatment effectiveness and improve long-term outcomes.

One limitation of the present study was the relatively small sample size, which may restrict the generalizability of the findings to broader populations of children with ADHD. In addition, participants were recruited from specialized psychiatric clinics in a single city, potentially limiting the representativeness of the sample. The study relied primarily on parent-reported measures, which may be influenced by subjective perceptions and reporting biases. Furthermore, the absence of a long-term follow-up assessment prevented evaluation of the durability of treatment effects over time. Finally, the study focused exclusively on children with Combined Type ADHD, and therefore the findings may not generalize to children with other ADHD presentations.

Future research should examine the long-term effectiveness of sleep-based cognitive behavioral interventions through extended follow-up periods. Studies involving larger and more diverse samples are needed to strengthen the external validity of findings. Researchers may also investigate the differential effectiveness of sleep interventions across ADHD subtypes, age groups, and levels of symptom severity. Future investigations could incorporate objective measures of sleep, such as actigraphy or polysomnography, alongside subjective assessments. In addition, exploring potential mediating mechanisms, including executive functioning, family processes, and neurobiological changes, may provide a deeper understanding of how improvements in sleep influence emotional and behavioral outcomes.

From a practical perspective, clinicians working with children with ADHD should routinely assess sleep quality as part of comprehensive evaluation procedures. Sleep-focused cognitive behavioral interventions may be incorporated into treatment programs to complement existing behavioral and pharmacological approaches. Parents should receive

education regarding sleep hygiene, bedtime routines, and environmental factors that support healthy sleep habits. Schools and healthcare providers may also collaborate to promote sleep health awareness and encourage practices that facilitate adequate sleep among children with ADHD. Integrating sleep-focused strategies into routine care has the potential to improve emotional functioning, daily performance, and overall quality of life for affected children and their families.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the study and participated in the research with informed consent. The present study is derived from a master's thesis in Special Education Psychology at the Islamic Azad University, Central Tehran Branch, with the ethics code IR.IAU.CTB.REC.1404.083.

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