



# The Interventions for Sleep Disorders in Children with Attention Deficit and Hyperactivity Disorder: A Narrative Review

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## Abstract

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**BACKGROUND:** Attention deficit and hyperactivity disorder (ADHD) is the most common neurodevelopmental disorder in childhood. Children with ADHD have more frequent comorbid sleep disorders than healthy children. The current methods of treating sleep disorders in ADHD children are still focused on pharmacological interventions which in fact only provide little benefit.

**AIM:** This study aims to identify existing studies regarding the types of nonpharmacological and complementary interventions for sleep disorders in children with ADHD using a narrative review approach.

**METHODS:** This was a narrative review. Inclusion criteria included articles in English and Bahasa, full-text articles, primary studies, and children with ADHD aged 18 years with or without comorbidities as the research sample, and the article having been published in the last 10 years. Searches were performed in several databases: PubMed, Springer, Web of Science, and Google Scholar.

**RESULTS:** The result showed that programs for managing sleep disorder in ADHD are behavioral therapy, behavioral parent training (BPT), behavioral sleep intervention, neurofeedback, mind-body therapy, L-theanine supplementation, horse milk supplementation, and play therapy. The programs are found to be effective in improving sleep.

**CONCLUSION:** The program most comprehensive with a high level of ease of implementation was BPT.

## Introduction

The period of growth and development of children is prone to disturbances and deviations. One of the child developmental disorders that focus on neurodevelopment is Attention Deficit and Hyperactivity Disorder (ADHD). The global prevalence of ADHD was estimated at 7.2% in 2015 for children aged <18 years [1], and the prevalence of ADHD that continues into adulthood is 4% [2]. In Indonesia, it was reported that 26.2% of children aged 6–12 years were suspected of having ADHD and until now the number continues to increase [3].

Previous research has stated that ADHD is the result of inadequate production of norepinephrine and dopamine in the Prefrontal Cortex (PFC) which causes children to become forgetful, easily distracted, impulsive, and experience deviant social behavior [4]. ADHD is classified into three types based on symptoms, namely: ADHD-I with symptoms that appear in the form of inattention, ADHD-H with symptoms that appear in the form of hyperactive and impulsive behavior, and ADHD-C with combined symptoms of ADHD-I and ADHD-H [5], [6].

Children with ADHD not only experience difficulties from the symptoms they experience, but they are also often accompanied by various comorbidities. Psychiatric comorbidities and other neurodevelopmental disorders are common in children with ADHD [7]. Nikles *et al.* (2020) found that comorbid sleep disorders were the most frequent comorbidities affecting children with ADHD in up to 50–70% of the total sufferers. Several comorbidities can be related to each other. For example, in research from Viring *et al.* (2016) who examined the effect of psychiatric comorbid symptoms on sleep in children with ADHD, the results showed that psychiatric comorbidities were considered to cause comorbid sleep disorders. This is supported by Jan *et al.* (2011), who stated that several ADHD comorbidities can trigger sleep disorders, namely autism spectrum disorder (ASD), internalization disorders, and externalization disorders [6], [8]. These three conditions are the conditions most often associated with sleep disorders in children with ADHD.

Inadequate sleep will have various impacts on children, especially those with ADHD. At the neurobiological level, the impact of sleep disorders is to increase activity in brain networks related to emotions so that it can lead to increased emotional lability [9]. Sleep

deprivation is associated with impaired communication between the emotional and emotional areas, known as PFC [9]. PFC is involved in several cognitive processes so that sleep deprivation will indirectly interfere with the cognitive function of children with ADHD [5]. In addition, sleep disturbances can cause a progressive worsening of the executive function of children with ADHD [10].

A previous research has shown that the relationship between sleep problems and ADHD is a two-way relationship. Sleep disorders can both cause and worsen symptoms of inattention and hyperactivity/impulsivity, and medications used to treat symptoms can both cause and worsen certain sleep disorders [11]. Persistent sleep loss can both cause and worsen cognitive impairment [5] and behavior [10]. As stated by Reynolds *et al.* (2017), sleep problems in children are not only related to academic disorders, functional behavior, emotions, and neuropsychological abilities but can affect family unity.

Research on the treatment of sleep disorders in children with ADHD is quite developed, but it needs to be explored even further. The results of a systematic review states that the treatment of ADHD symptoms and sleep disorders in children includes the application of good sleep hygiene, giving melatonin to increase sleep-wake rhythms so that children tend to wake up earlier, and giving higher doses of stimulants to reduce insomnia secondarily [12]. In one research stated that the administration of methylphenidate can improve sleep efficiency including the quality, composition, continuity, and consolidation of sleep, which improved after 1 week of administration [13]. However, methylphenidate administration only had a secondary effect on sleep problems as previously cited by Vigliano *et al.* (2016). The detrimental effect of stimulants is the worsening of sleep disturbances and in the long-term use can increase the risk of growth delay [14]. Another problem arises when parents realize that medication has side effects, which can worsen the child's condition because parents will tend to disobey the medication regimen.

To complement the shortcomings of pharmacological therapy, non-pharmacological and complementary approaches can be the right choice. Non-pharmacological therapies have been studied and proven to produce excellent improvement and long-term effects in the sleep patterns of patients with insomnia [15]. In addition, complementary and integrative approaches have been used to treat or manage disorders and symptoms related to the nervous system [16]. An analysis result based on a report submitted by Phillips (2014) stated that only 12% of children with ADHD were using complementary and alternative therapies to treat ADHD [17]. This shows that there is great potential for the development of the application of complementary therapies in Indonesia. This study was conducted to answer existing problems, namely:

“what kind of intervention, non-pharmacological and complementary, can be given to treat sleep disorders in children with ADHD?”

## Methods

The study aims to summarize and broadly evaluate the previous findings regarding the management of sleep disorders in children with ADHD. A search was performed in several databases: PubMed, Springer, Web of Science, and Google Scholar. Inclusion criteria included articles using English and Indonesian, full-text articles, primary studies, and children with ADHD aged 18 years with or without comorbidities as the research sample, and publication of the article over the past 10 years (2011–2021). After collecting the search results articles from various databases, the authors assess the duplication of articles by screening titles and abstracts. If similar articles are found, the authors eliminate duplicate articles. Articles that pass the title, abstract, and content selection thoroughly are read by the author in their entirety to obtain articles suitable for use to answer specific study objectives (Figure 1).

The selected article is then read in-depth by the author for subsequent analysis. At this stage, the author takes information that is relevant to the discussion. This type of information can be labeled study notes, which include a summary of the study, followed by detailed information about the methods, results, and interpretation of the results [18].

The information obtained from the studies can be processed in two ways: separately or synthetically [18]. In a separate organizational technique, the details of each study (including a study summary of the methods, results, and interpretation of the results) are recorded in a table. All data extraction results were then analyzed in the form of a narrative that explained the findings in groups for treating sleep disorders in children with ADHD (Table 1).

## Results

The results of the search for articles from the database in the form of PubMed, Springer, Web of Science, and the search engine Google Scholar using the relevant keywords obtained as many as 24,498 articles. After eliminating the duplication of articles, the number of articles reduced to 1370. The article selection stage continued to the title and abstract selection stage with a total of 81 articles obtained. The last stage of article selection is the stage of determining

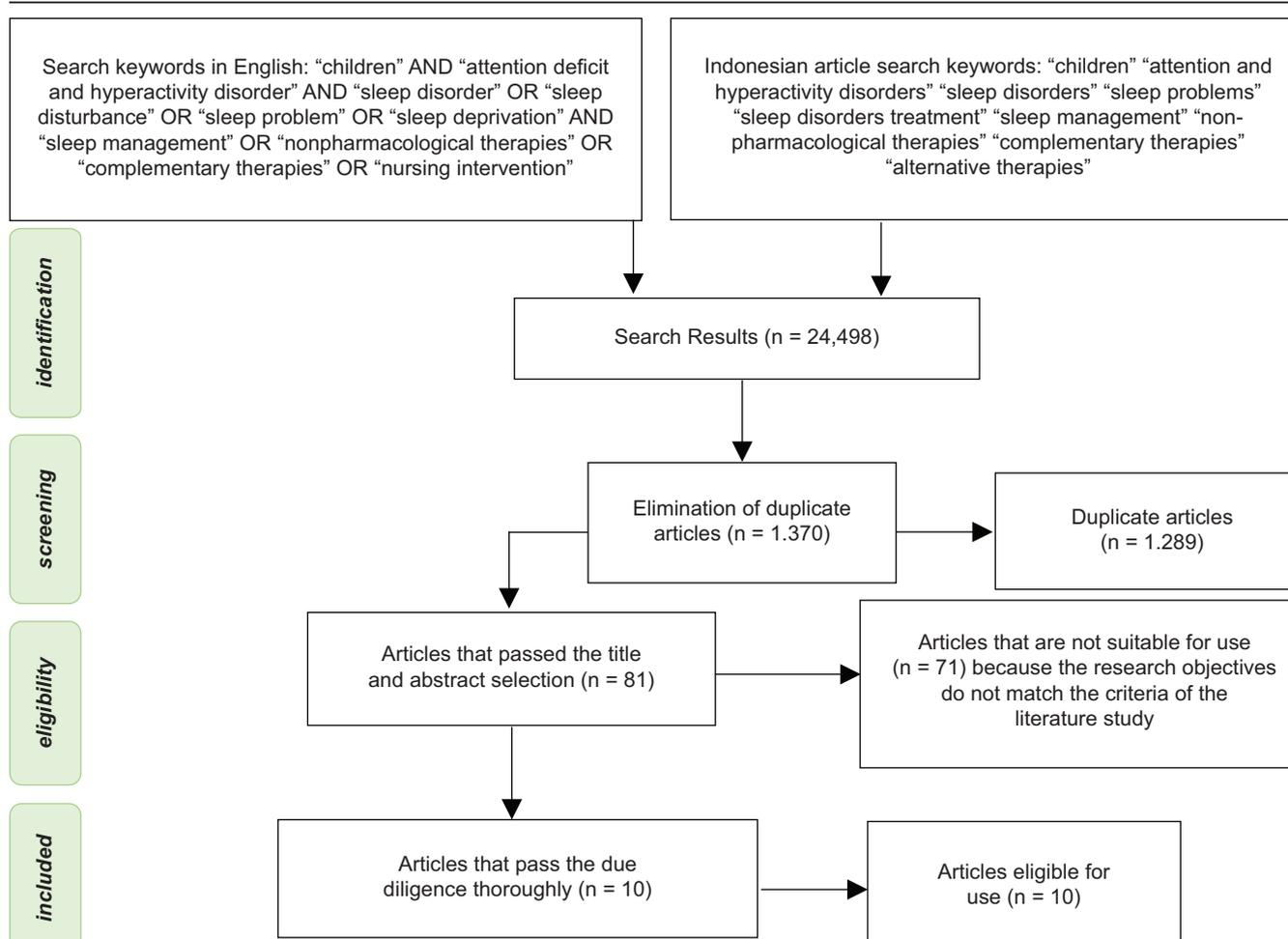


Figure 1: Article search process

Table 1: Data extraction

Author, Year of Publication, and Place of Research	Objectives and Outcomes	Methods and Participants	Child Age	Instrument	Program	Results
Sciberras <i>et al.</i> <sup>[19]</sup> Melbourne, Australia	Evaluate the feasibility and usefulness of behavioral sleep programs for children with ADHD and explore the impact of different program doses on child and family outcomes. Primary outcomes: sleep disturbance, ADHD symptom severity, QoL, daily functioning, school attendance. Secondary (caregiver) outcomes: mental health attendance at work	Randomized controlled trial 27 families with ADHD children	5–14 years	CSHQ, ADHD-RS IV, PQL 4.0, DPREMB, DASS	Behavioral therapy	The intervention administered to the extended intervention group resulted in decreased sleep problems, minimal changes in ADHD symptom scores, improved children's quality of life and daily functioning, and decreased parental anxiety
Sciberras <i>et al.</i> [23]. Victoria, Australia	Determine whether BSIs for children with ADHD lead to lasting benefits, and examine factors associated with treatment response. Outcomes: sleep, PQoL, behavior, daily functioning, comorbidities, mental health of the elderly	Randomized controlled trial 183 ADHD children	5–13 years	CSHQ, PedsQoL, SDQ, DPREMB, DASS, ADISC-IV	BSI	The intervention resulted in decreased sleep onset delay, night awakening, ADHD symptom severity, difficulty with daily functioning, negative behavior, minimal reduction in sleep refusal behavior, sleep duration, sleep anxiety, parasomnias, and daytime sleepiness, and improved quality of life and mental health of parents
Rigney <i>et al.</i> [24]. Canada	Knowing the similarities, the trend of outcomes used, and the quality of the methodology in providing BSI for children with a neurodevelopmental disorder (NDD), especially in children with ADHD, ASD, cerebral palsy, and fetal alcohol spectrum disorder. Outcomes: sleep concepts and behaviors, night awakenings, total sleep time, sleep onset latency	Systematic Review 435 children	4–15 years	Parent's report and actigraphy	BSI	Improved sleep onset latency (SOL), sleep duration, and sleep (in children following the yoga-only program) and decreased parental complaints about sleep disturbances and sleep problems in any of the outcomes (in the special modified group)

(Contd...)

Table 1: (Continued)

Author, Year of Publication, and Place of Research	Objectives and Outcomes	Methods and Participants	Child Age	Instrument	Program	Results
Herbert and Esparham [25]. United States of America	Review current research studying mind-body therapies for the treatment of children diagnosed with ADHD. Outcome: ADHD symptoms, the severity of the disorder, behavior, level of attention, awareness and orientation, impaired attention, inhibitory abilities, working memory	Literature review 134 children with ADHD	5–16 years	SNAP-IV, CGI-S, BOF, ADHD-RS IV, ANT, stroop task, trial marking test, and digit span	MbT	Reduced anxiety, daydreaming, negative emotions, ADHD symptoms, significantly improving behavior, increased dopamine and norepinephrine function, executive function and cognitive function, mood, immunity, stress management. Also reduced anxiety and pain, medication dosage, and increased TA for a sleep increase
Corkum et al. [20]. Canada	Determine the effectiveness of the intervention on sleep and psychosocial functioning of children with ADHD. Outcomes: total sleep disturbances, brain activity, behavioral disturbances (impaired internalization and externalization), and parental satisfaction	Randomized Controlled Trial 26 families with ADHD	5–12 years	CSHQ, actigraphy, CBCL, SRS	Behavioral therapy long distance	Decreased sleep problems (41.7% score of ADHD children became non-clinical), improved psychosocial functioning, and positively increased sleep onset delay, bedtime resistance, sleep duration, as well as high levels of satisfaction
Jokar et al. [26]. Iran	Comparing the effect of conventionally given horse's milk with cow's milk on sleep disturbances in children with ADHD. Outcomes: bedtime, sleep behavior, night awakening, and morning awakening	Randomized double-blind clinical trial 30 ADHD children other than ADHD-I type	6–14 years	CSHQ	Supplementation of horse milk and cow's milk	Consumption of horse milk reduced children's sleep problems on subscales 1, 3, and 4 (increased sleep time, decreased number of night awakenings, and increased morning awakening). The order of consumption of the two types of milk had no significant effect on the results of the analysis
Mehri et al. [27]. Iran	To examine the effect of behavioral parental training on sleep problems in children diagnosed with ADHD. Outcomes: bedtime resistance, sleep onset delay, sleep duration, anxiety, night awakenings, parasomnias, sleep-disordered breathing, and daytime sleepiness	Randomized Controlled Trial 56 ADHD children with participation from 23 mothers and 5 fathers	6–12 years	CSHQ	BPT (CPM)	Effectively improved sleep problems in school-age children with ADHD receiving methylphenidate treatment. The intervention resulted in decreased sleep problems, bedtime resistance, and increased sleep duration
Rao et al. [28]. Japan	To review the mechanisms, safety, and efficacy of L-theanine. Outcomes: sleep and wake times, total sleep time, sleep efficiency, and recovery from fatigue	Literature Review 93 boys with ADHD	8–12 years	MSLT, actigraphy, OSA-SIQ, WASO, ANS, PSQ, and VAS	L-theanine Macronutrient Supplementation	The intervention increased the percentage of sleep and sleep efficiency, reduced nighttime awakening, provided a relaxing effect from alpha wave induction, improved memory, learning performance, neuroprotection, sleep, as well as a positive increase in aggressive and defiant behavior. L-theanine is safe for consumption at a dose of 200 mg (3-5 g of tea leaves, maximum consumption 3 times a day), has no carcinogenic and toxic effects in long-term use, and causes few adverse events
Geladé et al. [29]. Dutch	Assessed the long-term effects of NFB in children with ADHD and compared behavioral and neurocognitive outcomes with a 6-month naturalistic follow-up of a RCT on NFB, methylphenidate, and physical activity (PA). Primary outcomes: behavioral problems, ADHD symptoms, neurocognitive, inhibitory control, and short-term memory. Secondary outcome: sleep quality	Multicenter three-way parallel-group, balanced, and randomized study 92 ADHD children	7-13 years old	SDQ, SWAN, auditory oddball task, SST, VSWM, and SDSC.	NFB	The NFB intervention reduced ADHD (even after controlling for medication use) was good for long-term use for ADHD children taking stimulants but had no significant effect on sleep quality and inhibitory control domains
El-Naggar et al. [30]. Jeddah, Saudi Arabia	Evaluating the effect of implementing play therapy on ADHD children. Outcomes: behavioral problems, ADHD symptoms, and anxiety symptoms	Quasi experimental 40 ADHD children accompanied by parents and teachers	4–12 years	CPRS-HI and CTRS-HI, CSI-4, VADRS, and VADTRS	Play therapy	The intervention decreased the sleep disturbance experienced and was effective in providing a positive increase in the domains of fear, anxiety, crying, and reducing negative behaviors such as thumb sucking behavior

ADHD: Attention deficit and hyperactivity disorder, BPT: Behavioral parent training, BSI: Behavioral sleep intervention, NFB: Neurofeedback, MbT: Mind-body therapy.

the eligibility of articles, resulting in a total of 10 articles that meet the criteria and are considered suitable for use in this literature study. Articles were selected based on predetermined criteria, namely articles using

English and Bahasa, full-text articles, primary studies, and children with ADHD aged 18 years with or without comorbidities as the research sample, and publication of the article over last 10 years (2012–2021).

The selected articles are studies with a randomized controlled trial research design of 5 articles, a literature review (including a systematic review) of four articles, and a quasi-experimental article of 1 article. Research respondents in all articles focused on children who had been diagnosed and/or had ADHD symptoms with and or without comorbidities. Subsequently, selected articles were thoroughly reviewed to answer the study questions. The article review rubric can be seen in Table 1.

All articles used are articles in English; the authors did not find articles in Indonesian that met the criteria for article selection and study objectives. From all 10 selected articles, there were 8 different interventions given including behavioral therapy, behavioral parent training (BPT), behavioral sleep intervention (BSI), neurofeedback (NFB), mind-body therapy (MbT) and meditation, macronutrient L-theanine supplementation, horse milk supplementation, and play therapy. Characteristics of participants are generally children who consume stimulants for the treatment of ADHD symptoms, accompanied by other comorbidities: ASD, internalizing disorders (anxiety or depression), externalizing disorders (oppositional defiant disorder or behavioral disorders), and other neurological disorders).

## Discussion

### **Non-pharmacological therapy**

#### *Behavioral therapy*

Behavioral therapy is a behavior-based intervention that aims to change and improve individual behavior to achieve a better degree of health. This intervention program is good for ADHD children who experience symptoms of ADHD severity with moderate to severe sleep disturbance, internalizing and externalizing disturbances without moderate to severe cognitive impairment, and other neurological disorders.

A research by Sciberras *et al.* (2011) on behavioral therapy intervention is provided with three training sessions and is supported by a printed module as a guide for implementing the intervention. In another research from Corkum *et al.* (2016), the whole series of therapy was done remotely. The therapy, which was provided over telephone, lasted for 5 weeks with a total of 5 training sessions. In both studies, the intervention targets were parents and showed that the participation and ability of parents in providing interventions to children greatly influenced the smoothness of therapy and the optimization of positive effects on children.

During the implementation of the intervention, parents were provided with various information to maximize implementation to their children, including psychoeducation, sleep hygiene, and basic clinical

strategies to manage sleep disorders experienced by children. In line with what is previously stated that psychoeducation is the first and main element of choice in providing treatment for sleep disorders in ADHD children with sleep disorders [21]. Similar to psychoeducation, sleep hygiene is an important element in efforts to treat sleep disorders. Providing information and discussing sleep hygiene can help parents to better understand what behaviors of their children can be changed to set strategies to improve children's sleep. Likewise the analysis of the relationship between family support and the quality of life of ADHD children showed that the higher the value of family support, the higher the quality of life of ADHD children [22]. Melatonin, which is formed at bedtime, helps children fall asleep faster or helps children not to experience disturbances at sleep onset. In implementing the intervention, Corkum *et al.* (2016) stated that distance therapy carried out by telephone was considered to be able to save costs and time, as well as provide easy access for parents to interventions. Scheduled parent training sessions in face-to-face programs are more at risk of clashing with parental work schedules. Comparative evaluation of therapy given face-to-face with therapy given remotely still cannot conclude its effectiveness against sleep disorders in children with ADHD.

#### *BSI*

In research conducted by Sciberras *et al.* (2019), the intervention is good for ADHD children with severe ADHD symptoms, moderate to severe sleep disturbances, who take medication for ADHD symptoms, and have comorbid internalizing (including anxiety) and externalizing disorders. The strategy used depends on the conditions experienced by the child. Sleep difficulties related to sleep onset were managed by an outdoor camping strategy, and the technique used was adult fading. The technique involves reducing the intensity of checking the parent's presence from the child's bed periodically for 7–10 days and rewarding the child for having the courage to sleep without a parent.

The delayed sleep phase is managed with a bedtime fading strategy, where parents adjust their child's sleep schedule according to their usual bedtime, moving this 15 min earlier each night. Children are not allowed to take a nap and parents set a time to wake up in the morning and make sure the child is exposed to the sun in the morning. Insomnia is managed with progressive muscle relaxation strategies and visual imagery, simple cognitive restructuring, reduced sleep time (sleep hours being late for a while, not staying in bed, and doing relaxation movements if the child doesn't sleep after 20 min). In line with research results, Wajszilber *et al.* (2018) state that CBTi is effective for use in adolescents with ADHD.

In research conducted by Rigney *et al.* (2018), the BSI program implemented includes a multi-component program, namely the application of psychoeducation, healthy sleep hygiene, reinforcement (positive and negative), extinction, bedtime fading, chronotherapy, diet therapy, and yoga alone. A special modification is in the form of a token economy, where children can “cash-out” tokens as a sign of compliant behavior. The combination of behavioral strategies that are generally applied to children are reinforcement, extinction, and bedtime fading strategies. The prospects for the success of the combination are increased in research that combines the reinforcement of the desired behavior along with the extinction of a particular behavior [31].

### *BPT*

Behavioral strategies used by Mehri *et al.* (2020) in their research on BPT are sleep hygiene, nutritional health, control of the child’s external environment, and the application of CBT. Researchers discussed together with parents to implement healthy sleep hygiene, discuss eating patterns (especially food elimination), and implement regular eating schedules. Further, there was the elimination some foods such as wheat, corn, dairy, and additives (artificial colors, preservatives, and artificial flavors) that are thought to have a destructive effect on ADHD symptoms. Research on food elimination (oligoantigenic diet) states that in addition to showing sensitivity to foods containing artificial coloring, ADHD children are sensitive to natural non-salicylic foods (such as milk, chocolate, soy, eggs, wheat, corn, and nuts) as well as grapes and tomatoes [32].

### *Play therapy*

Play therapy is included as one method of behavioral therapy under the name of cognitive-behavioral play therapy (CBPT). CBPT is an approach designed to teach coping skills to children by combining cognitive behavioral therapy with pretend play [33]. This program is good for use in school-age children who have had ADHD for <6 years, do not have siblings diagnosed with ADHD, and have sleep disorders. Purpose of play interventions is to build children’s confidence, increase children’s ability to stay focused, encourage children to show self-control, and teach children to consider consequences before acting [34]. Play therapy can be given by providing reinforcement (positive and/or negative) to children, reward for positive behavior, and token economy behavioral strategies as modifications to improve behavior.

Parents act as co-therapists or companion therapists, aiming to apply therapy at home on an ongoing basis. In a case-series study, children and their parents participated in the cognitive-behavioral play intervention (CBPI) program for 3 sessions for 20–30 min each session. Each parent received a sleep information session lasting

30 min. Results indicate that CBPI is potentially effective for reducing anxiety and difficulty with sleep problems [33].

### *NFB*

NFB is a non-pharmacological and non-invasive approach that aims to reduce ADHD symptoms [35]. The application of NFB in sleep disorders aims to create a relaxed condition, help individuals to fall asleep more easily, and avoid sleep disorders such as anxiety, nightmares, and fear that cause individuals to be very alert (causing sleep onset disorders). In the research conducted by Gelade *et al.* (2018), the therapy given is limited theta activity (4–8 Hz) and increased beta activity (18–30 Hz), or what is known as sensorimotor rhythm (SMR) NFB. SMR is the latest NFB protocol that can be applied, especially in individuals with ADHD [36]. SMR was assessed to increase sleep spindle density which was associated with reduced sleep onset latency, increased total sleep time, and exhibited a circadian rhythm similar to melatonin [37]. Sleep can easily occur during objectively controlled alpha or theta wave NFB training [38].

### **Complementary therapy**

#### *Horse milk supplementation (mare’s milk)*

Research conducted by Jokar *et al.* (2021) stated that horse milk supplementation provides benefits for children with ADHD, including the domain of children’s sleep. This is in line with the previous study stated how horse milk can be used as supportive therapy for several conditions (e.g., increased symptoms of ADHD) caused by substances that increase sensitivity by modifying their content [39].

This is backed by the other previous study stated that omega 3 significantly reduced the total sleep disturbance score in children diagnosed with sleep problems but did not affect the total sleep duration, sleep latency, or sleep efficiency of healthy children [40]. This supplementation program is good for school-age ADHD children who do not have comorbid ASD/mood disorders/personality disorders, do not experience mental retardation, do not experience schizophrenia or psychosis, and have at least one disorder in the 4 CHSQ domains. The weakness of horse milk therapy is the price of milk as it tends to be more expensive.

### *MbT*

A study from Herbert and Esparham (2017) discusses the function of MbT on sleep which is considered effective in reducing sleep disturbances experienced by children with ADHD. This program is good for children with school-age ADHD and is recommended but not limited to ADHD-I, and for children who experience anxiety, emotional problems,

or sleep disorders. MbT is a type of training program that focuses on physical and psychological training through exercises that involve concentration, deep breathing, and various directed movements. The types used are yoga, tai chi, physical activity, and meditation. Yoga is a combination of physical practice and mindfulness [41].

In the other study stated that tai chi can reduce symptoms of ADHD (inattention, hyperactivity, and impulsivity), defiant behavior, and dysfunction of executive function [42]. In addition to regulating various cognitive activities, previous research has found an association between sleep disturbances and executive function in children with ADHD. Herbert and Esparham (2017) mentioned that physical activity can be an intervention option. Physical activities that can be done include cardiovascular exercise (especially aerobics) and self-defense suitable for children with ADHD. Sleep and exercise had a substantial positive effect on each other [43]. Further, study analysis revealed that moderate-intensity physical activity was considered more effective in improving sleep quality, which could be beneficial for both children and adults [44].

#### *L-theanine macronutrient supplementation*

L-theanine (gamma-glutamylethylamide) is a complementary therapy that is included in the classification of natural products according to the NCCAM. L-theanine is found abundantly in tea leaves (especially black tea) which have an anti-anxiety (anxiolytic) effect, acting through the induction of alpha brain waves without any additive effects. L-theanine stimulates the production of alpha waves directly to create the effect of deep relaxation and a level of mental alertness as achieved through meditation [45]. The relaxing effect caused by L-theanine does not directly induce sleep but rather prepares the body and mind to enter the sleep phase efficiently [28]. In addition, L-theanine can maintain awareness during the day by not causing excessive sleepiness. The neurotransmitter gamma aminobutyric acid (GABA) is a neurotransmitter that inhibits the release of serotonin and dopamine as previously mentioned, playing a role in the regulation of waking behavior. The previous research results showed a decrease in sleep latency, an increase in sleep duration, and an increase in REM and NREM sleep compared to the control group after the administration of a mixture of GABA/L-theanine (100/20 mg/kg) [46].

#### **Limitations of the study**

The literature study has some limitations, especially in the article search process. Several articles with appropriate titles were forced to be excluded from the study because the articles did not contain full-text or

were paid articles. In addition, this literature study does not include studies conducted in Indonesia because the authors found it difficult to obtain research conducted in Indonesia that contained topics, objectives, and participants that met the criteria for this study.

## **Conclusion**

The total articles analyzed by this author amounted to 10 articles that encompassed 8 different types of intervention programs to treat sleep disorders in children with ADHD. The interventions in question are behavioral therapy, BPT, BSI, NFB, MbT, L-theanine macronutrient supplementation, horse milk supplementation, and play therapy. The program that shows the most comprehensiveness with a high level of ease of implementation was BPT.

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