

Research Article

The Application of Ball Blankets in the Treatment of Sleeping Difficulties in Children with Attention Deficit/Hyperactivity Disorder. Effect on Quality of Life and Daily Functioning

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Abstract

Sleeping difficulties are often associated with Attention Deficit Hyperactivity Disorder (ADHD). Both children with ADHD and their parents report sleeping difficulties more often than healthy controls. The purpose of this study was to examine the effect of weighted Ball Blanket on sleep onset latency, number of awakenings and duration of sleep, severity of ADHD symptoms, daily level of functioning and Quality of Life in a group of children with both ADHD and actigraphy-verified sleeping difficulties.

Material and Methods: The study investigated 36 children between 8 and 13 years of age diagnosed with ADHD. The participants were recruited after referred to an outpatient child and adolescent psychiatric department. The participants slept with a Ball Blanket for 8 weeks and sleep, Quality of Life and daily functioning were measured.

Results: The use of a Ball Blanket over a period of 8 weeks improved sleep, in particular sleep onset latency and reduced the score on core symptoms of ADHD. The daily level of functioning and the Quality of Life were increased. The Ball Blanket was the only new intervention in the group during the 8 weeks period.

Conclusions: We conclude that the Ball Blanket might be an effective non-pharmacologic treatment of sleep problems in ADHD.

INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common psychiatric conditions in children; 3-6% of school-aged children are affected by attention deficit dysfunction, inattention and impulsivity [1]. Furthermore, ADHD are often associated with comorbid conditions, such as anxiety, depression and behavioural disorders [2-5]. ADHD are also commonly associated with sleeping difficulties [6] and Parents of children with ADHD often report a range of sleeping difficulties in their children like little need for sleep, difficulty falling asleep, unsettled sleep, numerous awakenings and increased morning fatigue [7-9]. Children with ADHD also report sleeping difficulties more often than children without ADHD such as prolonged sleep onset latency, frequent night awakenings, restless sleep and sleep-disordered breathing [10-12], and more than half of children with ADHD report subjective sleeping difficulties [8,13-15]. Furthermore, sleeping difficulties in their children form a significant stress factor, and are often a cause of worry for parents [16,17].

Studies have shown increased instability in sleep-waking patterns with regard to sleep onset latency, length of sleep and real sleep time in ADHD individuals compared to controls [18,19]. Hvolby [20], found a significant positive correlation between sleep onset latency and high scores on the ADHD-RS in a group of healthy children. Additionally, another study found that treatment of sleep rhythm disturbances drastically reduced ADHD symptoms in a child referred for ADHD assessment [21].

In some clinical populations, sleeping difficulties have been associated with various comorbid conditions, e.g. anxiety and behavioural disorders [22,23], and psychiatric comorbidity was found associated with more severe sleeping difficulties [24]. Especially internalizing or autistic disorder lead to higher sleep problem score [25]. Whereas other studies have not been able to prove this hypothesis that comorbidity rather than ADHD is associated with sleeping difficulties [19,26]. However, there might be an increased risk of developing depression as a result of sleeping disturbance [27].

The core symptoms of ADHD - inattention, impulsivity and

hyperactivity - are strikingly similar to those seen in primary sleep disorders, such as sleep-related breathing disorders and periodic limb movement disorder. Evidence is indicating that these sleep disorders are related to hyperactivity and inattention [28,33]. Additionally, treatment of the sleep disorders has been found to simultaneously improve symptoms of ADHD [34]. Some studies have shown that non-medicated children with ADHD have more sleep problems compared to other children [19,26], and that sleep problems can worsen the symptoms of ADHD and also behavioural problems [35,36]. An earlier study has shown that children with sleeping difficulties tend to present learning disabilities more often than other children [37]. And sleeping problems is associated with poor executive functions [38]. and individuals with poor sleep are shown to have altered connectivity in the frontostriatal network [39], which is associated with executive functioning deficits [40]. In the light of a possible connection between ADHD symptoms and sleep disorders it would make sense to target existing sleeping difficulties in individuals with ADHD regardless of their status as the primary diagnosis or an artefact of medical treatment [11,21,36].

Previous studies have shown that sleep hygiene and melatonin can relieve sleeping problems (41+42), and behavioural interventions have shown positive effect on both ADHD symptoms, Quality of Life (QoL) and daily functioning [43].

Only one previous study has dealt with the possible effect on sleep in particular difficulties falling asleep, using Ball Blanket [44]. They found that application of a Ball Blanket for two weeks could reduce sleep onset latency in a group of children with ADHD to the level of healthy controls. In that study was showed a small but non-significant drop in the severity of ADHD symptoms evaluated by teachers (approx. 10% improvement), who were blind to the fact that the child was using a ball blanket. Also the parents reported an approx. 6% improvement. Both groups reported continued improvement in ADHD symptoms even after stopping using Ball Blankets.

A Ball Blanket is a weighted blanket whose design is based on the American occupational therapist and psychologist A. Jean Ayres' theories of sensory integration [45]. The effect of the ball blanket is based on the weight of loose balls inside the blanket that creates pressure on certain body points, stimulating both the sensation of touch and muscle and joint senses. Ball Blankets have been used in psychiatric inpatient wards for some years as a tranquillising method, and according to non-scientific or unpublished work, application of these blankets is connected to reduced use of medical tranquilisers.

The actigraph unit is a wrist worn activity monitor (Basic Mini Motionlogger, Ambulator Monitoring Inc., New York). In the present study actigraphs are used with the purpose to differentiate between sleep and waking states, and data is analysed using an algorithm developed to perform this differentiation in the Actigraphic Scoring Analysis Program. Actigraphy is a precise and recognised method for sleep evaluation and, despite the fact that no EEG measurements are performed, the method has demonstrated 90% agreement with polysomnography measurements including sleep onset latency [46,47].

The method also has the advantage of being less invasive to the child's sleep as measurements can be taken in the child's usual environment, which is important because children with ADHD are known to be more sensitive to sleep measurement than their control counterparts [48].

The aim of this study was to investigate whether use of a Ball Blanket in treatment of actigraphy-verified sleeping difficulties was able to improve sleep onset latency as well as to reduce ADHD symptoms, improve daily level of functioning and QoL in a group of children with ADHD. Treatment of sleeping difficulties in children with ADHD can help reduce ADHD core symptoms, improve daily level of functioning and improve QoL.

MATERIAL AND METHOD

Included were children aged 8-13 years referred to outpatient Child and Adolescent Psychiatric Department and received a clinical diagnosis based on the ICD-10 criteria for Hyperkinetic Disorder (DF 90.0) and Hyperkinetic Behavioural Disorder (DF90.1) [49].

Additionally, these diagnoses were subsequently verified with the clinical interview Kiddie-SADS [50], Danish version to ensure the fulfilment of the DSM-IV criteria for ADHD combined subtype. Furthermore, all participants underwent cognitive evaluation with WISCIV [51].

All children who were enrolled in the study presented prolonged sleep onset latency, verified by an actigraph unit prior to the study.

Inclusion criteria

1) ADHD-combined type, 2) Age 8-13 years, 3) average sleep onset latency > 25 minutes and at least 4 of 7 days with sleep onset latency > 30 minutes, 4) None of the participants were receiving any treatment for sleeping problems.

Exclusion

Participants with major sensory-motor handicaps (paralyses, deafness and blindness), psychoses, autism or a total IQ of < 70.

Intervention

For this project a Ball Blanket size 140 x 200 cm with 50 mm plastic balls and a weight of 7 kg were used and were free of charge for the participants of the study. The participants were asked to use the Ball Blanket every night for 8 weeks. Parents were asked to register the use of the Ball Blanket in a sleep diary.

MEASURES

Evaluation of sleep

To clarify sleep patterns, actigraphy and sleeping diaries completed by the parents were used. Actigraphy was used to get an objective evaluation of sleep onset latency, number of nightly awakenings and length of sleep. Actigraphic measurements were performed over 7 consecutive nights [52], at baseline before the Ball Blanket was used, and again for 7 consecutive days after 8 weeks' use of the Ball Blanket. Parents entered information on bedtime, lights out and time falling asleep into a sleeping diary. The sleeping diary was completed in connection with the

objective sleep registration (actigraphy) at baseline and again at follow up and was used to verify sleep onset latency.

Evaluation of ADHD symptoms

The ADHD-Rating Scale questionnaire (ADHD-RS) [53], Danish version was used to evaluate the severity of ADHD symptoms, based on DSM-IV criteria. The questionnaire consists of 18 items describing inattention, hyperactivity and impulsivity scored on a scale of 0 (“not present”) to 3 (“present to a large extent”). 8 items evaluate behavioural problems on a scale of 0-3. The questionnaire is age and sex standardised for the Danish population. Questionnaires were given to the parents and to the child’s main teacher/social educator.

Level of functioning

One of the methods used to describe the child’s level of functioning and quality of life was the Dundee - Difficult Times of the Day Scale (D-DTODS) [54]. This scale evaluates the child at 10 different times during the day on a scale of 1-4 (1 representing “no problems” and 4 “many difficulties”).

In addition, the child’s QoL was evaluated, using the Weiss Functional Impairment RatingScale (WFIRS) [55]. The WFIRS is a parent questionnaire and evaluates the well-being of the child in 6 everyday domains - family, learning and schooling, life skills, the child’s self-perception, social activities and risk behaviour. Scores are ranging from 0 to 3 (0 indicating “never or not at all”, and 3 indicating “very often and very much”).

DATA ANALYSIS

Means and standard deviations are reported for all outcomes. Pre and post scores are tested for significant changes using a non-parametric Wilcoxon signed-rank test. Linear regression with bootstrapped error estimates is used to test the association between time-to-sleep improvements (difference between pre and post time-to-sleep measured using the Actigraph) and change in QoL and D-DTODS. Regression estimates are controlled for pre measurements of QoL and D-DTODS.

RESULTS

The study included a total of 36 children aged between 8 and 13 years with ADHD and actigraphy-verified sleep onset latency (average age 10 years and 2 months (Table 1), who were referred to an outpatient Department of Child and Adolescent.

This study show that sleep can be improved by using a Ball Blanket (Table 2). On average, sleep onset latency measured by actigraphs improved from 30.6 minutes to 18.9 minutes, which is an improvement of 38.2% ($p < 0.001$)

Sleep onset latency registered by parents using a sleep diary improved from 41.1 minutes to 29.8 minutes on average, which is an improvement of 27.5% ($p < 0.01$) 13 of the 36 children spent more than 30 minutes on average falling asleep before using the ball blanket, whereas no children spent more than 20 minutes on average falling asleep while using the Ball Blanket. Likewise, the number of nightly awakenings measured by actigraphy was reduced by 16% (ns).

In five of the children a prolongation of sleep onset latency

was found. All five children had measured sleep onset latency of more than 25 minutes both before and during the use of the Ball Blanket. ADHD symptoms as evaluated on the ADHD-RS improved both at school and at home (Table 3).

At school, the symptom ratings for inattention and impulsivity/hyperactivity fell by approx. 20%, while ratings for behavioural symptoms almost halved.

At home, as reported on the ADHD-RS, fewer symptoms of inattention and impulsivity/hyperactivity were also seen, with an improvement of approx. 20%, although the effect on behavioural symptoms was lower, with an improvement of only 14%. ($p < 0.01-0.001$)

The daily level of functioning measured by D-DTODS increased markedly by 30% ($p < 0.001$), likewise there was a change of the more general evaluation of QoL, where we found an 11% higher evaluation of QoL ($p < 0.01$)

DISCUSSION

Sleeping problems can resemble the symptoms of ADHD, and disprove ADHD as the correct diagnosis [21,30], and in some cases improving sleep can reduce symptoms [43]. It therefore seems highly relevant to attempt to target any existing sleeping problems before introducing medical treatment for ADHD, especially in case of severe sleeping difficulties. This study shows that sleep can be improved by using a Ball Blanket.

Table 1: Descriptive characteristic of children and parents.

			Numbers	Daily Dose interval
Age		10 years 2 month (8.1 – 12.8)		
Gender	Boys		32	
	Girls		4	
Parent Social class	Self employed		3	
	Salary-earner		30	
	Student		3	
Family type:				
	Two-parent family*		29	
	Single-parent		7	
Medication:				
	Stimulants		24	(interval 5-72 mg a day)
	Atomoxetine		2	(interval 26-60 mg a day)
	Omega n-3 fatty Acid		6 **	
	No medication		10	

*Two parents in the family. Two biological parents or one biological parent and his/her cohabiting partner.

** In combination with medicine or no medical Treatment

Table 2: Sleep parameters, minutes (mean).

	Before use of Ball Blanket	After 8 weeks use of Ball Blanket	p-value*
Sleep onset latency measured with actigraph	30.6 (15,0)	18.9 (12,1)	p<0,001
Sleep onset latency, parent estimate	41,1 (19,9)	29,8 (12,5)	p<0,01
Number of awakenings, numbers	8.1 (4.8)	6.8 (4.3)	ns

*.Wilcoxon sign rank test

Table 3: Attention-Deficit Hyperactivity Disorder Rating Scale Scores (ADHD-RS), Quality of Life (QoL) and Dundee – Difficult Times of the Day Scale (D-DTODS) Mean Scores, (SD.)

	Before Use of Blanket	After 8 weeks of Blanket use	p-value **
<u>ADHD-RS School: total score</u>			
Inattention	13,1 (6,8)	11.0 (5.9)	p<0,001
Hyperactivity/impulsivity	15,0 (5,1)	13,0 (5.6)	p<0,001
Behaviour	7,5 (6.9)	5,7 (5.9)	p<0,01
<u>ADHD-RS Home: total score</u>			
Inattention	14.1 (6.3)	11,6 (6.5)	p<0,001
Hyperactivity/impulsivity	12,4 (6,2)	10.0 (5.8)	p<0,01
Behaviour	8,0(5.6)	5,9 (4,6)	p<0,01
<u>QoL total score</u>	43.8 (20,6)	38.8 (20.9)	P<0,01
<u>D-DTODS total score</u>	19.3 (4.7)	13.4 (4.8)	p<0.001

** Wilcoxon sign rank test

As found in Hvolby et al. [44], this present study shows that use of Ball Blankets can improve sleep - in particular improve sleep onset latency - for children with ADHD in medical treatment for ADHD. At the same time, the study shows fewer ADHD symptoms, fewer behavioural problems, especially in relation to school but also at home, and improved QoL and daily functioning when using the Ball Blanket. A relation also found by Hiscock et al. [43].

Importantly, this study raises the hope that the behavioural problems often seen in relation to ADHD and sleeping problems [4,36] can be effectively improved - especially in relation to school.

In agreement with Hvolby et al. [19], this study has shown that there is a difference between the parents' evaluation of sleep and the measurements shown using actigraphy. Sleep onset latency is often perceived longer by parents than measured by actigraphy. Furthermore, we found that only 64% of the parents experienced an improvement in their child's sleep when using a Ball Blanket, while the actigraph unit measured improvements in sleep in 86% of the participants.

This difference could be related to the child's difficult behaviour around bedtime. However, it could also be a consequence of the substantial day-to-day variations that typify the sleeping patterns of children with ADHD [18,19].

We found that the use of a Ball Blankets over a period of 8 weeks improved sleep, in particular sleep onset latency, and that the improved sleep seemed to reduce the core symptoms of ADHD (inattention, impulsivity/hyperactivity), the daily level of functioning and also quality of life.

It seems relevant to treat sleeping problems in children who are already in medical treatment for ADHD because - as this study

has shown - it could help further reduce symptoms and improve daily level of functioning.

CONCLUSION

Based on this study, it can be concluded that the Ball Blanket can be an effective method for treating sleeping difficulties, especially sleep onset latency in children with ADHD. Despite some promising results, we cannot with certainty conclude a direct relation between better sleep and the positive changes found in daytime symptoms. More studies will be needed to examine the effect of sleep improving on ADHD symptoms, QoL and daily level of functioning.

LIMITATIONS

This study has a number of weaknesses. It is a relatively small study and we did not make a power calculation before including participants. The study was not controlled, and the patients were not randomised to a Ball Blanket. The children were used as their own controls (sleep pattern before and after using ball blanket) and it is a limitation that we did not use a control group. We were not able to compare children with and without medication. However, the participants did not change their medication or other treatment during the study, neither for ADHD nor sleeping difficulties.

In this study, we did not diagnose any primary sleep disorders, e.g. sleep apnoea or Restless Leg Syndrome, although these sleep disorders are seen in children with ADHD [28-33]. We included a clinically referred group of children diagnosed with ADHD, but we did not consider or adjust for any comorbidity. This study included children aged 8-13, and it is not possible on the basis of this study to make any conclusion regarding the effect of sleep

treatment using ball blankets for younger children, adolescent or adults.

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REFERENCES

- American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders, 1994, 4rd. ed. (DSM-IV). Washington DC, American Psychiatric Association.
- Biederman J. A prospective 4-years follow-up study of attention-deficit hyperactivity and related disorders: Arch Gen Psych. 1996; 53: 437-446.
- Barkley RA: Attention deficit hyperactive disorder: A handbook for diagnosis and treatment, Guilford, New York 1990.
- Corcum P, Moldofsky H, Hogg-Johnson S, Humphries T, Tannock R. Sleep problems in children with Attention-deficit/Hyperactive disorder: Impact of subtype, comorbidity, and stimulant medication. J Am Acad Child Adolesc Psychiatry. 1999; 38: 1285-1293.
- Mulraney M, Giallo R, Lycett K, Mensah F, Sciberras E. The bidirectional relationship between sleep problems and internalizing and externalizing problems in children with ADHD: a prospective cohort study. SleepMed. 2016; 17: 45-51.
- Jensen CM, Steinhausen H-C, Comorbid mental disorders in children and adolescent with attention deficit hyperactivity disorder in a large nationwide study. ADHD Attention Deficit and Hyperactivity Disorder. 2015; 7: 27-38.
- Kaplan BJ, McNicol J, Conte RA, Moghadam HK: Sleep disturbance in preschool-aged hyperactive and nonhyperactive children. Pediatrics. 1987; 80: 839-844.
- Trommer B. Sleep disturbance in children with attention deficit disorder: Annals neurol. 1988; 24: 322.
- Hvolby A, Jørgensen J, Bilenberg N. Parental rating of sleep in children with attention deficit/hyperactivity disorder. Eur Child Adolesc Psychiatry. 2009; 18: 429-438.
- Owens J A, Maxim R, Nobile C, Mcguinn M, Msall M: Parental and self-report of sleep in children with attention deficit hyperactive disorder: Arch Pediatr Adolesc Med. 2000; 154: 549-555.
- Cortese S, Faraone SV, Konofal E, Lecendreux M. Sleep in children with attention-deficit/hyperactivity disorder: meta-analysis of subjective and objective studies. J Am Acad Child Adolesc Psychiatry. 2009; 48: 894-908.
- Becker SP, Langberg JM, Byars KC. Advancing in biopsychosocial and contextual, model of sleep in adolescent: areview and introduction to the special issue. Journal of Youth and Adolescent. 2015; 44: 239-270.
- Ball J D, Tiernan M, Janusz J, Furr A: Sleep patterns among children with attention deficit hyperactive disorder: A re-examination of parent perception. J Paediatr Psychol. 1997; 22: 389-398.
- Greenhill L, Puig-Antic J, Goetz R, Hanlon C and Davies M. Sleep architecture and REM sleep measures in prepubertal children with attention deficit disorder with hyperactivity. Sleep. 1983; 3: 91-101.
- Lycett K, Sciberras E, Mensah FK, Hiscock H. Behavioral sleep problems and internalizing and externalizing comorbidities in children with attention-deficit hyperactivity disorder. European Child and Adolescent Psychiatry. 2015; 24: 31-40.
- Saxby H, Morgan H. Behavior problems in children with learning disabilities: to what extent do they exist and are they a problem?. Child: care, health and development. 1993; 19: 149-157.
- Goldman SE, Bichell TJ, Surdyka K, Malow BA. Sleep in children and adolescents with Angelman syndrome: Association with parent sleep and stress. J Intellectual Disab Res. 2012; 56: 600-608.
- Gruber R, Sadeh A, Raviv A. Instability of sleep patterns in children with attention deficit hyperactive disorder. J Am Acad Child Adolesc Psychiatry. 2000; 39: 495-501.
- Hvolby A, Jørgensen J, Bilenberg N. Actigraphic and parental reports of sleep difficulties in children with attention-deficit/hyperactivity disorder. Arch Pediatr Adolesc Med. 2008; 162: 323-329.
- Hvolby A. Søvnvanskeligheder hos børn med ADHD - Actigrafimåling og spørgeskemavurdering af søvnen hos 6-11 årige børn med ADHD: Ph.d.- afhandling, Det Sundhedsvidenskabelige Fakultet, Syddansk Universitet, 2008c.
- Hvolby A, Jørgensen JI, Bilenberg N. Søvnrytmeforstyrrelse kan ligne symptomer på opmærksomhedsforstyrrelse. Ugeskr Læger. 2005; 167: 3893-3894.
- Mick E, Biederman J, Jetton J, Faraone SV. Sleep disturbance associated with attention deficit hyperactive disorder: The impact of psychiatric comorbidity and pharmacotherapy. J Child Adol psychopharmacol. 2000; 10: 223-231.
- Aronen ET, Lampenius T, Fontell T, Simola P. Sleep in children with disruptive behavioral disorders. Behav Sleep Med. 2014; 12: 373-388.
- Moreau V, Rouleau N, Morin CM. Sleep of Children with Attention Deficit Hyperactivity Disorder: Actigraphic and Parental Reports. Behavioral Sleep Medicine. 2014; 12: 69-83.
- Virring A, Lambek R, Jennum PJ, Møller LR, Thomsen PH. Sleep Problems and Daily Functioning in Children With ADHD: An Investigation of the Role of Impairment, ADHD Presentation, and Psychiatric Comorbidity. J Attention Disorders. 2017; 21: 731-740.
- Virring A, Lambek R, Thomsen PH, Møller LR, Jennum PJ. Disturbed Sleep in attention-deficit hyperactivity disorder (ADHD) is not a question of psychiatric comorbidity or ADHD presentation. J Sleep Res. 2016; 25: 333-340.
- Breslau N, Roth T, Rosenthal L, Andreski P. Sleep disturbance and psychiatric disorders : A longitudinal epidemiological study in young children. Biol Psychiatry. 1996; 39: 411-418.
- Chervin R D, Dillon J E, Bassetti C, Ganoczy D A, Pituch K J. Symptoms of sleep disorders, inattention, and hyperactivity in children. Sleep. 1997; 20: 1185-1192.
- Chervin R D, Archbold K H. Hyperactivity and polysomnographic findings in children evaluated for sleep-disordered breathing. Sleep. 2001; 24: 313-320.
- Chervin R D, Archbold K H, Dillon J E, Panahi P, Pituch K J, Dahl R E et al : Inattention, hyperactivity, and symptoms of sleep-disordered breathing. Pediatrics. 2002; 109: 449-456.
- Divgi V. What about sleep?. Arch Pediatr Adolesc Med. 2000; 154: 636.
- Picchiatti DL, England SJ, Walters AS, Willis K, Verrico T. Periodic limb movement disorder and restless legs syndrome in children with attention-deficit hyperactivity disorder. J Child Neurol. 1998; 13: 588-594.
- Picchiatti DL, Underwood DJ, Farris WA, Walters AS, Shah MM, Dahl RE, et al. Further studies on periodic limb movement disorder and restless legs syndrome in children with attention-deficit hyperactive disorder. Movement Dis. 1999; 14: 1000-1007.

34. Walters A S, Mandelbaum D E, Lewin D S, Kugler S, England S J, Miller M. Dopaminergic therapy in children with restless legs/periodic limb movements in sleep and ADHD. *Pediatr Neurol.* 2000; 182-186.
35. Gomes-Tiago AP, Costa DS, Alvim-Soares Jr AM, Malloy-Diniz LF, de Miranda DM. Sleep duration and intensity of ADHD symptoms. *Rev Bras Psiquiatr.* 2016; 38: 348-349.
36. Smedje H, Broman JE, Hetta J. Associations between disturbed sleep and behavioural difficulties in 635 children aged six to eight years: a study based on parents' perceptions. *Eur Child Adolesc Psychiatry.* 2001; 10: 1-9.
37. Steenari MR, Vuontela V, Paavonen EJ, Carlson S, Fjallberg M, Aronen E. Working memory and sleep in 6- to 13-year-old schoolchildren. *J Am Acad Child Adolesc Psychiatry.* 2003; 42: 85-92.
38. Taveras EM, Rifas-Shiman SL, Bup KL, Gillman WM, Oken E. Prospective study of insufficient sleep and neurobehavioral functioning among school-age children. *Acad Pediatr.* 2017; 17: 625-632.
39. Lu FM, Liu CH, Lu SL, Tang LR, Tie CL, Zhang J et al. Disruptive topology of frontostriatal circuits is linked to the severity of insomnia. *Front neurosci.* 2017; 11: 214.
40. Riley JD, Moore S, Cramer SC, Lin JJ. Caudate atrophy and impaired frontostriatal connections are linked to executive dysfunction in temporal lobe epilepsy. *Epilepsy Behav.* 2011; 21: 80-87.
41. Van der Heijden KB, Smits MG, Van Someren EJ, Ridderinkhof KR, Gunning WB. Effect of melatonin on sleep, behavior, and cognition in ADHD and chronic sleep-onset insomnia. *J Am Acad Child Adolesc Psychiatry.* 2007; 46: 233-241.
42. Weiss MD, Wasdell MB, Bomben MM, Rea KJ, Freeman RD. Sleep hygiene and melatonin treatment for children and adolescents with ADHD and initial insomnia. *J Am Acad Child Adolesc Psychiatry.* 2006; 45: 512-519.
43. Hiscock H, Sciberras E, Mensah F, Gerner B, Efron D, Khano S et al. Impact of a behavioural sleep intervention on symptoms and sleep in children with attention deficit hyperactivity disorder, and parental mental health randomised controlled trial. *BMJ.* 2015; 350.
44. Hvolby A, Bilenberg N. Use of Ball Blanket in attention-deficit/hyperactivity disorder sleeping problems. *Nord J Psychiatry.* 2011; 65: 89-99.
45. Ayres, A. Jean. Sensory integration and the child. Los Angeles, CA: Western Psychological Services; 1982.
46. Sadeh A, Alster J, Urbach D, Lavie P. Actigraphically based automatic bedtime sleep-wake scoring. Validity and clinical applications. *J Ambulatory monitoring.* 1989; 2: 209-216.
47. Sadeh A, Lavie P, Scher A, Tirosh E, Epstein R. Actigraphic home-monitoring sleep-disturbed and control infants and young children: A new methods for pediatric assesment of sleep-wake patterns. *Pediatrics.* 1991; 87: 494-499.
48. Palm L, Persson E, Bjerre I, Elmquist D, Blennow G: Sleep and wakefulness in preadolescent children with deficits in attention, motor control and perception. *Acta paediatr.* 1992; 81: 618-624.
49. World Health Organization. The ICD-10 Classification of Mental and Behavioural Disorder: Diagnostic Criteria for Research. Geneva, Switzerland: World Health Organization, 1993.
50. Chambers WJ, Puig-Antich J, Hirsch M, Paez P, Ambrosini PJ, Tabrizi MA, et al. The assessment of affective disorders in children and adolescents by semistructured interview. Test-retest reliability of the schedule for affective disorders and schizophrenia for school-age children, present episode version. *Arch Gen Psychiatry.* 1985; 42: 696-702.
51. Wechsler D. Wechsler Intelligence Scale for Children, 4rd edn, 2003.
52. Acebo C, Sadeh A, Seifer R, Tzischinsky O, Wolfson AR, Hafer A et al: Estimating sleep patterns with monitoring in children and adolescent: How many nights are necessary for reliable measures?. *Sleep.* 1998; 22: 95-103.
53. Barkley R A, Attention-Deficit Hyperactive Disorder, A clinical workbook. New York: Guilford Publications, 1998.
54. Coghill D, Dundee - Difficult Times of the Day Scale.
55. Weiss M, Weiss Functional Impairment Rating Scale.

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