ปัญหาการนอนหลับและปัจจัยที่เกี่ยวข้องในผู้ป่วยเด็กออทิสติก

Sleep Disturbances and Associated Factors in Thai Children with Autism Spectrum Disorder

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บทคัดย่อ

วัตถุประสงค์ เพื่อศึกษาปัญหาการนอนหลับ และหาปัจจัยที่มีความสัมพันธ์กับปัญหาการนอนหลับในผู้ป่วยเด็กออทิสติก

วิธีการศึกษา เป็นการวิจัยเชิงวิเคราะห์ ณ จุดเวลาใดเวลาหนึ่ง ในผู้ป่วยเด็กออทิสติกที่ได้รับการวินิจฉัยตามเกณฑ์ของ DSM -5 โดยจิตแพทย์เด็ก ที่มีอายุ 4-12 ปี รับการรักษาที่แผนกผู้ป่วยนอกโรงพยาบาลยุวประสารทไวทโยปถัมภ์ จ.สมุทรปราการ ระหว่างเดือนมีนาคมถึงพฤษภาคม พ.ศ. 2561 จำนวน 102 ราย และให้ผู้ดูแลเด็กแบบสอบถามปัญหาการนอนในเด็กฉบับภาษาไทยสำหรับเด็กวัยเรียน - The children's sleep habits questionnaire (CSHQ) Thai version และให้ข้อมูลเกี่ยวกับปัจจัยที่อาจมีผลต่อปัญหาการนอน เช่น กิจวัตรการนอน ปัญหาพฤติกรรมและอารมณ์ โดยตอบแบบประเมินจุดแข็งและจุดอ่อน ชุดผู้ปกครอง - Thai version of the parent-rated strengths and difficulties questionnaire (SDQ) แพทย์ผู้รักษาให้ข้อมูลด้านความรุนแรงของโรคออทิสซึม โรคร่วม และยาที่ใช้ หาความสัมพันธ์ระหว่างตัวแปรกับปัญหาการนอนโดยวิเคราะห์ สหสัมพันธ์ของเพียร์สัน (Pearson's correlation) และวิเคราะห์สมการถดถอยพหุคูณแบบเป็นขั้นตอน (Stepwise multiple regression analysis)

ผลการศึกษา กลุ่มประชากรศึกษาส่วนใหญ่เป็นเพศชาย (ร้อยละ 86.3) ที่มีระดับความรุนแรงของโรคออทิสซึมตั้งแต่ระดับต่ำ (ร้อยละ 50.0) ปานกลาง (ร้อยละ 30.0) ไปจนถึงรุนแรง (ร้อยละ 20.0) มีคะแนนรวมของ CSHQ เฉลี่ยที่มากกว่า 41 คิดเป็นร้อยละ 89.2 ปัญหาการนอนที่พบมากที่สุดได้แก่ ไม่ยอมเข้านอน ร้อยละ 57.0, ปัญหาการนอนเนื่องมาจากความวิตกกังวล ร้อยละ 37, ปัญหาการนอนที่เกี่ยวข้องกับการหายใจ ร้อยละ 35 ผลการศึกษาพบว่าปัจจัยที่สัมพันธ์กับปัญหาการนอนโดยรวมอย่างมีนัยสำคัญได้แก่ อายุผู้ปกครอง การไม่มีกิจวัตรการนอนที่สม่ำเสมอ การเรียนในระดับชั้นประถม คะแนนรวมของจุดอ่อนใน SDQ ภาวะออทิสซึมในระดับรุนแรง และการใช้ยากลุ่ม psychostimulant จากการวิเคราะห์สมการถดถอยพหุคูณแบบเป็นขั้นตอนพบว่า ตัวแปรที่สามารถทำนายคะแนนรวมของปัญหาการนอนได้ดีที่สุดคือ คะแนนรวมจุดอ่อนใน SDQ ซึ่งบ่งบอกถึงปัญหาด้านอารมณ์และพฤติกรรมโดยรวม

สรุป ปัญหาการนอนเป็นปัญหาที่พบได้บ่อยในผู้ป่วยเด็กออทิสติก การประเมินปัญหาการนอนรูปแบบต่างๆ อย่างละเอียดเพื่อปรับปรุงคุณภาพการนอนมีความสำคัญในการดูแลรักษาผู้ป่วยเด็กออทิสติก

คำสำคัญ ปัญหาการนอน ปัจจัยที่เกี่ยวข้อง ออทิสติก ออทิสซึม

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ABSTRACT

Objectives : This study aimed to explore sleep patterns, sleep disturbances, and their associated factors in Thai children with ASD.

Methods : Data from 102 children aged 4-12 years at Yuwaprasart Waithayopathum Child and Adolescent Psychiatric Hospital, Samut Prakan, Thailand were collected for this cross-sectional, analytic study. Participants were children diagnosed with ASD who visited the outpatient department during March and May 2018. Sleep disturbances were examined using the children's sleep habits questionnaire (CSHQ)- Thai version, reported by parents. Associated factors studied included sleep practices and environment, emotional and behavioral problems, using the strengths and difficulties questionnaire (SDQ), autism severity, comorbidities, and medication. Pearson's correlations and stepwise linear regression analysis were used to determine predictors for overall sleep disturbances.

Results : Of the total 102 participants, 86.3% were male, with autism severity level ranging from mild (50.0%), moderate (30.0%), to severe (20.0%), based on DSM-5. Most children had disturbed sleep, with overall disturbances rates of 89.2%. Most common sleep domains were bedtime resistance (57.0%), sleep anxiety (37.0%), and sleep disordered breathing (35.0%). Results showed that younger parental age, absence of bedtime routine, higher SDQ difficulties scores, and severe autism significantly associated with increased overall sleep disturbances. Lower sleep disturbances were found in primary school children and methylphenidate users. After stepwise linear regression analysis, total SDQ difficulties remained the strongest predictor of overall sleep disturbances.

Conclusions : A large portion of autistic children were affected by sleep disturbances. Treatment for ASD should always include management of sleep practices and factors that contribute to sleep problems.

Keywords : Autism, ASD, spectrum disorder, sleep disturbance, associated factors

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Introduction

Autism is a neurodevelopmental disorder with essential features of social communication deficits, and restrictive, repetitive behaviors which impair everyday life functioning from early childhood.[1] The Centers for Disease Control and Prevention (CDC) has estimated that about 1 in 59 children has been diagnosed with autism spectrum disorders (ASD).[2] The prevalence of autism in Thai children aged one to five years surveyed in 2004 was 9.9 per 10,000.[3] Studies have revealed consistently that sleep problems in children in ASD were greater than controls, with rates ranging from 43-86%.[4-10] A study of children aged 4 to 10 years with ASD in the North of Thailand reported sleep disturbance rate of 84%.[11] Compared to their peers, children with ASD had shorter total sleep time, longer sleep latency periods, and decreased sleep efficiency.[12] The most reported types of sleep problems included sleep onset and maintenance, and sleep duration problems.[13] Studies have shown the impact of sleep disturbances on behavior problems and also specific ASD symptoms. Sets of sleep disturbances accounted for between 22 to 32% of the variance explaining hyperactivity, aggression, and inattentive behaviors.[14] Fewer hours of sleep per night predicted overall autism scores, social skills deficits, and stereotypic behavior,[15] highlighting relations of sleep and intensified symptoms of autism.

Studies found that sleep problems correlated with younger age,[6,7] female gender, older parental age, higher hyperactivity, and poorer prosocial behavior.[10] Some studies did not find age, gender, and intellectual level to associate with sleep. However, characteristics such as hyperactivity, mood problems, aggression, and autism severity were consistently reported to account to the problem.[14,16,17] One study proposed a bidirectional framework of the interactions between behavior problems and sleep. The core deficits of ASD predispose the child to internal instability and being easily triggered by stressors, each time presenting as externalizing and internalizing behaviors. Those behavior problems resulted in overall over-arousal and insomnia. Reciprocally, disturbed sleep affects the child's behaviors which intensifies symptoms of ASD itself.[18]

Other variables contributing to sleep patterns such as medication and sleep environment were also studied, but the results remain inconsistent. A study with participants on various types of medication did not find associations between any of the agents with sleep problems.[8] Another study found that children who took sleep medication, stimulant, or atomoxetine had greater sleep disturbances, while neuroleptic, SSRI and mood stabilizers effects on sleep were nonsignificant.[16] Sleep hygiene, living space, noise around the house, co-sleeping, and other environmental factors did not predict sleep outcome in a study in China.[10] On the other hand, protective factors such as following a regular bedtime routine benefited sleep significantly in

children with ASD.[19] As a result of available knowledge on sleep and ASD, intervention studies have been conducted continuously to improve the treatment of sleep problems in this population. Parent training programs and education on sleep were shown to improve sleep behaviors and outcomes in several studies.[20, 21]

There is limited data on sleep problems in Thai autistic children and correlated factors have not been fully understood. This study aimed to describe sleep patterns, sleep disturbances and associated factors in children with ASD. We hypothesized that sleep disturbances would be common in this population, and that correlated factors would be severity of autism, emotional and behavioral problems, and sleep practices (e.g., bedtime routine, caffeine, stimulating activities, bedroom environment).

Methods

Study design and participants

This cross-sectional, analytic study was conducted at Yuwaprasart Waithayopathum Child and Adolescent Psychiatric Hospital, Samut Prakan province. Yuwaprasart Waithayopathum serves as a tertiary care and excellence center for autism in Thailand, under the Department of Mental Health Services, Ministry of Public Health. This study was approved by the Ethics Committee of Ramathibodi Hospital and Yuwaprasart Waithayopathum Child and Adolescent Psychiatric hospital. A minimum sample size of 81 was calculated referring to a study in China by Wang[10] (alpha (α) = 0.05, error (d) = 0.1). We enrolled 102 patients who visited the outpatient clinic between March and May 2018. Participants were 4 to 12 years old, diagnosed with ASD by board-certified child psychiatrists, and met the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) criteria for ASD. Those who could not respond to or understand the measures in Thai were excluded from the study. Parents were asked to provide informed assent if they were primary caretakers who were living with the child and could confidently provide information on their sleep. Respondents completed measures for demographic data and sleep practices, The children's sleep habits questionnaire (CSHQ) Thai version, and the parent-rated strengths and difficulties questionnaire (SDQ) Thai version. Clinical information including severity of autism, medication and comorbidities were provided by participants' physicians.

Measures

Sleep disturbances and patterns

The children's sleep habits questionnaire (CSHQ) was developed to examine domains of sleep patterns and problems in children aged 4 to 10 years.[22] It is a valid measure used worldwide and contains 48 items (33 scored) of sleep, categorized into 8 following domains: 1) bedtime resistance, 2) sleep-onset delay, 3) sleep duration, 4) sleep anxiety, 5) night wakings, 6) sleep-disordered breathing, 7) parasomnia, 8) daytime sleepiness. Parents recall their children's sleep on a typical week and rate each item on a three-point Likert scale as follows:

"usually" if occurred 5-7 times a week; "sometimes" if 2-4 times a week; and "rarely" for 0-1 times a week. Total score ranges from 33 to 99, with the cutoff of >41 identifying overall sleep disturbances. Referring to standard practices and previous studies,[10, 23] cutoffs for specific domains were defined as subscale scores above 2 standard deviations of the published community control mean values.[24] The Thai version of CSHQ was translated by Disayawanwat P & Pityaratstian N, Department of Psychiatry, Chulalongkorn University (total scale internal consistency 0.83, subscales 0.392 - 0.776). The cutoffs for subscales in Thai population is still in progress.

Emotional and behavioral problems

The strength and difficulties questionnaire (SDQ) is a screening tool for emotional and behavioral problems in children aged 3-16 years.[25] It had been used in typically developing and children with psychopathology, including ASD. The SDQ consists of 5 domains of behavior adding up to a total of 25 items (emotional, conduct, hyperactivity, peer problem, and prosocial behavior). Total SDQ score is a sum of four difficulties subscale scores. Each item is rated by parents on a three-point Likert scale: 0 for "not true", 1 for "somewhat true", and 2 for "very true". Higher total difficulties scores indicate more emotional and behavioral problems. Reversely, higher score on the prosocial behavior domain indicates better function. The Thai version of SDQ was originally translated in 1998, and later improved with recommendations for reference values.[26] We used the updated version authorized by the Department of Mental Health, Ministry of Public Health, Thailand in our study.

Child and family characteristics and sleep practices

Parents provided information on their age, relationship with the child, educational level, and family income. They also answered a seven-item sleep practices survey developed for this study. Sleep practices contribute greatly to sleep quality in general population, and sleep hygiene management is first-line treatment of insomnia.[27] We believe it would determine sleep outcome of ASD population as well. The survey questions included caffeine intake, having a bedtime routine, stimulating activities before bedtime, bed use for other activities than sleep, bedroom noise, darkness and temperature. Data on child's age, gender, pubertal stage, educational level, comorbidities, medication use, and autism severity were obtained from subjects' psychiatrists. Severity of autism was rated mild, moderate or severe based on requirement for support, according to the DSM-5.[1]

Statistical analyses

IBM SPSS version 24.0 for Windows was used for all analyses. We described the sample characteristics, sleep practices, prevalence and domains of sleep disturbances using descriptive statistics. Chi-square was used to compare categorical data. Independent t-tests were used to compare means of total CSHQ scores. One-way ANOVA was used for variables with more than two

means. Levels of education and autism severity required LSD post-hoc ANOVA analyses to specify which level differed significantly in the means of total CSHQ. Odds ratios (OR) and 95% confidence intervals (CI) were presented for categorical variables that associated with scoring above cutoff (total CSHQ >41), using binary logistic regressions. Associations between factors and total CSHQ score were explored using Pearson's correlation. Statistical significance was set at $p < 0.05$. Predictors of total CSHQ score were identified using stepwise linear regression.

Results

Sleep practices and sleep disturbances

As shown in Table 1, Mean sleeping duration was 8.9 hours (SD = 1.2), and mean night wakings was 7.9 minutes (SD = 29.7). Problematic sleep practices found in more than half of the sample included having stimulating activities before bed e.g. playing exciting games (78.4%) and absence of bedtime routine e.g. praying, reading stories (55.9%). Table 2 shows frequencies of overall sleep disturbances and specific sleep problems. The mean CSHQ total score of this sample was 49.73 (SD = 7.23), identifying 89.2% as having overall sleep disturbance. The mean scores of most domains remained below the cutoff, except for bedtime resistance. Bedtime resistance (57.0%), sleep anxiety (37.0%), and sleep disordered breathing (35.1%) were sleep domains with the highest rates.

Emotional/behavioral problems

Our sample of children with ASD had mean SDQ total difficulties scores of 17.59 (SD = 5.59). 69.7% of participants were identified as having significant emotional/ behavioral problems according to the normal reference value in Thai context.[26] Rates of specific emotional/ behavioral domains were shown in Table 3. The difficulty domain with highest frequency was hyperactivity (67.7%). Positive prosocial behavior was reported by parents in as much as 76.8% of the sample.

Clinical factors

As shown in Table 1, children with ASD recruited in this study consisted of mild (50.0%), moderate (30.0%), and severe cases (20.0%). Most participants were male (86.3%), about half (53.2%) had other diagnoses along with ASD. Their comorbidities included attention-deficit/ hyperactivity disorder (ADHD), specific learning disorder (SLD), intellectual disabilities (ID), obesity, epilepsy, global developmental delay (GDD), language disorder, speech sound disorder, and major depressive disorder (MDD). Most participants (84.0%) were on at least one psychotropic medication. Agents used included methylphenidate, atypical antipsychotics (i.e., risperidone, aripiprazole), anticonvulsants (i.e., valproic acid, carbamazepine, topiramate), fluoxetine, trihexyphenidyl, and clonidine.

Table 1 Sample characteristics and sleep practices

Sociodemographic characteristics and sleep practices	N (%)
Parent identity	
Father	18 (18.0)
Mother	66 (66.0)
Other i.e. grandparent, aunt	16 (16.0)
Parent age, M (SD), range	42.7 (9.7) 24-73
Parent education	
Undergraduate or above	27 (28.7)
High school or below	67 (71.3)
Family income per month (Thai Baht)	
20,000 or above	43 (50.6)
Below 20,000	42 (49.4)
Male gender	88 (86.3)
Age, M (SD), range	8.26 (2.6), 4-12
Pubertal stage	
Prepubertal	88 (90.7)
Pubertal	9 (9.3)
Educational level	
Kindergarten	30 (30.3)
Primary school	57 (57.6)
Secondary school	3 (3.0)
Special education	3 (3.0)
None (out-of-school)	6 (6.1)
Autism severity	
Mild	50 (50.0)
Moderate	30 (30.0)
Severe	20 (20.0)
Currently on medication	84 (84.0)
Comorbidities present	50 (53.2)
Sleep practices	
Bedtime, M (SD), range	9:00 PM (1.0), 7:00 PM-12:00 AM
Wakeup time, M (SD), range	6:30 AM (1.0), 4:00 AM-9:00 AM
Total sleeping duration, hours (SD), range	8.9 hrs (1.3), 5.5-13.0
Night waking duration, minutes (SD), range	7.9 mins (29.7), 0.0-210.0
Caffeine after 5 PM	31 (30.4)
Absence of bedtime routine	57 (55.9)
Stimulating activity within 1 hour	80 (78.4)
Inadequate darkness	19 (18.6)
Inadequate noises	16 (15.7)
Inadequate temperature	6 (5.9)
Bed use for other purposes	42 (41.2)

Table 2 The children's sleep habits questionnaire (CSHQ) subscales scores and total scores

CSHQ score	Mean (SD)	Sleep disturbances N (%)
Bedtime resistance	11.11 (2.48)*	57 (57.0)
Sleep-onset delay	1.69 (0.76)	18 (17.6)
Sleep duration	4.54 (1.57)	26 (26.3)
Sleep anxiety	6.58 (2.01)	37 (37.0)
Night waking	3.62 (1.06)	9 (9.1)
Parasomnias	8.77 (1.75)	17 (18.3)
Sleep-disordered breathing	4.13 (1.27)	33 (35.1)
Daytime sleepiness	13.02 (3.25)	18 (18.8)
Total score	49.73 (7.23) *	83 (89.2)

*Mean scores exceeding cutoff for subscale or total scores, defined as scores > 2SDs of the published community control mean values.

Table 3 The strengths and difficulties questionnaire (SDQ) subscales scores and total scores

SDQ domains	Mean (SD)	Rate N (%)
Emotional problems	2.97 (1.98)	20 (20.2)
Conduct problems	2.94 (1.69)	35 (35.4)
Hyperactivity	6.62* (2.31)	67 (67.7)
Peer problems	5.08* (1.89)	59 (59.0)
Prosocial behavior	5.35 (2.65)	76 (76.8)
Total difficulties score	17.59* (5.59)	69 (69.7)

*Mean scores exceeding cutoff for subscale or total scores, according to reference values in Thai context

Factors associated with sleep disturbances

As speculated, significant Pearson's correlations ($p < 0.01$) were found between multiple sleep domains and emotional/behavioral factors, as seen in Table 4. CSHQ total score significantly

associated with both SDQ total difficulties score ($r = 0.506$, $p < 0.001$), and scores on all domains. Among specific domains, conduct problems had the strongest association ($r = 0.455$, $p < 0.001$) with overall sleep disturbances. Initial one-way ANOVA analysis of autism severities (mild, moderate, severe) revealed that the CSHQ total score did not differ significantly among severity groups ($p = 0.08$). However, after post-hoc analysis, severe level of autism had significantly greater overall sleep disturbance ($r = 0.230$, $p = 0.026$), as opposed to the mild and moderate groups ($p = 0.04$). Post-hoc analysis also showed that primary school children had significantly lower CSHQ total scores ($p = 0.006$) compared to other levels of education. Absence of bedtime routine put children at 5 times greater risk of having sleep disturbance (OR = 5.48, $p = 0.038$). Negative associations with CSHQ total score were found in psychostimulant users ($r = -0.269$, $p = 0.010$) and parental age ($r = -0.219$, $p = 0.038$).

Factors that did not associate with overall sleep disturbance included child's age and gender, pubertal stage, comorbidities, respondent identity, respondent educational level, family income. Problematic sleep practices other than absence of bedtime routine did not contribute to sleep disturbances in our study.

Predicting sleep disturbance from study variables

To identify predictors of overall sleep disturbance, selected factors including sociodemographic factors, sleep practices, emotional/behavioral problems, autism severity, comorbidities, and medication use were analyzed. Shown in Table 5 are the remaining significant predictors of CSHQ total score, analyzed with stepwise linear regression. The model of best fit explained 31.5% of overall sleep disturbance in this sample ($R^2 = 0.31$, $p = 0.002$). SDQ total score was the strongest predictor of increased CSHQ total score ($B = 0.413$, $p < 0.001$), while psychostimulant use accounted for lower total scores of CSHQ ($B = -0.347$, $p = 0.002$).

Table 4 Pearson's correlations between CSHQ and SDQ domains

	CSHQ domains																	
	Bedtime resistance		Sleep-onset delay		Sleep duration		Sleep anxiety		Night wakings		Parasomnias		Sleep-disordered breathing		Daytime sleepiness		Total score	
	r	*p*	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*
SDQ domains																		
Emotional problems	0.29**	0.004	0.07	0.465	0.15	0.131	0.43**	<0.001	0.14	0.175	0.03	0.715	0.19	0.066	0.05	0.608	0.29**	0.005
Conduct problems	0.30**	0.003	0.25**	0.010	0.15	0.133	0.27**	0.006	0.19	0.054	0.03**	0.004	0.10	0.336	0.21*	0.039	0.45**	<0.001
Hyperactivity	0.40**	<0.001	0.10	0.289	0.12	0.216	0.47**	<0.001	0.24*	0.017	0.20*	0.050	0.23*	0.027	0.04	0.692	0.36**	<0.001
Peer problems	0.29**	0.003	0.20*	0.039	0.18	0.072	0.29**	0.003	0.32**	0.001	0.29**	0.004	0.21*	0.039	0.02	0.821	0.36**	<0.001
Prosocial behavior[a]	-0.37**	<0.001	-0.19	0.054	-0.13	0.178	-0.38**	<0.001	-0.32**	0.001	-0.19	0.067	-0.18	0.076	0.04	0.698	-0.29**	0.004
Total difficulties score	0.46**	<0.001	0.21*	0.030	0.21*	0.033	0.53**	<0.001	0.31**	0.002	0.29**	0.005	0.26*	0.011	0.10	0.305	0.50**	<0.001

*p < 0.05; **p < 0.01

[a]higher scores indicate strength and better behavior

Table 5 Stepwise linear regression analysis predicting CSHQ total scores

	B	*SE*	β	*p*	95% confidence interval for B	R^2	R^2 change
SDQ total score	0.496	0.130	0.413	<0.001	0.236 to 0.756	0.195	0.195
Psychostimulant use (0 = no, 1 = yes)	-4.945	1.543	-0.347	0.002	-8.032 to -1.858	0.315	0.119

Variables were entered to the model for stepwise linear regression analyses. Criteria for entry and removal were 0.05 and 0.10, respectively.

Discussion

To our knowledge, this study is one of the few to describe sleep problems and determine factors of sleep disturbances in Thai children with ASD. The results revealed that Thai children with ASD had high rate of overall sleep disturbances, compared to typically developing children. Criteria of overall sleep disturbances defined as CSHQ total score > 41 were met in 89.2% of the sample, with mean score of 49.7. The rate and severity of sleep problem in our study were comparable to those of China,[10] the USA,[5, 7] and the North of Thailand.[11] The most common domains of sleep problems reported by parents were bedtime resistance and sleep anxiety. This agreed with previous studies indicating that trouble falling asleep and sleep maintenance were specific problems in autistic children.[9, 16] Mean sleep duration in our sample was 8.9 hours, which was slightly less than the 9-11 hours requirement for children 6-12 years.[28] However, average night waking duration was only 7.9 minutes, and ranked lowest among domains of CSHQ. This was surprisingly low and could be due to effects of psychotropic medication. Problematic sleep practices were common in our sample. As much as 78.4% had stimulating activities before sleep, and more than half (55.9%) did not have regular bedtime routines. Regular use of bed for other purposes and caffeine consumption were also reported. However, the only sleep practice that significantly associated with overall sleep problem was the absence of bedtime routine.

As a specialized ASD center, Yuwaprasart Waithayopathum Child and Adolescent Psychiatric Hospital provided sufficient samples in all severities, allowing for analysis of severity effects on sleep. The SDQ subscales and total scores reflected emotional/behavioral problems usually seen in this population. Although unspecific to core features of autism, they did contribute significantly to sleep disturbances, as hypothesized.

Summary of factors significantly associated with overall sleep disturbances included responders age, absence of bedtime routine, primary school level, total difficulties and subscales score of SDQ, severe autism, and psychostimulant use. Parental age negatively correlated with overall

sleep disturbance, indicating that children with older parents had better sleep. In our view, this could be due to the observation that older caretakers (i.e. grandparents) were more available, while younger parents might still be working or studying during child's bedtime. This finding contradicted with different perspectives on parental age as a factor associated with greater autism severity, which might account to greater sleep problems.[10, 16] The only sleep practice correlated with greater sleep disturbances in our study was the absence of bedtime routine. Consistent with previous studies, regular bedtime routines were proven to improve sleep for children with ASD[19, 29] and also typically developing children.[30, 31] Regular routines before bed help as environmental cues and sooth the restrictive nature of autistic children. Compared to other levels of education, children in primary school had significantly less sleep disturbances. It is possible that primary school schedules offer more structure to daily life, since evening classes or activities often take place at this period. Primary school children exhausted from a long day should easily feel the need for sleep as bedtime arrives. The secondary school participants in this study consisted of only three children aged 12, all have reached puberty. Their CSHQ total scores did not differ significantly from other educational levels. However, the number was too small for this group to determine contribution of pubertal stage and secondary school level on sleep.

Consistent with previous studies,[10, 14, 16] emotional and behavioral problems reflected by SDQ scores contributed significantly to both CSHQ total score and subscale scores, with small to moderate effect sizes. Overall sleep disturbances were affected most strongly by overall SDQ difficulties and conduct problems. Similar studies revealed slightly different results on domains that best predicted sleep (i.e., hyperactivity, prosocial strength[10], anxiety,[16, 17] oppositional and aggressive behavior[14, 16]). The bidirectional framework[18] explains how these traits, although unspecific to ASD, could contribute to sleep problems. The five subdomains were removed from the model in our stepwise regression analysis, leaving only the total difficulties score as a significant predictor. Although it is interesting to know which specific traits predict sleep best, we view that the SDQ total difficulties reflects child's overall mental state more realistically. For example, severe peer problems could be due to individual's hyperactivity and low prosocial strengths, which in turn result in his/her emotional or conduct problems.

Regarding autism severity, the mild and moderate cases did not differ from each other in the CSHQ total score, but they had significantly lower scores compared to the severely autistics. Our findings support previous studies regarding autism severity associations with sleep.[16, 17, 32] Among multiple interacting mediators, circadian rhythm dysfunction[33] and lower production of melatonin[34] were reported in ASD samples. Further research is required to explore links of autism and

the pathophysiology of sleep. Of 99 participants with medication data, risperidone (69.7%) and methylphenidate (40.4%) were most frequently used. Among all medication, methylphenidate was the only agent associated with lower CSHQ total score and remained in the model predicting sleep disturbances. The negative association found in our study contradicted with the knowledge that stimulants have undesirable effects on sleep, both generally and in ASD population.[16] However, regular use of stimulants effectively ease hyperactivity symptoms, which could improve sleep quality in the long term. This newer point of view has been supported by several studies that did not find significant contribution of stimulants to sleep disturbances.[35, 36]

In contrast with previous studies,[6, 7, 10] we did not find child's age and gender, parental education and family income to contribute to their sleep problems. Problematic sleep practices that did not affect sleep included caffeine intake, stimulating activities, bed use for other purposes, and inadequate bedroom environment. This might be due to the use of self-developed brief survey that might not be as effective for the examination of sleep hygiene. Comorbidities did not correlate significantly with sleep disturbances, as oppose to emotional and behavioral problems in SDQ. Our speculation is that comorbidities are often listed out and treated specifically, while SDQ problems were not. For example, an autistic child with hyperactivity symptoms that did not meet the criteria of ADHD might be undertreated, and therefore the restlessness and hyperactivity symptoms remain to disturb his/her sleep.

There are several limitations to this study. First, Intelligence quotient (IQ) has been reported in several studies to contribute to sleep problems in ASD population,[6, 19] but was not included in our study due to impracticalities in obtaining confirmed data. Secondly, during data collection, some of eligible children had severe symptoms of aggression and agitation that did not allow for participation in the study. This might result in the less power of autism severity level, which could have stronger contribution to sleep problems. Thirdly, data on medication use and comorbidities were inadequate due to our small sample size. Very high CSHQ total scores were found in participants with comorbid obesity (N = 1), epilepsy (N = 2), on clonidine (N = 3), on fluoxetine (N = 4), but the number was too low to efficiently analyze their association with sleep disturbance. Fourth, there was no healthy control group in this study to directly compare the prevalence and types of sleep problems.

Further investigations on sleep disturbances using measures such as polysomnography should allow more objective detection of sleep problems and confirm parental report. Studies of associated factors should control for confounding factors and monitor for collinearities. More understanding on pathophysiology and mechanisms of sleep disturbance in ASD would improve the quality of sleep and result in better care for this population.

Conclusion

This study is one of the first few studies in Thailand regarding sleep disturbances and associated factors in children with ASD. Similar to previous studies, we found that a large portion of autistic children suffer greatly from disturbed sleep. Sleep problems in this population were severe, common, and consisted of diverse domains. Increased overall sleep disturbances in this sample correlated with absence of bedtime routine, SDQ total difficulties, and severe level of autism. Older parental age and use of psychostimulants associated with lesser overall sleep disturbances. The strongest predictor of sleep disturbance was SDQ total difficulties. Sleep practices and quality should be examined and highlighted in ASD treatment. The findings underline the importance of treating not only ASD symptoms, but also factors that might contribute to sleep.

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