



Prevalence of restless legs syndrome and sleep problems in Korean children and adolescents with attention deficit hyperactivity disorder: a single institution study

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Purpose: Attention deficit hyperactivity disorder (ADHD) is a common disorder in school-aged children. Patients with restless legs syndrome (RLS) often present with ADHD symptoms and vice versa. This study was the first to attempt to identify the prevalence of RLS and sleep problems in children with ADHD in Korea.

Methods: Patients diagnosed with ADHD were asked to complete a sleep questionnaire. The sleep questionnaire included items to help identify the presence of four typical symptoms that are used as diagnostic criteria for RLS.

Results: A total of 56 patients, including 51 boys and 5 girls (mean age, 10.7 years old) participated. Of these, 24 complained of pain, discomfort, or an unpleasant sensation in the legs. Based on the RLS diagnostic criteria, 2 patients were diagnosed with definite RLS and 4 with probable RLS. There were no significant differences in age, medication dosage, or neuropsychological test scores between the patients with and without RLS symptoms.

Conclusion: Approximately 42.9% of patients with ADHD presented with RLS symptoms and 7.1% of these were diagnosed with RLS. Patients with ADHD also experienced various other sleep disorders. Thus, appropriate assessment and treatment for sleep disorders in patients with ADHD is essential.

Key words: Attention deficit disorders with hyperactivity, Child, Adolescents, East Asian, Restless legs syndrome

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Introduction

Attention deficit hyperactivity disorder (ADHD) is a common neurobehavioral and psychiatric disorder present in 4% to 12% of school-aged children^{1,2}. ADHD affects children of all ages, and it persists throughout adolescence³. Many patients with ADHD have comorbid disorders such as conduct disorders, anxiety disorders, mood disorders, learning disorders and sleep disorders⁴. Previous studies have shown that various sleep problems were reported by patients with ADHD^{5,6}. The sleep problems most commonly reported are excessive daytime sleepiness and difficulties initiating and maintaining sleep⁷. Regarding sleep disorders, several studies have found a higher rate of specific sleep disorders including restless legs syndrome (RLS), periodic limb movement disorder and sleep apnea⁸⁻¹⁰. Meticulous attention is required in the assessment of ADHD patients because RLS patients can be misunderstood as ADHD patients, and ADHD can also be

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accompanied with RLS¹¹). Since Picchietti et al.¹⁰ reported the association between ADHD and RLS in 1998, a number of studies have been conducted about the relationship. However, none have been reported in Korea. Therefore, this study was aimed to investigate the evidence on the association between ADHD and RLS and sleep problems in Korean children and adolescents with ADHD.

Materials and methods

The cross sectional study was carried out in the pediatric and Department of Psychiatry, Kyungpook National University Medical Center in South Korea between April to September, 2012. A sleep questionnaire administered in the Korean language was given to the children and adolescents with ADHD and their parents in the out-patient clinic.

1. Diagnosis of ADHD

Fourth edition, test revision of Diagnostic and Statistical Manual of Mental Disorders was used in diagnosis of ADHD.

Table 1. Sleep questionnaire items and RLS diagnostic criteria used for screening of participants

Clinical findings
Sleep screening
1. I have bedtime problems.
2. I feel sleepy during the day or it is hard to wake up in the morning.
3. I awake during the night or experience abnormal behaviors.
4. I usually sleep well.
5. I snore or have other sleep disorders.
RLS criteria
1. An urge to move the legs is usually accompanied or caused by uncomfortable and unpleasant sensations in the legs.
2. The urge to move or unpleasant sensations begin or worsen during periods of rest or inactivity such as lying or sitting.
3. The urge to move or unpleasant sensations are partially or totally relieved by movement such as walking or stretching, at least as long as the activity continues.
4. The urge to move or unpleasant sensations are worse in the evening or night than during the day or only occur in the evening or night.
5. The above four questions were asked to patients as well as their 1st degree family members (father, mother, brothers, and sisters).
Current sleep habits or sleep problems
1. Bedtime behaviors and symptoms of behavioral insomnia
2. Night awakening
3. Behavior during sleep or symptoms of parasomnia
4. Sleep disordered breathing
5. Daytime sleepiness and behavior

RLS, restless legs syndrome.

2. Sleep questionnaire

Sleep questionnaire and RLS criteria for the subjects are shown in Table 1.

3. Case finding and data collection

We reviewed the respondents of the questionnaire and medical data of the patients. The medical records of the patients were reviewed focusing on the psychological test and treatment of ADHD.

4. Diagnosis of RLS

According to the diagnostic criteria of the International Restless Legs Syndrome Study Group¹², when a child meets all the essential adult criteria and two additional criteria (a first degree family history of definite RLS, sleep disturbance for age) who is aged 12 and under was diagnosed to be “definite RLS”. Another supportive criterion (periodic limb movements index ≥ 5 by polysomnography) was not applied for this study, because polysomnogram was not done in any patients. Adult diagnostic criteria were used for patients older than 13 years old. If a patient meets all the essential criteria except the criterion “The urge to move or unpleasant sensations are worse in the evening or night than during the day or only occur in the evening or night,” and has a family history of definite RLS was diagnosed as “probable RLS”.

5. Statistical analysis

Statistical analysis was performed using PASW Statistics 18.0 (SPSS Inc., Chicago, IL, USA). The average values of the two groups classified according to the presence of RLS symptoms were compared using the Mann-Whitey *U* test or *t* test.

6. Ethics statement

This study was approved by the Institutional Review Board for clinical research at Kyungpook National University Medical Center (2012-04-007). The aim of this study was explained in the first page of the sleep questionnaire and a formal consent was obtained from the patients and parents.

Results

1. Clinical characteristics of the subjects

Table 2 shows the clinical demographics of study subjects. The mean age of the patients was 10.7 ± 2.7 years, and the mean treatment for the duration of medication for ADHD was 27.9 ± 22.1 months.

Table 2. Demographic features of study participants

Demographic data	Female	Male	Total
No. of patients with ADHD	5	51	56
Patient age (yr), mean (range)	8.0 (8–9)	10.8 (6–16)	10.7 (6–16)
Mean medical treatment duration (mo)	17	29	28

ADHD, attention deficit hyperactivity disorder.

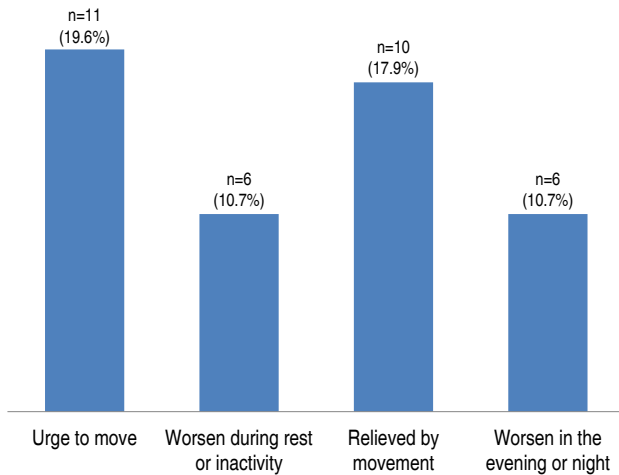


Fig. 1. Prevalence of restless legs syndrome (RLS)-related symptoms in study patients. Twenty-four patients had symptoms of RLS. The symptoms “an urge to move the legs” and “relief by movement” were most common, followed by “worsening during rest” and “worsening in the evening or night.”

2. Prevalence of RLS of the subjects

Seven patients had a family history of RLS (12.5%) and 24 patients (42.9%) showed symptoms of RLS. The highest responses were made to the statement “An urge to move the legs, usually accompanied or caused by uncomfortable and unpleasant sensation in the legs”, with 11 answers (19.6%), followed by “The urge to move or unpleasant sensations are partially or totally relieved by movement” which 10 patients (17.9%) answered to. There were 6 patients (10.7%) who answered to “The urge to move or unpleasant sensations begin or worsen during periods of rest or inactivity” and 6 patients (10.7%) who answered to “The urge to move or unpleasant sensations are worse in the evening or night than during the day or only occur in the evening or night” (Fig. 1). Assessing the subjects based on the sleep questionnaire, 2 patients (3.6%) were diagnosed with “definite RLS” and another 2 patients (3.6%) were diagnosed with “probable RLS”.

3. Comparison of psychological results, treatment, sleep characteristics between patients with RLS symptoms and without RLS symptoms

There were no significant differences in intelligence quotient, ADHD scale, medication dosage and treatment duration between

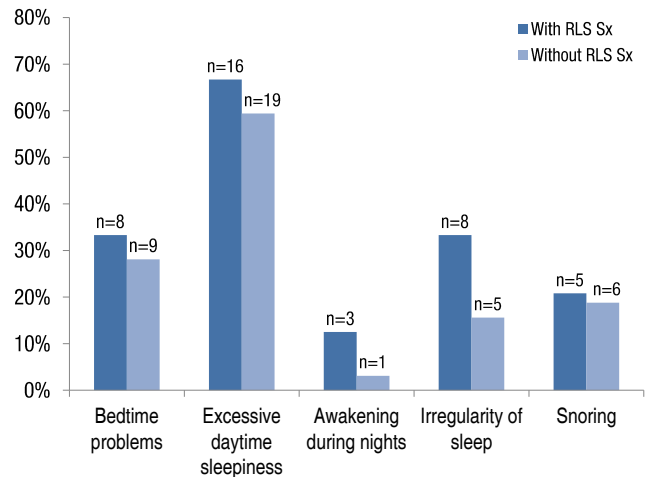


Fig. 2. Sleep problems in the study patients. Sleep problems were observed in 42 patients (75%) among the subjects. Excessive daytime sleepiness was the most common symptom, followed by bedtime problems, snoring, irregularity of sleep, and awakening during the night. There were no significant differences between the two groups. RLS Sx, restless legs syndrome symptom.

Table 3. Comparison of sleep-related characteristics between patients with and without RLS

Characteristic	With RLS Sx (n=24)	Without RLS Sx (n=32)	P value
Age (yr)	10.8±2.34	10.6±2.78	NS*
BWt (kg)	38.4±10.69	36.3±14.45	NS
Full IQ	96.4±13.62	95.2±16.87	NS
Verbal IQ	101.1±12.97	96.9±17.69	NS
Performance IQ	92.7±17.29	94.0±16.27	NS
ADHD scale K-ARS	31.1±10.12	31.2±11.29	NS
Inattention	18.3±4.23	16.7±5.10	NS
Hyperactivity	17.1±6.57	14.6±7.04	NS
Tx. duration (mo)	26.1±19.83	30.5±25.40	NS
Medication dosage (kg)	38.1±15.70	37.9±13.09	NS
Sleep latency (min)	20.5±11.97	25.87±16.63	NS
Total sleep time (min)	502.4±50.14	505.2±80.10	NS

Values are presented as mean±standard deviation.

P value, by Student t test or Mann-Whitney test

RLS Sx, restless legs syndrome symptom; BWt, body weight; IQ, intelligence quotient; ADHD, attention deficit hyperactivity disorder; K-ARS, Korean -ADHD rating scale; Tx., treatment; NS, not significant.

the groups. Regarding sleep characteristics such as sleep problems, sleep latency and total sleep time, we did not find any significant differences between two groups (Table 3).

4. Sleep screening questions

Among patients with ADHD, sleep problems were observed in 42 patients (75%); with the highest response 35 patients (62.5%) answered to “Excessive daytime sleepiness”; 17 patients (30.4%) answered to “Bedtime problem”; 11 patients (19.6%) answered

to “snoring”; 7 patients (12.5%) answered to “problems in Regularity and duration of sleep”; 4 patients (7.1%) answered to “Awakening during sleep” (Fig. 2).

5. Sleep problems in children and adolescents with ADHD

Twenty-nine patients had symptoms of behavioral insomnia, they complained that they felt afraid of sleeping on their own (n=25, 45%) or they tend to look for their parents when they go to bed. Four children showed night awakening and 27 patients had symptoms of parasomnia, they showed twisting or turning of the body (n=25, 45%), teech grinding (n=17, 30%), kicking legs (n=12, 21%). Thirty subjects had symptoms of sleep disordered breathing, such as mouth breathing (n=27, 48%) or snoring (n=10, 18%). Forty-five patients complained about daytime sleepiness, they showed unrefreshed sleep in the morning (n=43, 77%) or looking tired (n=33, 50%).

Discussion

The most important finding of this study is that considerable numbers of patient with ADHD may have RLS symptoms or be diagnosed with definite RLS. In this study, 42.9% of the subjects (n=24) had RLS symptoms and 7.2% of the subjects (n=4) were diagnosed with probable or definite RLS. Considering the fact that RLS symptoms can be mild and intermittent in children and RLS is usually progressive^{13,14}, it is expected that the numbers of RLS patients will increase during follow-ups. The first study on the comorbidity between ADHD and RLS, conducted with 69 children with ADHD by Picchietti et al.¹⁰ in 1998, showed that 11.5% of the patients with ADHD had RLS according to the pediatric version of the diagnostic criteria for RLS. A study of Konofal et al.¹⁵ for 43 children with ADHD reported that 44% of the study subjects met RLS diagnostic criteria. Other studies also reported that RLS symptoms were seen in 10.5%–24% of ADHD children^{11,16,17}. Compared to 2%–2.74% of the prevalence in the general population^{18,19}, children with ADHD are more likely to experience RLS. In this study, there were 24 patients who complained of RLS symptoms (42.9%) and 7% of the subjects (n=4) were diagnosed with RLS based on the symptoms which was similar to previous studies.

Although the association between RLS and ADHD are not yet clearly understood, several hypotheses have been suggested. Some maintain that ADHD is resulted from sleep disturbance secondary to RLS. While sleep deprivation in adults causes excessive daytime sleepiness, sleep deprivation in children can lead to inattentiveness and paradoxical overactivity^{20,21}. In our study, 86% of the subjects (n=42) complained of sleep disturbance. Of them, problematic bedtime behaviors and symptoms of insomnia were seen in 52% (n=29) and kicking

legs while sleeping was seen in 21% of the subjects (n=12). It is known that adolescents with ADHD experience sleep disturbance 2–3 times more compared to normal healthy children²². It is also reported that sleep disorders should be included in the assessment and treatments of ADHD patients since a prognosis and treatment response of ADHD can be affected by various sleep disorders including RLS⁷. Comparison between patients with RLS symptoms and without RLS symptoms showed that the former had more sleep problems, however there were no statistical significances (Fig. 2). Polysomnographic studies of RLS reported increased sleep latency²³, but in the present study, patients with RLS showed decreased sleep latency. This study was based on sleep questionnaires, so objective examinations such as PSG or actigraphy are needed to verify these results.

Another hypothesis is that the manifestations of RLS could be misclassified as ADHD symptoms¹⁰. Children with RLS can be mistaken as ADHD patients because they move about without being able to stay still due to an urge to move and present with a lack of attentiveness secondary to leg discomfort²⁴. A study conducted with adults with RLS also showed that RLS patients increased inattention and hyperactivity²⁵. Since separate treatments for RLS is required if a patients is accompanied with RLS, RLS screening should be included in assessment of ADHD. With recent increasing interests in ADHD, the condition has been recognized as a public health problem. Therefore, clinicians should also be aware of the significance of RLS. Others suggest that either RLS is comorbid with ADHD or RLS and hyperactivity have a common central nervous system pathophysiology. Several studies have shown decreased dopaminergic function in patients with ADHD^{26,27} or iron deficiency in children with ADHD²⁸. According to these theories, administration of iron supplements and dopamine agonists should be considered in addition to methylphenidate. Therefore it is needed to evaluate the iron status for iron deficiency in ADHD patients with RLS symptoms and consider iron therapy for them. And we need to check whether RLS symptoms improved or not after iron supplementation. Whereas previous studies have reported that ADHD symptoms are more severe when patients with ADHD have both conditions^{29,30} and are absent of RLS symptoms³¹, there was no statistically significant difference in this study.

In our study, it was difficult to identify whether ADHD symptoms are resulted from RLS or RLS symptoms are caused by ADHD or RLS and ADHD were concurrent in patients with RLS symptoms and patients diagnosed with RLS. Therefore, further evaluation and managements for RLS will be required to clarify these.

It is shown that children and adolescents with ADHD are more likely to experience sleep disorders compared to the normal healthy population with the same age²². This has been proven both in subjective evaluation and objective examination^{32,33}.

The subjects of this study also complained of various sleep problems such as bedtime resistance, sleep onset difficulties, difficulties with morning awakening, daytime sleepiness. Moderate and severe sleep problems lower the quality of living for ADHD patients as well as other members of the family^{6,34}. Thus, adequate treatments will be essential. This research was a cross-sectional observational study, we didn't try any treatment for the sleep problems. However, education or teaching good sleep hygiene help the children with sleep problems, so we need to consider behavioral therapy for sleep disorders.

It is practical to assess sleep problems prior to the commencement of drug therapy in patients with ADHD because it is tricky to differentiate whether sleep problems are primarily associated with ADHD or are associated with drug therapy when ADHD patients on medication complain of sleep problems.

Compared to an increasing interest in ADHD, sleep disorders and RLS in children are much less acknowledged, which make it difficult to diagnose and provide appropriate treatments.

This study is the first study concerning the relationship between sleep problems and RLS in children and adolescents with ADHD conducted in Korea. However, there were some limitations which need to be addressed. First of all, the influence of drug therapy was not excluded. In addition, objective tests such as PSG or iron workup were not performed for the subjects. The study sample was also small and there was an absence of a control to compare. Nonetheless, it was acknowledged that sleep problems should be assessed and identified prior to the diagnosis and treatment of ADHD because a considerable number of ADHD patients were suffered from RLS symptoms and were actually diagnosed with RLS. In this study, there were no significant differences in the medication dosage and neuropsychological test between patients with RLS symptoms and patients without RLS symptoms, which were thought to be stemmed from the small sample size. Therefore, larger studies will be required in the future to validate this result.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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