Snoring and Sleep Problems in Children with and without Allergic Rhinitis: A Case Control Study

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Objective: *To compare the sleep problems between children with and without allergic rhinitis (AR).*
Material and Method: *A case-control study was conducted in 65 children aged 6-15 years with allergic rhinitis and 104 control subjects matched individually by age, height and weight. Cases were recruited from the Pediatric Allergy Clinic at Thammasat University Hospital. The selection of cases was based on clinical history, physical examination and skin prick test. Matched healthy control children were recruited from the Thammasat primary school. Children and their caregivers who usually sleep with them completed the questionnaire.*
Results: *86.2% of allergic rhinitis was classified as persistent rhinitis and 63.1% had moderate to severe disease. The most common presenting symptom was nasal blockage (66.2%). Allergic rhinitis patients had significant sleep problems with snoring, sleep apnea, restless, night sweating, mouth breathing, dry throat, morning headache, falling asleep in class, difficulty in waking up and not refreshed in the morning ($p<0.05$). Patients who categorized as blockers had significantly more restless sleep and dry mouth on waking up compared to that of non-blockers ($p<0.05$).*
Conclusion: *There was a higher prevalence of sleep problems in children with AR then those without AR.*

Keywords: *Allergic rhinitis, Children, Sleep problem, Snoring, Nasal blockage*

J Med Assoc Thai 2015; 98 (Suppl. 2): S138-S144
Full text. e-Journal: *http://www.jmatonline.com*

Allergic rhinitis (AR) is highly common in Thailand, affecting 40-50% of Thai children[1,2]. It is an increasingly prevalent disease that generates high health care costs and has a significant effect on quality of life (QOL)[3]. Besides the classic symptoms of congestion, rhinorrhea, postnasal drainage, sneezing and pruritus, children with allergic rhinitis often experience daytime fatigue and somnolence, disrupted sleep at night and decreased cognitive performance[4]. According to the ARIA workshop group, AR is defined as mild when there was no impairment in any of these items (sleep, daily activities/sport, work/school, and troublesome symptoms), and moderate/severe when there is impairment in 1 or more areas[3]. Several mechanisms explain the effects of allergic rhinitis on sleep, including direct mechanical effects of posture and congestive obstruction, and indirect effects of inflammatory cytokines and other mediators on sleep patterns[5,6]. Sleep disturbances can reduce QOL[7,8] and cause fatigue, irritability, memory deficits, daytime somnolence, and depression[8].

Mccolly et al reported that allergy is frequently present in pediatric patients with habitual snoring and increased risk of obstructive sleep apnea in this population[9]. Urschitz et al found that signs of nasal obstruction were an independent risk factor for habitual snoring in primary school children[10]. There are few reports on the prevalence of sleep problems in children with AR. The aim of the present study was to test the hypothesis that children with allergic rhinitis have a higher prevalence of sleep problems than children without AR using a case-control study design.

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Material and Method

Study design and participants

A cross-sectional study was performed between June 2010 and December 2011. Sixty-five allergic rhinitis patients were enrolled from the pediatric allergy clinic, Thammasat University Hospital. 104 healthy volunteers matched by age and body mass index were included from Thammasat primary school. The study protocol was approved by the Ethics Committee of the Thammasat University Hospital. Written informed consent was obtained from all participants. The informed consent was obtained from

all the parents and children.

Inclusion criteria

Female and male subjects between the age of 6 to 15 years with the presence (case) or absence (control group) of allergic rhinitis were included. Allergic rhinitis was diagnosed on the basis of medical history, clinical assessment, and positive skin prick test[11]. The children required to have active symptoms at the time of the study and need for treatment. Inclusion criteria for the control group without AR were negative response to ISAAC phase I questionnaire regarding allergic symptoms (nasal congestion, rhinorrhea, sneezing, snoring and itchy/watery eyes)[12]. All patients were required to be untreated for allergic rhinitis at the time of inclusion at least 4 weeks in case of intranasal corticosteroids and 1 week in case of oral antihistamines and anti-leukotrienes.

Exclusion criteria

Patients with co-existing diseases that might affect nocturnal sleep or nasal breathing such as neuromuscular diseases, or craniofacial anomalies, patients with recent respiratory tract infection, chronic cough, acute/chronic rhinosinusitis and patients who had been on anti-allergic medications or medications that might affect sleep or daytime performance were excluded from the study.

Questionnaire

The ISAAC phase I questionnaire surveys were obtained from control non-allergic rhinitis children in the Thammasat primary school. This questionnaire was used to survey prevalence of allergic disease in Thailand[13-15]. Children were excluded if they had more than one positive response to the six questions of AR in ISAAC questionnaire. Sleep problems of all participants were assessed using a modified Hong Kong Sleep Questionnaire[16]. The questionnaire was modified to exclude questions regarding allergy, sleeping time and academic results. Children and their caregivers who usually sleep with them completed the questionnaire.

Patient evaluation

The following information was recorded for all participants: demographic data, allergic co-morbidities (asthma, atopic dermatitis, and allergic rhinoconjunctivitis), presence of passive smoking and sleep problems. The patients who had nasal blockage as their most troublesome symptoms were classified as "blockers" whereas those with sneezing and watery discharge as their main symptoms were described as "sneezers or non-blockers"[17]. Complete nose and throat examinations were done by investigators. Tosillar hypertrophy were recorded if patients had tonsil size at least grade 3+ or greater than 80% obstruction of the oropharyngeal airway[18]. Skin prick testing to common aeroallergens; house dust mite (HDM), cockroach (CR), mixed grasses, cat, dog and mold was performed. Glycerine and histamine were used as negative and positive controls, respectively. Positive result was considered when wheal size was 3 mm greater than negative control[19]. AR patients were categorized as having intermittent or persistent rhinitis according to ARIA classification[3] and symptoms of AR. A lateral skull radiograph for assessing adenoid hypertrophy was obtained in some cases depending on clinical impression.

Outcome measures

The snoring and sleep problems were assessed using a modified version of Hong Kong children sleep survey questionnaire[16]. It was translated into Thai language and modified after pilot study. The parents who usually sleep with children were asked to administer the questionnaire. Parents or children rated the impairment during the preceding week by responding to each of items.

The questionnaire included questions such as frequency of snoring, excessive day time sleepiness (falling asleep while watching television, falling asleep during a lesson, falling asleep while doing homework, and falling asleep in a vehicle), nocturnal enuresis, teeth grinding, mouth breathing, restless sleep, breathing difficulties, sleep apnea and morning headache. Habitual snoring was defined as snoring for 6 or 7 nights a week. Primary nocturnal enuresis was defined as nocturnal bed-wetting beyond the age of 5 years and never having a period of dryness. Secondary nocturnal enuresis was defined as bed-wetting after a period of at least 6 months of dryness.

Statistical analysis

The sample size and power of test were calculated by using PS software. For sample size calculation we used the case-control study of Ishman et al[20] who reported the prevalence of sleep-disordered breathing in children with allergy (19%) and control (6%). To estimate sample size, the authors used alpha = 0.05, power of test = 0.7 and case/control = 1.5. It was estimated that 61 subjects for case and 92 subjects for

control. Therefore, in the present study the authors used 65 and 110 subjects for case and control, respectively. For statistical analyses, unpaired t-test, Chi-square, Fisher's exact test and odd ratio were used to analyze variables where appropriated. Values were considered statistically significant at $p<0.05$. All analyses were performed using SPSS version 22 (SPSS Inc., Chicago, Illinois).

Results

Subject demographic characteristics

Sixty-five patients were enrolled from allergy clinic, Thammasat University Hospital with a mean age 10.6 (±2.5) years old. The male: female ratio was 40: 25. To obtain the control subjects, 200 invitation letters were sent to caregivers of student aged 6-15 years. 52% of caregivers agreed to complete sleep questionnaire. Table 1 shows clinical characteristic in allergic rhinitis cases and control group. The number of patients in allergic rhinitis cases and control group was 65 and 104, respectively. The mean ages, sex, body mass index of cases and controls were not statistically significant difference (Unpaired t-test, $p>0.05$). There were significantly differences between the AR and control groups with history of passive smoking, asthma, atopic dermatitis and allergic conjunctivitis being more prevalent in the AR group (Fisher's exact test, $p<0.05$). None of control group had history of other allergic diseases.

Clinical characteristics of allergic rhinitis cases

The clinical characteristics of allergic rhinitis cases are shown in Table 2. Fifty-six (86.2%) patients were classified as having persistent symptoms. 41/65 (63.1%) of these patients were classified as having moderate to severe disease. 66.2% of patients presented with nasal blockage. All patients had positive a skin prick test to common aeroallergens. The most common aeroallergens sensitization was to perennial allergens, in particular house dust mite and HDM + Cockroach (CR). Tonsillar hypertrophy was found in only 33% of AR patients. Of the 35 patients who had lateral skull radiography performed, 23 (65.7%) had adenoid hypertrophy.

Snoring and sleep-related problems in AR patients versus controls

The overall prevalence of snoring and restless sleep in AR patients was 46.2% (30/65) and 75.4% (49/65), respectively, confirming the high burden of these symptoms in AR patients. A comparison of the snoring and sleep related problems in AR patients and controls, is shown in Table 3. Allergic rhinitis patients had significantly more sleep problems with snoring, sleep apnea, restless sleep, night sweating, mouth breathing, thirsty/dry throat, difficulty in waking up, not feeling

Table 1. Demographic data in allergic rhinitis cases and control group

	Allergic rhinitis cases	Control cases
N	65	104
M: F	40:25	45:59
Mean ages, years (SD)	10.6 (2.5)	9.2 (1.4)
Mean body mass index (kg/m^2)	19.2 (5.3)	18.2 (4.5)
Passive smoking* (%)	33 (50.8)	33 (31.7)
Other allergic diseases* (%)		
Asthma	16 (24.6)	0
Atopic dermatitis	8 (4.7)	0
Allergic conjunctivitis	20 (30.8)	0

* Fisher's exact test, $p<0.05$

Table 2. Allergic rhinitis patients' characteristics (n = 65)

	Allergic rhinitis cases (%)
Frequency	
Intermittent	9 (13.8)
Persistent	56 (86.2)
Severity	
Mild	24 (36.9)
Mod to severe	41 (63.1)
Presenting symptoms	
Blockers	43 (66.2)
Non-blockers	22 (33.8)
Positive skin-prick test	65 (100.0)
House dust mite (HDM)	15 (23.1)
HDM + Cockroach (CR)	15 (23.1)
HDM + CR + Grasses	10 (15.4)
HDM + Mold	4 (6.2)
HDM + CR + Dog + Grasses	4 (6.2)
HDM + Grasses-all allergens	3 (4.6)
HDM + CR + Cat	3 (4.6)
Others	2 (3.1)
Tonsillar hypertrophy	9 (13.8)
Lateral skull radiograph	15 (33.1)
Done	35 (53.8)
Adenoidal hypertrophy	23 (65.7)

Table 3. Snoring and sleep related problems

	Allergic rhinitis cases (%) n = 65	Control cases (%) n = 110
Snoring[#]		
None	35 (53.8)	78 (75.0)
1-2 night/week	5 (7.7)	14 (13.5)
3-5 night/week	11 (16.9)	5 (4.8)
6-7 night/week	14 (21.5)	7 (6.1)
Teeth grinding	24 (36.9)	26 (25.0)
Primary enuresis	12 (18.5)	11 (10.6)
Secondary enuresis	0	2 (1.9)
Sleep apnea*	8 (12.7)	1 (1.0)
Restless sleep*	49 (75.4)	49 (47.1)
Night Sweating*	23 (35.4)	4 (3.8)
Mouth breathing*	41 (63.1)	21 (20.2)
Thirsty/dry throat*	33 (50.8)	6 (15.4)
Difficult to wake up*	34 (52.3)	131 (29.8)
Feel unrefreshed in the morning*	47 (72.3)	34 (32.1)
Morning headache*	20 (30.8)	7 (6.7)
Sleep on TV	29 (44.6)	51 (49.0)
Sleep on homework	7 (10.8)	6 (5.8)
Sleep on car	40 (61.5)	53 (51.0)
Sleep in class*	11 (16.9)	4 (3.8)
Family member snoring	42 (64.6)	77 (74.0)
Duration of sleep (hour)	8.6 (1.1)	9.0 (0.8)

[#] Chi-square test, $p<0.05$
* Fisher's exact test, $p<0.05$

refreshed in the morning, morning headache and sleeping in class ($p<0.05$). The odds ratios (OR) of these sleep-related problems between allergic rhinitis and control groups were calculated as shown in Table 4. The patients who were categorized as blockers (43/65) had higher prevalence of habitual snoring (3-7 nights a week), mouth breathing and dry mouth on waking up compared to non-blockers (22/65), but these differences were not statistically significant (Table 5). However, nasal blockers had a significantly higher prevalence of restless sleep and thirsty/dry throat compared to non-blockers (Table 5).

Discussion

The authors showed that AR patients have a higher prevalence of snoring, sleep apnea, restless sleep, night sweating, mouth breathing, thirsty/dry throat, morning headache, sleeping in class, difficulty in waking up and not feeling refreshed in the morning. Furthermore, AR patients categorized as blockers had a significantly higher prevalence of restless sleep and dry mouth on waking up than AR patients classified as non-blockers did.

This is the first report to compare sleep problems in allergic rhinitis children with control group. In the present study, the allergic rhinitis was more prevalent in boys than girls similar to previous studies[21]. Exposure to passive smoking was greater in AR patients than controls, although previous studies have not found a relationship between parental smoking and allergic rhinitis[22]. The polysensitisation to common aeroallergens, particularly perennial allergens, was observed frequently in the present study similar to studies of allergic rhinitis children in primary care[23]. The most common severity of AR was persistent moderate to severe, similar to previous studies[24,25].

Adenoid hypertrophy was only investigated when clinically indicated based on clinical findings (35 of 65 cases). Since lateral skull radiographs were not obtained in all cases, we cannot conclude whether adenoid hypertrophy is the cause of sleep problem in our AR patients. Tonsillar hypertrophy was found in 33% of allergic rhinitis cases, whereas sleep problems were much more prevalent. The authors found that sleep problems were significantly more prevalent in AR patients than in controls. The authors agree with Anuntaseree et al[26] that allergic rhinitis is the significant risk factor for habitual snoring. The systematic review on the association between AR and sleep problem in children found that 12 of 18 articles showed a statistically significant association between AR and SDB[27]. The authors found that nasal blockage is the common presenting symptoms in allergic rhinitis cases that may be the cause of snoring in these patients. Therefore, we specifically analyzed the relationship between nasal obstruction and sleep-related symptoms. The authors found no association between habitual snoring and nasal blockage which is contrast with a study in adults[28]. It is possible that our subjects were having less severe nasal congestion. However, our AR patients with nasal blockage had an increased prevalence of restless sleep and thirsty/dry throat. The clinical distinction of AR patients as "blockers" or "non-blockers", therefore, was not particularly useful with regard to identifying the children with sleep-related symptoms. This may also reflect the fact that the distinction between "blockers" and "non-blockers" was based solely on parent's observations.

The limitations of the present study are the fact that control children were not objectively examined for the presence of allergic diseases and tonsillar

Table 4. Association between AR and sleep problem

Variable	AR (%)	Control (%)	OR (95% CI)
Habitual snoring	25 (38.5)	12 (11.5)	4.6 (2.05-9.88)*
Teeth griding	24 (36.9)	26 (25)	1.76 (0.90-3.40)
Enuresis	12 (18.5)	11 (10.6)	1.91 (0.80-4.53)
Sleep apnea	8 (12.7)	1 (1)	14.46 (1.75-59.61)*
Restless sleep	49 (75.4)	47 (47.1)	3.71 (1.89-7.15)*
Night sweating	23 (35.4)	4 (3.8)	13.69 (4.23-36.02)*
Mouth breathing	41 (63.1)	21 (20.2)	6.75 (3.30-13.10)*
Thirsty/dry throat	33 (50.8)	16 (15.4)	5.67 (2.71-11.28)*
Moring headache	20 (30.8)	7 (6.7)	6.16 (2.36-14.51)*
Feel unrefresh in the morning	47 (72.3)	34 (32.1)	5.38 (2.67-10.30)*
Difficult to wake up	34 (57.3)	31 (29.8)	2.58 (1.35-4.84)*
Sleep on television	29 (44.6)	51 (49)	0.84 (0.45-1.56)
Sleep in car	40 (61.5)	53 (51)	1.48 (0.78-2.75)
Sleep in class	11 (16.9	4 (3.8)	5.09 (1.51-14.71)*

OR refers to the Odd Ratio, * $p<0.05$ (Fisher's exact test)

Table 5. Comparison of the prevalence of sleep-related problems in allergic rhinitis patients classified as "blockers" or "non-blockers"

Variable	Blocker (%) n = 43	Non-blocker (%) n = 22
Habitual snoring	18 (41.9)	7 (31.8)
Sleep apnea	5 (11.6)	3 (13.6)
Tooth grinding	13 (30.2)	11 (50)
Restless sleep*	37 (86.0)	12 (54.5)
Difficult to wake up	20 (46.5)	14 (63.6)
Primary enuresis	8 (18.6)	4 (18.2)
Night sweating	14 (32.6)	9 (40.9)
Mouth breathing	29 (67.4)	12 (54.5)
Thirsty/dry throat*	26 (60.5)	7 (31.8)
Morning headache	15 (34.9)	5 (22.7)
Feel un-refreshed in the morning	29 (67.4)	18 (81.8)
Sleep in class	6 (14)	5 (22.7)
Sleep on TV	21 (48.8)	8 (36.4)
Sleep on homework	4 (9.3)	3 (13.6)

* Chi-square test, $p<0.05$

hypertrophy. In addition, some of allergic rhinitis cases and controls may have adenoid hypertrophy, as the authors did not investigate for adenoid hypertrophy in all children. Only snoring allergic rhinitis patients received this investigation. Moreover, the subjects did not undergo nocturnal polysomnography to determine the presence of obstructive sleep apnea syndrome.

Conclusion

In summary, our results point out that allergic rhinitis is a risk factor for: habitual snoring, sleep apnea, mouth breathing, night sweating, morning headache, thirsty/dry throat in the morning, not feeling refreshed in the morning and falling asleep in class. Furthermore, restless sleep and thirsty/dry mouth were more prevalent in AR children who presented with nasal obstruction. The authors encourage physicians to search for underlying allergic rhinitis in children with snoring and sleep problems.

Acknowledgement

The authors wish to thanks all parents, children and teacher for great cooperation. The authors also thank Associate Professor Tippawan Hansakunachai for kindly advice in sleep problem. The present study received a grant from Thammasat Research Fund.

Potential conflicts of interest

None.

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ปัญหาการนอนหลับในผู้ป่วยเด็กที่เป็นโพรงจมูกอักเสบภูมิแพ้: การศึกษาเปรียบเทียบกับกลุ่มควบคุม

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วัตถุประสงค์: เพื่อเปรียบเทียบปัญหาการนอนหลับระหว่างเด็กที่เป็นโพรงจมูกอักเสบภูมิแพ้และเด็กที่ไม่เป็น

วัสดุและวิธีการ: ศึกษาเปรียบเทียบระหว่างผู้ป่วยเด็ก 65 รายอายุ 6-15 ปีที่ได้รับการวินิจฉัยว่าเป็นโพรงจมูกอักเสบ ภูมิแพ้และเด็กปกติที่เป็นกลุ่มควบคุม จำนวน 104 รายที่มีอายุส่วนสูงและน้ำหนักใกล้เคียงกัน ผู้ป่วยได้รับการคัดเลือกจากคลินิกภูมิแพ้เด็กโรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติโดยวินิจฉัยจากประวัติตรวจร่างกายและการทดสอบภูมิแพ้ทางผิวหนัง ส่วนกลุ่มควบคุมได้รับการคัดเลือกจากโรงเรียนประถมธรรมศาสตร์ เด็กและผู้ปกครองที่นอนร่วมกับเด็ก ร่วมกันตอบแบบสอบถาม

ผลการศึกษา: *ร้อยละ 86.2 ของผู้ป่วยเด็กที่เป็นโพรงจมูกอักเสบภูมิแพ้ถูกจัดเป็นประเภทมีอาการเรื้อรังและร้อยละ 63.1 มีความรุนแรงระดับปานกลางถึงมาก อาการแสดงที่พบบ่อยที่สุดคืออาการคัดจมูกโดยพบร้อยละ 66.2 ผู้ป่วยที่ได้รับการวินิจฉัยว่าเป็นโพรงจมูกอักเสบภูมิแพ้ มีปัญหาเกี่ยวกับการนอนมากกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติในเรื่องดังต่อไปนี้ คือ นอนกรน หยุดหายใจขณะนอนหลับ กระสับกระส่าย เหงื่อออกตอนกลางคืน อ้าปากหายใจ คอแห้ง ปวดศีรษะในตอนเช้า หลับในห้องเรียน ตื่นยากและไม่สดชื่นในตอนเช้า (OR = 4.6, 14.5, 3.7, 13.7, 6.8, 5.7, 6.2, 5.4, 2.6 และ 5.1 ตามลำดับ) นอกจากนี้ผู้ป่วยที่ถูกจัดอยู่ในกลุ่มอาการจมูกอุดกั้นเด่นจะมีปัญหากระสับกระส่ายตอนนอนและคอแห้งเมื่อตื่นนอนมากกว่าผู้ป่วยที่ไม่มีอาการจมูกอุดกั้นอย่างมีนัยสำคัญทางสถิติ*

สรุป: *ผู้ป่วยเด็กที่เป็นโพรงจมูกอักเสบภูมิแพ้พบปัญหาการนอนหลับได้บ่อยกว่ากลุ่มเด็กที่ไม่เป็นจมูกอักเสบภูมิแพ้*