



Letter

Assessment of sleep disturbance in children with allergic rhinitis

Sleep disturbance significantly impairs daily living of children and young adults with allergic rhinitis (AR) in 80% of patients.^{1–3} Compared with asymptomatic individuals, patients with chronic nocturnal rhinitis symptoms were more likely to report impaired cognitive function and decreased work productivity and performance.⁴ The Allergic Rhinitis and Its Impact on Asthma (ARIA) guidelines suggest that any report of sleep disturbance indicates moderate or severe AR, which has significant implications on treatment recommendations. However, there is no gold standard assessment method of sleep disturbance across age groups. Specifically, in children, adolescents, and young adults with AR, a quick assessment method that also captures the effect of sleep disturbance on quality of life is unknown. Children are more likely to exhibit diminished school performance or functioning at home, as opposed to reporting frank sleep disturbance, so assessments that can review both sleep-related impairment and sleep-disturbance are needed.⁵

One quick self-reporting clinical assessment tool that has not been previously used to assess the effect of sleep disturbance and quality of life in AR is the National Institutes of Health Patient Reported Outcome Measurement Information System (PROMIS).⁶ There are several PROMIS assessment measures, all of which have undergone rigorous testing in control and chronic disease populations. These standardized measures address sleep disturbance, sleep-related impairment, and other key topics related to physical, mental, and social health. Although the pediatric sleep measures are currently in development, the PROMIS instruments are developed for children and adults and are comparable between age groups.

Our objective was to use several patient self-report questionnaires to determine the optimal assessment method of disturbed sleep and its effect on physical, mental, and social health in patients with AR.

We recruited patients aged 8 to 30 years old ($n = 144$) with controlled asthma (Asthma Control Test score >19) from the Chicago metropolitan area. Race/ethnicity was categorized by self-report. All patients had clinical assessments and completed the following questionnaires: ARIA disease severity questions, PROMIS profile, modified Epworth Sleepiness Scale (ESS), Pediatric Perceived Cognitive Function/Applied Cognition–General Concerns, and Sino-Nasal Outcome Test (SNOT-22) (eSupplement). PROMIS sleep disturbance focuses on patient perceptions of sleep quality, sleep depth, and restoration associated with sleep. The Sleep Impairment questionnaires focus on the consequences of impaired sleep, such as daytime sleepiness, difficulty falling and staying asleep, and perceived functional impairment. To determine the best assessment tool for sleep disturbance and sleep-related

impairment, we used the ESS (a frequently used tool to categorize severity of sleep disturbance in general populations). We compared ESS to ARIA sleep question and correlated these with the PROMIS sleep scores. We then stratified groups based on disease severity using ARIA criteria to determine the effect on quality of life of sleep and disease severity in different age groups using SNOT-22 and PROMIS. Perceived cognitive function was assessed to determine the overall effect of sleep disturbance on this domain. The North-western Institutional Review Board approved this study, and all participants provided written informed consent.

Of the 144 patients who participated in this survey (43% male; 59% white, 20% Latino, 13% African American, 8% Asian), 67 were children 8 to 11 years old ($n = 31$) or 12 to 17 years old ($n = 36$), and 77 were adults (18–30 years old). A total of 100 patients had moderate/to severe AR. Sleep disturbance was reported based on 1 question from ARIA questionnaire (eMaterial) in 66% adults compared with 43% in children with AR. Of all patients recruited, responses on the modified ESS indicated that 5 (3%) had dangerous excessive daytime sleepiness, 29 (21%) had excessive daytime sleepiness, and 39 (29%) had any amount of daytime sleepiness. Interestingly, 24 (37.5%) of 64 patients who reported no sleep disturbance on the ARIA question had excessive or dangerously excessive daytime sleepiness on the ESS. Patients who reported sleep disturbance on the ARIA questionnaire had higher mean (SD) PROMIS sleep disturbance T-scores but no difference in sleep-related impairment ($\mu = 49.2$ [6.9] vs 44.6 [9.2], $P = .01$, and $\mu = 52.2$ [8.4] vs 50.7 [8.5], $P = .29$). The ESS sum scores correlated strongly with PROMIS sleep-related impairment and sleep disturbance (Table 1).

Overall, those with moderate to severe vs mild AR (determined via ARIA criteria) reported more sleep disturbance using the PROMIS measure (PROMIS, $\mu = 47.9$ [8.2] vs 44.5 [9.1], $P = .04$). Furthermore, patients with moderate to severe vs mild AR expressed more anxiety (PROMIS, $\mu = 51.7$ [11.1] vs 49.0 [11.0], $P = .03$), more depression (PROMIS, $\mu = 47.2$ [9.8] vs 45.0 [8.0], $P = .02$), and more fatigue (PROMIS, $\mu = 51.8$ [9.7] vs 44.2 [9.5], $P < .01$). Participants with moderate to severe AR had more trouble with social interactions (PROMIS, $\mu = 58.5$ [7.3] vs 62.5 [4.6], $P < .01$) and more perceived signs of cognitive dysfunction (PROMIS, $\mu = 58.5$ [7.3] vs 62.5 [4.6], $P < .01$).

Table 1 gives the correlations between PROMIS sleep disturbance and sleep-related impairment tools in children and adults with AR compared with ESS, SNOT-22, and other factors of physical, mental, and social health. When considering children younger than 12 years, reports of sleep-related impairment significantly correlated with depression and fatigue ($r = 0.60$, $P < .01$, and $r = 0.58$, $P < .01$). However, in this age group, reports of sleep disturbance did not correlate with depression or fatigue.

This study has potential limitations. This was a small cohort, and there was no objective measure of sleep. In addition, because the

Disclosures: Authors have nothing to disclose.

<http://dx.doi.org/10.1016/j.anai.2016.12.022>

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Table 1
Association Between Sleep Disturbance in Children and Adults With Allergic Rhinitis and Its Effect on Physical, Mental, and Social Health

Test	PROMIS sleep disturbance	PROMIS sleep-related impairment
Adults (≥ 18 years) (n = 77)		
SNOT-22	$r = 0.46, P < .01$	$r = 0.49, P < .01$
ESS	$r = 0.21, P < .01$	$r = 0.50, P < .01$
Applied Cognition-General Concerns	$r = 0.51, P < .01$	$r = 0.68, P < .01$
PROMIS depression	$r = 0.29, P = .01$	$r = 0.26, P = .02$
PROMIS anxiety	$r = 0.23, P = .04$	$r = 0.28, P = .01$
PROMIS fatigue	$r = 0.63, P < .01$	$r = 0.74, P < .01$
PROMIS social interactions	$r = -0.46, P < .01$	$r = -0.45, P < .01$
Pediatric (8–17 years) (n = 67)		
ESS	$r = 0.37, P < .01$	$r = 0.55, P < .01$
Perceived cognitive function	$r = -0.52, P < .01$	$r = -0.55, P < .01$
PROMIS depression	$r = 0.31, P = .01$	$r = 0.48, P < .01$
PROMIS anxiety	$r = -0.34, P < .01$	$r = -0.31, P = .02$
PROMIS fatigue	$r = 0.38, P < .01$	$r = 0.51, P < .01$
PROMIS peer relationships	$r = -0.44, P < .01$	$r = -0.54, P < .01$

Abbreviations: ESS, modified Epworth Sleepiness Scale; PROMIS, Patient-Reported Outcome Measurement Information System.

PROMIS sleep disturbance questionnaires we administered are not specific to the pediatric population, these questions may not adequately assess unique consequences to children, such as hyperactivity from sleep deprivation. Although we tried to minimize questionnaire burden, it can be challenging for patients to fill out multiple questionnaires. Future work is needed in piloting objective measures in a larger cohort in conjunction with pediatric-specific PROMIS questionnaires.

In conclusion, 1 question assessment of sleep disturbance is inadequate in screening for sleep disturbance or sleep-related impairment. In the pediatric age group specifically, sleep disturbance can manifest in other forms, such as in peer relationships and daytime functioning, which are not currently assessed in ARIA. In addition, ESS might perform better than ARIA in categorizing sleep disturbance in AR itself. PROMIS is the only tool that can assess sleep disturbance and capture other quality-of-life measures. Although child-specific PROMIS sleep assessments are not currently available, questions about AR-induced sleep problems in children younger than 12 years with moderate to severe AR should

focus on sleep-related impairment, depression, and fatigue. Objective assessment of sleep disturbance will also help determine the ability of these questionnaires to assess sleep itself. However, patient perception of their daytime function is a key treatment goal in AR, which is why this study focused on self-reporting measures. Larger studies in a broader population will allow for generalizability of sleep assessment tools, such as PROMIS, in children and adults with AR for clinical and research visits.

Supplementary Data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.anai.2016.12.022>.

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Allergic Rhinitis (ARIA)

Sleep Related Impairment

Please respond to each item by marking one box per row.

In the past 7 days...

	Not at all	A little bit	Somewhat	Quite a bit	Very much
1. I had a hard time getting things done because I was sleepy	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2. I felt alert when I woke up	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3. I felt tired	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
4. I had problems during the day because of poor sleep	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5. I had a hard time concentrating because of poor sleep	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
6. I felt irritable because of poor sleep.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
7. I was sleepy during the daytime...	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
8. I had trouble staying awake during the day.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Sleep Related Disturbance

Please respond to each item by marking one box per row.

In the past 7 days...

	Not at all	A little bit	Somewhat	Quite a bit	Very much
1. My sleep was restless.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2. I was satisfied with his/her sleep.....	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
3. My sleep was refreshing.....	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
4. I had difficulty falling asleep.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

In the past 7 days...

	Never	Rarely	Sometimes	Often	Always
1. I had trouble staying asleep.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2. I had trouble sleeping.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3. I got enough sleep.....	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

In the past 7 days...

Very Poor Poor Fair Good Very good

1. My sleep quality was... ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1

Sleep Questions from Adolescent Rhinoconjunctivitis Quality of Life Questionnaire

(AQLQ):

How troubled were you by LACK OF A GOOD NIGHT'S SLEEP during the past week?

- ☐ 6= Extremely troubled ☐ 5= Very troubled ☐ 4= Quite troubled
☐ 3= Moderately troubled ☐ 2= Somewhat troubled ☐ 1= Hardly troubled at all
☐ 0=Not troubled

How troubled were you by feeling TIRED/ WORN OUT during the past week?

- ☐ 6= Extremely troubled ☐ 5= Very troubled ☐ 4= Quite troubled
☐ 3= Moderately troubled ☐ 2= Somewhat troubled ☐ 1= Hardly troubled at all
☐ 0=Not troubled

Sleep Questions from Pediatric Rhinoconjunctivitis Quality of Life Questionnaire (PRQLQ):

21. How often did your allergies make it HARD TO GET TO SLEEP during the past week?

- ☐ 6= All of the time ☐ 5= Most of the time ☐ 4= Quite often
☐ 3= Some of the time ☐ 2= Once in awhile ☐ 1= Hardly any of the time
☐ 0= None of the time

22. How often did your allergies WAKE YOU UP DURING THE NIGHT during the past week?

- ☐ 6= All of the time ☐ 5= Most of the time ☐ 4= Quite often
☐ 3= Some of the time ☐ 2= Once in awhile ☐ 1= Hardly any of the time
☐ 0= None of the time