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Original article

Rating scales for inattention and sleepiness are correlated in adults with symptoms of sleep disordered breathing syndrome, but not in adults with symptoms of attention-deficit/hyperactivity disorder

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Abstract

Background and purpose: To evaluate relationship between sleepiness and inattention/hyperactivity in adult patients presenting with sleepiness or early childhood onset inattention.

Patients and methods: Thirty-eight consecutive adult patients (29 males, nine females, mean age 48.7 ± 15.5 years) presenting with snoring and sleepiness; and 18 consecutive adult patients (15 males, three females, mean age 31.9 ± 12.2 years) presenting with early childhood onset inattention were administered the Epworth sleepiness scale (ESS) and the attention-deficit/hyperactivity disorder rating scale (ADHDRS with AD score measuring inattention and HD score measuring hyperactivity-impulsivity). All sleepy snorers underwent polysomnography (PSG) and multiple sleep latency test (MSLT) the following day.

Results: For the sleepy snorers, significant correlations included AD score with ESS ($r = 0.49$, $P = 0.002$), and HD score with lowest saturation ($r = -0.36$, $P = 0.025$). MSLT or respiratory event index (REI) were not significantly correlated with AD or HD scores or ESS. For the inattentive patients, there were no significant correlations between ESS, AD or HD score.

Conclusions: Scores on rating scales for sleepiness (ESS) and inattention (AD score on the ADHDRS) are not significantly correlated in adults with early childhood onset inattention, but they are significantly correlated in sleepy snorers. Thus, in patients presenting primarily with early childhood onset inattention, sleepiness is not associated with and does not explain the inattention, even though increasing sleepiness and inattention may be associated symptoms in sleepy snorers.

Keywords: Attention-deficit/hyperactivity disorder; Attention-deficit; Sleepiness; Epworth sleepiness scale; Sleep apnea; snoring/sleep disordered breathing

1. Introduction

An association between snoring/sleep disordered breathing (SDB) and hyperactivity, impaired school performance, or attention-deficit/hyperactivity disorder (ADHD) has been reported [1–4], leading to some speculation that SDB may be found in a significant proportion of patients with ADHD and may be a significant cause of ADHD. However, among children referred for sleep disordered breathing (SDB), children with or without SDB on polysomnography (PSG) had similar levels of hyperactivity [5]. Although children with mild symptoms of ADHD showed high prevalence of snoring, children with significant ADHD symptoms showed no increase in SDB, and no sleep variable accounted for a significant proportion of the neurobehavioral dysfunction [6].

In our own clinical experience in treating adults and children with SDB, as well as those with ADHD, we find them to be independent disorders with different natural histories and treatments. Neither disorder protects from the other disorder, so a subset of patients may have both disorders.

There is not much work on adult ADHD and SDB. Adams et al. [7] reported that sleepiness (but not the respiratory disturbance index, arousal index, or sleep associated hypoxemia) predicted vigilance in patients with SDB. If SDB (and the sleepiness it induces) is the cause of ADHD symptoms in a substantial proportion (rather than a small subset) of ADHD patients, then there should be correlation between sleepiness and inattention both in patients presenting with symptoms of SDB and in patients

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presenting with symptoms of ADHD. We hypothesized that such a correlation would not be present in patients presenting with symptoms of ADHD, although it would be present in patients presenting with symptoms of SDB, because sleepiness impairs vigilance. If our hypothesis is correct, it would suggest that the lack of attention in ADHD patients is not caused by sleepiness.

2. Materials and methods

Medical records of 56 adult patients presenting to an office clinical neurophysiology practice specializing in sleep disorders and ADHD were examined retrospectively. All patients evaluated in the office are either physician-referred, or undergo a telephone pre-screening to ensure they are symptomatic before they are brought in to be seen. The 56 patients included 38 consecutive adult patients presenting with snoring and sleepiness and 18 consecutive adult patients presenting with early childhood onset inattention. All patients were routinely administered the 8-items Epworth sleepiness scale (ESS) [8] and the 18-items attention-deficit/hyperactivity disorder rating (ADHDRS) [9,10] (created by rating each of the 18 DSM-IV [11] ADHD symptoms on a scale of 0–3, for a maximum possible score of 54). The maximum possible score was 27 for the inattention sub-group of 9-items (AD score) and 27 for the hyperactivity-impulsivity sub-group of 9-items (HD score).

The sleepy snorers included 29 males and nine females ranging in age from 19 to 84 (mean 48.7 ± 15.5). All 38 patients underwent PSG followed by the multiple sleep latency test (MSLT) the following day. The PSG included monitoring of EEG, EOG, submental EMG, ECG, airflow, respiratory effort, oximetry and leg movements. The MSLT consisted of monitoring of EEG, EOG and submental EMG during four nap opportunities 2 h apart in which the patient was asked to lie down in a dark room and try to fall asleep. Sleep onset was defined as the first epoch of any stage of sleep, and the nap opportunity was terminated 15 min after sleep onset or at 20 min if there was no sleep onset.

The adults presenting with early childhood onset inattention included 15 males and three females ranging in age from 18 to 56 (mean 31.9 ± 12.2).

Descriptive statistics were calculated using SPSS for Windows. Sleepy snorers and inattentive patients were compared using the Student's *t*-test for independent samples. Pearson's correlations were calculated, separately for sleepy snorers and inattentive adults, between ESS, AD score, HD score, age, and where available respiratory event index (REI), lowest percent saturation and MSLT.

3. Results

Table 1 shows the means and SDs of the age, ESS score, A Score, H Score, and where applicable the REI, lowest percent desaturation and MSLT for the sleepy snorers and the inattentive adults.

Table 1
Means and SDs

	Sleep disordered adults		Attention-deficit adults	
	Mean	SD	Mean	SD
Age (years)[a]	48.7	15.5	31.9	12.2
ESS[a]	12.9	5.1	8.3	5.6
AD score[a]	9.6	6.3	19.1	3.5
HD score[a]	5.5	5.0	10.3	6.4
REI (h)	27.0	23.5		
Lowest sat (%)	83.2	11.0		
MSLT (min)	5.9	3.9		

[a] Sleep disordered adults different from attention-deficit adults, $P < 0.01$.

Compared to the inattentive adults, the sleepy snorers were significantly older ($P < 0.001$), had higher ESS ($P = 0.003$), and lower AD ($P < 0.001$) and HD ($P = 0.003$) scores.

Of the 38 adults with symptoms of sleepiness and snoring, 34 had SDB (REI > 5/h sleep). AD score was significantly correlated with ESS ($r = 0.49$, $P = 0.002$). HD score and lowest saturation were also significantly correlated ($r = -0.36$, $P = 0.025$). Lowest saturation was also significantly correlated with REI ($r = -0.594$, $P < 0.001$) and with MSLT ($r = 0.35$, $P = 0.029$). There were no other significant correlations, including between AD and HD scores, and between MSLT and ESS, AD or HD scores.

All 18 adults with early childhood onset inattention met DSM-IV diagnostic criteria for ADHD or for ADHD in partial remission. There were no significant correlations, including between ESS and either AD score or HD score.

4. Discussion

It has been reported that pre-pubertal children with ADHD have shorter MSLT than control children with learning disorders without ADHD (16.7 vs. 18.9 min) [12], with the clinical data suggesting that the ADHD children who fell asleep more often had predominantly inattentive type of ADHD. However, both groups of patients had high mean sleep latencies. PSG was also performed, but without cardiorespiratory monitoring or monitoring of limb movements.

We found that scores on rating scales for sleepiness (ESS) and inattention (AD score on the ADHDRS) were not significantly correlated in patients with ADHD, even though they were correlated in sleepy snorers. This suggests that, in patients with ADHD, sleepiness does not correlate with, much less explain, the inattention. Thus, it would seem to be unlikely that SDB or other sleep disorders causing sleepiness are the cause of the inattention in a substantial

portion of patients presenting with AD. However, in SDB patients, increasing sleepiness may be accompanied by increasing impairment of attention.

Our findings are consistent with Chervin and Archbold's reported lack of association between hyperactivity and rate of hypopneas and apneas [5], although, unlike them, we did find a correlation between lowest oxygen saturation and hyperactivity. This may suggest that significant desaturation in SDB patients might make them restless, hyperactive and impulsive, but not inattentive, during the day. The inattention in sleepy snorers may be related to sleepiness, as suggested by Adams et al.'s findings that sleepiness, not indices of SDB, predict impairment in vigilance [7]. On the other hand, correlation does not necessarily mean causation, and both sleepiness and inattention may be consequences of the brain dysfunction in the SDB patients.

Interestingly, increased risk of auto accidents has been reported both in SDB [13] and in ADHD [14–18] patients. Inattention (as in cell phone use) [19] also increases risk of accidents. The lack of significant sleepiness in ADHD patients and the lack of a correlation between sleepiness and inattention in these patients suggest that the increased motor vehicle accident risk in ADHD patients is not caused by sleepiness, but rather by the inattention itself. It has generally been considered that the sleepiness is the cause of the increased accident risk in SDB. However, if inattention, by itself, even in the absence of sleepiness, can increase risk of accidents, then the inattention may contribute to the risk of accidents in SDB, also.

Limitations of this study include the lack of PSGs or MSLTs for ADHD patients, the absence of a control group of sleepy patients without SDB (such as narcolepsy or idiopathic hypersomnia), as well as small group sizes.

The clinical implication seems to be that, although sleep disorders can produce inattention, sleep disorders are not the cause of the inattention in most ADHD patients. Further research using PSG (including cardio-respiratory monitoring and monitoring of limb movements) in patients with ADHD without clinical symptoms of SDB or other primary sleep disorders (seemingly the vast majority of ADHD patients) would be useful.

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