

## SHORT REPORT

## The prevalence of asthma in patients with obstructive sleep apnoea

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**Abstract****Background:** Most of the studies that have explored the relationship between obstructive sleep apnoea (OSA) and asthma have focused on the prevalence of snoring and OSA symptoms in patients with asthma.**Objectives:** This study was conducted to measure the reverse relationship – the prevalence of asthma in patients with diagnosed OSA.**Methods:** We assessed the prevalence of asthma in all patients diagnosed polysomnographically to have OSA during the study period. A logistic regression model was developed to assess the predictors for asthma in patients with OSA.**Results:** Six-hundred-and-six patients with OSA with a mean age of 40±14.5 yr (66.7% males) were included. Asthma was present in 213 OSA patients – a prevalence of 35.1%. Body mass index (>35 kg/m<sup>2</sup>) was the only predictor of asthma.**Conclusions:** Physicians should keep in mind the link between OSA and asthma. When one of these disorders is diagnosed, clinicians should consider the possible presence of the other.

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**Keywords** asthma, diagnosis, obstructive sleep apnoea, prevalence**Introduction**

Asthma is a lung disease characterised by airway inflammation resulting in reversible airway obstruction.<sup>1</sup> Obstructive sleep apnoea (OSA) is a common sleep-related breathing disorder characterised by temporary cessation of airflow during sleep for 10 seconds or more despite continuing ventilatory effort.<sup>2</sup> About 4% and 2% of middle-aged men and women, respectively, suffer from symptomatic OSA. These percentages are higher (24% for men and 9% for women) when an apnoea/hypopnea index (AHI) of 5 or more is present regardless of co-existent daytime somnolence.<sup>2</sup> A greater proportion of asthma patients tend to die at night than in the general population.<sup>3</sup> In addition, Gami *et al.* found that sudden death of OSA patients occurs more commonly between midnight and 06.00 and correlates with a worsening AHI.<sup>4</sup>

OSA and asthma are common, share similar nocturnal

symptoms, and involve airway obstruction (albeit at different levels in each condition<sup>5</sup>) as the cornerstone of their pathophysiology. Most of the studies that have explored the relationship between OSA and asthma have focused on the prevalence of snoring and OSA symptoms in patients with asthma.<sup>6-9</sup> Both obesity and OSA act to aggravate existing asthma making it more difficult to control symptoms.<sup>10</sup> However, to our knowledge, no study has directly addressed the reverse relationship – i.e. the prevalence of asthma in patients with a confirmed diagnosis of OSA. Therefore, we conducted this study to measure the prevalence of asthma in patients diagnosed to have OSA in the sleep disorders center (SDC) and to define the characteristics of patients with OSA who do have asthma.

**Methods**

All patients who were referred to the SDC in our institute

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from the outpatient clinics between March 2003 and October 2007 and who were diagnosed to have OSA – based on a type I attended overnight sleep study (polysomnography) and according to the International Criteria of Sleep Disorders (ICSD)<sup>11</sup> – were included. The definition of asthma was based on a respiratory questionnaire.<sup>12-14</sup> The three questions selected from this questionnaire were as follows: (1) Have you ever had asthma? (2) Do you still have it? (3) Was it confirmed by a doctor? Definite asthma was defined as positive responses to these three questions.<sup>6</sup> Sleep studies of patients who had audible wheezing on auscultation or who reported uncontrolled symptoms were postponed until symptoms were controlled. Patients who were labelled by their treating doctors to have COPD were excluded.

The following demographic and polysomnographic parameters were identified: age; gender; current history of smoking; body mass index (BMI); AHI (the number of apnoea/hypopnoea episodes per hour of sleep); arousal index (i.e., arousals/hour); desaturation index (the number of desaturation events per hour of sleep); and the lowest O<sub>2</sub> saturation during sleep. Daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS)<sup>15</sup> which is a validated, specialised sleep questionnaire containing eight items that assess the likelihood of dozing in a variety of situations.

Data were analysed using SPSS PC version 11.0 statistical software. Descriptive statistics (mean, standard deviation and proportions) were used to describe the study variables. Student's t-test for two independent samples was used to compare the mean values of continuous study variables. A logistic regression model was used to identify the independent predictors of asthma in OSA patients. Crude and adjusted odds ratios with its 95% confidence intervals were calculated. A p-value of  $\leq 0.05$  was considered as statistically significant.

The study was approved by the ethics committee in our institute and informed consent was obtained from all patients.

## Results

Six-hundred-and-six patients with OSA with a mean age of  $40 \pm 14.5$  yr (66.7% males) were included. Asthma was present in 213, a prevalence rate of 35.1%. Forty-seven percent of OSA patients with asthma were females and 53% were males.

Table 1 presents a comparison between OSA patients with and without asthma. BMI, AHI and lowest oxygen saturation were significantly higher in OSA patients with asthma compared to those without asthma. There was no difference in smoking history between OSA patients with and without asthma; 10.5% vs. 15.6% ( $p=0.1$ ). Additionally, no significant differences were found in the mean values of arousal index and ESS score. Body mass index ( $>35$  kg/m<sup>2</sup>) was the only predictor of asthma in the multivariate logistic regression model (crude odds ratio 2.05; 95% confidence interval (CI)

**Table 1. Demographic and polysomnographic features of OSA patients with and without asthma.**

	OSA patients with asthma	OSA patients without asthma	p-value
Age	46.9 $\pm$ 14.2	45.7 $\pm$ 15.3	0.3
BMI	38.3 $\pm$ 9.4	35.4 $\pm$ 9.9	0.001
ESS	9.8 $\pm$ 6.2	9.4 $\pm$ 5.9	0.4
AHI	53.9 $\pm$ 37.8	47.8 $\pm$ 36.8	0.05
Desaturation index	32.4 $\pm$ 29.4	31.4 $\pm$ 30.2	0.7
Lowest O <sub>2</sub> saturation	79.6 $\pm$ 13.4	81.7 $\pm$ 11.6	0.04
Arousal index	55.7 $\pm$ 33.1	52.7 $\pm$ 33.9	0.3

BMI, body mass index; ESS, Epworth Sleepiness Scale; AHI, apnoea hypopnoea index; OSA, obstructive sleep apnoea.

1.4, 2.9: adjusted odds ratio 2.1; 95% CI: 1.7, 2.4). The other variables were not predictors of asthma in OSA patients neither in univariate nor multivariate analyses.

## Discussion

This study demonstrates a high prevalence of asthma (35.1%) in patients with OSA as compared to the prevalence of asthma in the general population.<sup>16</sup> OSA patients with asthma had a higher BMI and AHI compared to OSA patients without asthma. Body mass index  $\geq 35$  kg/m<sup>2</sup> was a significant predictor of asthma in OSA patients. Both OSA and asthma have been linked to obesity – obesity is a well-known risk factor for OSA and the size of the upper airways has been shown to correlate with OSA.<sup>17</sup> On the other hand, there have been numerous reports in the literature suggesting an association between wheezing, asthma, and obesity.<sup>17</sup>

The arousal index in the two groups was not significantly different due to the fact that we only included stable asthmatics on treatment. Despite the fact that physicians have long noticed an association between the symptoms of OSA and asthma,<sup>18</sup> previous studies have only explored the prevalence of OSA symptoms and snoring in asthmatic patients and no study has explored the relationship in reverse – the prevalence of asthma in polysomnographically-diagnosed OSA patients. A number of studies have reported a higher prevalence of snoring among asthmatic patients compared with non-asthmatic patients.<sup>6,7,19</sup> A 20.5% prevalence of habitual snoring ( $\geq 3$  nights per week) was reported in a large population-based cohort of young atopic women.<sup>19</sup> Yigla and colleagues performed an overnight sleep study for 22 consecutive patients with severe unstable asthma who required intermittent oral corticosteroid therapy and demonstrated OSA in 21 (95.5%) of these patients, despite the observation that this group had a normal mean BMI.<sup>10</sup>

In the present study, OSA was more severe in patients who

have concurrent asthma. Although a cause and effect relationship has not been established, several theories have been proposed for the relationship between OSA and asthma. The recurrent upper airway obstruction might cause reflex bronchoconstriction by stimulating neural receptors in the pharyngeal region or by generating negative intrathoracic pressure.<sup>9,20</sup> Another plausible explanation relates to gastro-oesophageal reflux (GOR); it is known that the large intrapleural pressure swings during apnoeic episodes facilitates GOR,<sup>21</sup> and GOR is a potential trigger of asthma that may occur even without oesophageal symptoms.<sup>22</sup> Recently, studies have shown that OSA is associated with systemic inflammation.<sup>23</sup> Theoretically, OSA may contribute to the development of lower airway obstruction through its effect on airway inflammation. Good support for a cause and effect relationship between OSA and asthma comes from studies that showed improvement in asthma after treating OSA. Chan *et al.* demonstrated in nine patients with asthma and concurrent OSA that the initiation of continuous positive airway pressure (CPAP) therapy resulted in marked improvement in their asthma, with decreased symptoms, improved peak expiratory flow rate, reduced need for bronchodilator therapy, and resolution of their pattern of nocturnal worsening.<sup>24</sup> A recent prospective study of 20 patients with severe OSA and concurrent asthma demonstrated that CPAP therapy results in significant improvement in asthma quality of life.<sup>25</sup>

A limitation of this study is the fact that we relied on the referring physicians' diagnosis and patients' response to a standardised questionnaire to define asthma, and did not perform spirometry to assess the bronchodilator response in the SDC. Nevertheless, most of the studied asthmatics were controlled on inhaled steroids at the time of referral to the SDC, which makes the assessment of bronchodilator response less beneficial.

The present study demonstrates that asthma is prevalent in patients with OSA. Physicians in general and primary care physicians in particular should keep in mind the link between the two disorders. When one of these disorders is diagnosed, clinicians should consider the possible presence of the other.

### Conflict of interest declaration

The authors declare that they have no conflicts of interest in relation to this article.

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