Correlation between subjective classification of snoring and the apnea-hypopnea index

Marcos Marques Rodrigues¹, Ralph Silveira Dibbern¹, Carla Willemann Kruel Goulart¹

ABSTRACT

Objective: Obstructive sleep apnea syndrome (OSAS) has gained increased attention in recent years, mainly due to the increased number of diagnosed cases and OSAS’s relationship with other diseases. About 90% of the patients with OSAS snore. The objective of this paper was to investigate the relationship between the Stanford classification and the apnea-hypopnea index in patients with OSAS.

Methods: Two hundred and six patients were included in a longitudinal cohort study. The patients were evaluated and classified according to the Mallampati score, Stanford classification and the severity of their OSAS, as measured by the apnea-hypopnea index (AHI) using polysomnography.

Results: A total of 18 patients who underwent polysomnography in the sleep laboratory were included in the final study. In a cross-tabulation of the Stanford classification for snoring and the AHI, the relative risk (RR) was 3.06 (95% CI: 1.47 - 6.33). Therefore, we can infer that a patient with loud and intense snoring has a greater chance of developing moderate to severe OSAS.

Conclusions: We concluded that there is a positive correlation between the intensity of snoring and OSAS severity.

Keywords: Snoring/classification; Sleep apnea syndromes/complications; Polysomnography/methods

INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) has been increasingly recognized and diagnosed in recent years. Accurate diagnosis and appropriate treatment are the key to managing a disease that has socioeconomic repercussions and complications, including increased incidence of cardiovascular diseases. The Western population is becoming increasingly overweight, and excess weight is associated with greater risk for developing OSAS and snoring¹,².

A large epidemiological study in the United States, involving 5,201 adult patients, showed that 19% of women and 33% of men older than 65 years old snore³. Within the general population, about 18% of men and 7% of women have snoring problems³,⁴. Risk factors for OSAS and snoring include age between 40 and 65 years; male gender; obesity; smoking; alcoholism and sedentary lifestyle⁵. The main physical examination findings associated with OSAS include increased neck circumference, oropharyngeal obstruction, flaccid palate, nasal obstruction, turbinate hypertrophy, septal deformity, nasal cavity tumors, enlarged tonsils, macroglossia and retrognathia⁶. Anatomic findings such as vibration factors and collapsed upper airway have been described in studies that used cephalometry, computed tomography, magnetic resonance imaging and nasal fibroscopy⁷.

Most patients who consult a specialist complain primarily of snoring that bothers their partners. Snoring is present...
in 90 to 95% of patients who have OSAS and upper airway resistance syndrome (UARS)\(^8\).

Burschtin et al. reported a positive correlation between snoring intensity and OSAS severity, in which snoring intensity was assessed with a scale that grades snoring severity from 0 to 9. Patients with scores higher than 7 points are considered at high risk for OSAS\(^9\).

Guilleminault et al. studied snoring in 1,139 individuals by measuring sound levels with a decibel monitor. They observed a positive correlation between the intensity, in decibels, of snoring, daytime sleepiness and apneaa-hyponoee index (AHI). They found that men snored louder than women, and men with body mass indexes (BMI) above 30 and snoring louder than 38 dB had a relative risk of 4.1 of developing AHI scores above 10\(^7\).

Several studies have associated snoring with OSAS, but few studies have evaluated the relationship between a subjective classification of snoring (the Stanford classification) and OSAS severity. Therefore, the objective of this study was to verify the relationship between the Stanford classification and apnea-hypopnea in patients with OSAS.

**METHODS**

This research project was approved by the Research Ethics Committee, under the Protocol Number 114/08. It was entered in the Clinical Trials registry under ID NCT00883376. The enrolled patients signed a consent form. A total of 206 patients were retrospectively evaluated. Patients were treated at the OSAS clinic of the Santa Casa de Limeira Hospital between August 2006 and October 2009. Patients whose primary complaint was habitual snoring were included in this study. Patients presenting Class III obesity (BMI \(\geq 40\)), craniofacial alterations, sedative or stimulant drug use, nasal obstruction caused by nasal polyps and/or nasal tumors were excluded from this study to avoid bias. All patients underwent an assessment protocol that included medical history, Epworth Sleepiness Scale, Scale of Subjective Snoring (Stanford)\(^8\), the Friedman classification and a complete ENT examination. Of the 206 patients initially included in the protocol, 168 patients were included in the study.

The Epworth Sleepiness Scale is widely used to assess daytime sleepiness. It consists of eight questions about the level of sleepiness the patient experiences in certain daily activities. Total score can range from 0 to 24 points; a score higher than 10 points indicates excessive daytime sleepiness\(^10\). The Friedman classification is used to evaluate oropharyngeal obstruction by evaluating tonsil size, the modified Mallampati classification and BMI. The Friedman classification uses grades ranging I to IV\(^11\).

The patients underwent nasal fibroscopic exam using a Machida fibroscope with a 2.8-mm channel. The level of upper airway obstruction was classified according to the Fujita classification\(^12\). All 168 patients underwent nocturnal polysomnography in the sleep lab, in accordance with the American Academy of Sleep Medicine guidelines\(^13\). The following channels were fully monitored: eye movements, leg movements, airflow by nasal cannula and thermistor, chest movement, electroencephalogram, electrocardiogram, heart rate and oxygen saturation. Patients’ disease severity was classified according to the criteria established by the American Academy of Sleep Task Force\(^13\).

The subjective snoring classification developed in Stanford\(^8\) assigns patients a grade from 0 to 10, based on the extent to which snoring affects their family relationships, especially with their spouses (Figure 1). Patients responded to this questionnaire in the presence of a spouse or family member.

<table>
<thead>
<tr>
<th>Grade</th>
<th>0</th>
<th>1 to 3</th>
<th>4 to 6</th>
<th>7 to 9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Classification</strong></td>
<td>No snoring</td>
<td>Mild</td>
<td>High</td>
<td>Very high</td>
<td>Intense</td>
</tr>
<tr>
<td>0</td>
<td>=no snoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3</td>
<td>=mild (does not disturb the partner during sleep)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-6</td>
<td>=high snoring (enough to disturb the partner)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-9</td>
<td>=very intense (disturbs people in other rooms)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>=the partner leaves the room</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Figure 1:** Scale of subjective snoring (Stanford).

OSAS severity is classified by the American Academy of Sleep as follows: fewer than 5 AHI events/hour: no OSAS or primary snoring; between 5 and 15 AHI events/hour: mild OSAS; between 15 and 30 AHI events/hour: Moderate OSAS; more than 30 AHI events/hour: severe OSAS. In this study, we divided the subjects into four groups. Group I consisted of 85 patients with AHI scores below 15; i.e., patients with primary non-apneic snoring or mild apnea. Group II consisted of 83 patients with AHI scores above 15; i.e., patients with moderate to severe OSAS (Chart 1). The relative percentage of samples from both groups is shown in Figure 1. Group III consisted of 40 patients with mild to high snoring and Stanford scores below 7. Group IV consisted of 128 patients with loud, intense snoring that their spouses could not tolerate and Stanford scores greater than or equal to 7. Data are shown in Chart 2.
Table 2 is based on the model for dichotomous variables. It contains cross-tabulations of the OSAS severity based on

**Table 1: OSAS protocol data**

<table>
<thead>
<tr>
<th></th>
<th>Stanford</th>
<th>BMI</th>
<th>Epworth</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>8.1</td>
<td>29.42</td>
<td>11.25</td>
<td>47.95</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>2.10</td>
<td>5.55</td>
<td>5.14</td>
<td>11.25</td>
</tr>
<tr>
<td>Minimum</td>
<td>2</td>
<td>16.44</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Maximum</td>
<td>10</td>
<td>51.02</td>
<td>24</td>
<td>77</td>
</tr>
</tbody>
</table>

*Stanford subjective snoring value; Body Mass Index; Epworth Sleepiness Scale score

**Table 2: Cross-tabulation of AHI and Stanford classification**

<table>
<thead>
<tr>
<th>Group I</th>
<th>Group II</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI&lt;15</td>
<td>AHI&gt;15</td>
<td></td>
</tr>
<tr>
<td>Group III: Stanford&lt;7</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>Group IV: Stanford≥7</td>
<td>57</td>
<td>72</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>83</td>
</tr>
</tbody>
</table>

AHI (Groups I and II) and snoring intensity based on the Stanford classification (Groups III and IV).

The calculation of relative risk (RR) was based on data from Table 2. The RR was 3.06, with 95% confidence interval (95%CI) between 1.47 and 6.33. The calculations were performed and checked using SPSS 16.0 from the company SPSS Inc.

**DISCUSSION**

Snoring is a significant factor in OSAS; 90 to 95% of patients with OSAS snore. There are few reports of patients with OSAS who do not snore. The primary cause of snoring is flaccidity of the oropharyngeal tissues, which causes vibration and partial blockage of the upper airway during sleep. OSAS occurs primarily when the upper airway collapses.

Snoring was the main complaint of the patients analyzed in the ENT clinic, which is similar to what has been reported in the literature. Therefore, we must always be alert to complaints of snoring, which often indicate OSAS and/or increased upper airway resistance (UARS). The clinical examination of a patient with snoring should include polysomnography, a method suitable for diagnosing sleep breathing disorders.

Several studies have examined the correlation between snoring and OSAS. An important study by Chervin et al. showed a significant positive correlation between the intensity of snoring, in decibels, and the presence of OSAS. However, this study only related snoring intensity to the presence or absence of OSAS, and not to the severity of OSAS. In clinical practice, it is difficult to obtain a measurement of snoring in decibels because the polygraphs on the market do not offer such measure. A system with multichannel capability would be necessary to capture audio, and it should be able to filter out environmental noises and exclude them from the polysomnogram results.
Mair et al. discuss the feasibility of an acoustic assessment of snoring and its potential use to assess snoring and its source in the upper airways. The authors concluded that acoustic evaluation is useful for assessing and guiding the management of patients with palatal snoring, but they admit that standardization is necessary.

We evaluated the correlation between the severity of snoring based on Stanford classification and the severity of OSAS, as determined by the AHI. This evaluation provides a practical in-office assessment of a patient’s risk of developing a severe sleep breathing disorder. To develop the model, we used a longitudinal, historical cohort study to evaluate the possible influence and correlation of snoring intensity and OSAS severity. Applying the model of dichotomous variables, we found a relative risk of 3.06 (95%CI: 1.47 - 6.33). Therefore, the correlation is positive and statistically significant.

Burschtin et al. found a positive correlation between snoring intensity and OSAS severity. The authors of that study assessed snoring subjectively with the Severity of Snoring Scale. As a measure of snoring severity, this questionnaire can provide a fast and easy indication of the severity of OSAS. Subjective and standardized scales for evaluating snoring are useful in countries like Brazil, where acoustic means of analyzing snoring are not readily available or standardized.

Thus, snoring intensity is associated with sleep apnea, as the literature has shown. Most studies have associated snoring with the presence of sleep apnea and daytime sleepiness. When interviewing a snorer, physicians must seek details and try to quantify, even subjectively, the intensity of snoring.

As previously demonstrated, OSAS is a progressive and multifactored disease. Anatomical, neuromuscular, connective tissue and genetic factors influence its evolution. Therefore, physicians should be careful when treating patients with high Stanford scores; because of their high risk of sleep apnea, these patients should be referred for nighttime multichannel polysomnography.

A patient with a sleep breathing disorder and/or snoring should undergo a thorough, standard evaluation, including assessments of the upper airways (nasal endoscopy, Friedman classification), daytime sleepiness (Epworth Sleepiness Scale), BMI, age and medical history, as well as an ENT examination and a complete Type I polysomnography.

We concluded that snoring is linked to OSAS and seems to be associated with AHI scores. In situations in which there is no established and standardized means of assessing snoring acoustically, the subjective snoring questionnaires provide a useful means of assessing patients with sleep breathing disorders. We must vigilantly evaluate all patients with primary snoring because OSAS is a progressive disease, and increased frequency or intensity of snoring can indicate worsening OSAS.

REFERENCES