Epidemiologic Profile of Obstructive Sleep Apnea Patients attending a Dental Sleep Medicine Clinic in a University Setting

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Abstract

Introduction: Obstructive sleep apnea (OSA) is a common sleep breathing disorder characterized by recurrent episodes of hypopnea (reduced airflow) and apnea (breathing cessation for at least 10 seconds). OSA is a growing health concern and Canadian data reports approximately 3% of Canadian adults to be affected.

Objectives: The overarching goal of this retrospective study is to contribute to national and international epidemiologic research data on OSA.

Materials and Methods: A retrospective chart review was performed of all patients who were referred to the dental sleep medicine (DSM) clinic at the College of Dentistry, University of Manitoba, for the period of June 2014 to May 2016. A questionnaire was devised to obtain and filter information from both electronic and paper patient chart sources. All patient information used in this study was obtained in compliance with the Freedom of Information and Protection of Privacy Act (FIPPA) regulations.

Results: A total of 201 patients were referred to DSM Clinic; the majority of the referred patients were males (61%) and the age of patients ranged from 18 to 80 years old with an average age of 49 years. Close to one third of referred patients had a diagnosis of mild OSA, followed by near even frequencies for moderate OSA and severe OSA. The epidemiological profile of patients seen in this study correlates with Canadian national statistics as reported by the Public Health Agency of Canada (2009).
Introduction

Obstructive sleep apnea (OSA) is a common sleep breathing disorder characterized by recurrent episodes of hypopnea (reduced airflow) and apnea (breathing cessation for at least 10 seconds) despite respiratory efforts.\(^1\) It is a growing health concern and is reported to affect 9% of middle-aged males and 3% of women in North America. Canadian data reports approximately 3% of Canadian adults to be affected by OSA. There has been an upsurge in OSA interest based on the increase in published OSA literature in the last decade. Speculation of reasons for this interest is the fact that sleep disorders are associated with motor vehicle accidents and human errors.\(^2-6\)

The medical diagnosis of obstructive sleep apnea is associated with several comorbidities with increased risk for respiratory, cardiovascular, neurocognitive, psychiatric and gastrointestinal disorders.\(^7-10\) Its' negative impact on endocrine function\(^11\) and neurocognitive function\(^12\) has been reported on. In addition, over 1 in 4 Canadian adults report on symptoms and risk factors associated with a high risk of having or developing obstructive sleep apnea.\(^13\) Of these risk factors, increased age and obesity are of great significance. As our population is aging and rates of obesity are on the rise, we expect that we will see an increase in the number of diagnosed apneas.\(^9\) Patients with OSA also show to have increased health care expenditures even before their OSA diagnosis is made.\(^6\)

Obstructive sleep apnea is a medical diagnosis made by a sleep medicine physician, and is based on extensive sleep-oriented data collected from the patient. Data collection includes a sleep-oriented questionnaire; sleep oriented history, physical examination and objective testing (in-laboratory polysomnography and/or home testing with a portable monitor).\(^14\) Based on the diagnostic data analysis, a medical diagnosis is made and treatment strategies devised. The apnea hypopnea index (AHI) is used as a measure to determine the severity of OSA. It represents the number of apnea and hypopnea events per hour of sleep. The American Academy of Sleep Medicine (AASM) define OSA severity as mild for AHI scores between $\geq 5$ and $< 15$, moderate for AHI scores of between $\geq 15$ and $< 30$ and severe for AHI scores greater than 30.

Treatment options for obstructive sleep apnea include surgery, continuous positive airway pressure (cPAP), oral appliances (including mandibular advancement devices, or MADs) and behavioral therapy. Continuous positive airway pressure (cPAP) therapy is the gold standard for treating obstructive sleep apnea. A near linear correlation between cPAP compliance and a reduction in the utilization of health care services were found in a group of newly diagnosed patients with moderate to severe OSA.\(^7\) MADs are recommended as an alternative to cPAP, and
regarded as a first line treatment option for snoring, mild to moderate OSA and (3) in more severe OSA cases where CPAP treatment has failed.\textsuperscript{14, 15}

A position paper by Canadian dental sleep medicine professionals provides guidelines for interdisciplinary teamwork and clarifies the role of dentists in the management of OSA.\textsuperscript{15} Gauthier and colleagues emphasize the importance of dentists being able to recognize the signs and symptoms of sleep breathing disorders such that patients can be adequately referred for diagnosis and treatment.

The University of Manitoba (UM) recognized this very concern in the province of Manitoba and in 2012, the College of Dentistry opened its doors as a dental sleep medicine (DSM) treatment facility for OSA. In collaboration with the Misericordia Sleep Disorder Center, the UM Dental Sleep Medicine Clinic provides a much needed centrally regulated service in Manitoba and contributes to the educational curriculum of dental students.

The overarching goal of this retrospective study is to contribute epidemiologic data on OSA to the national and international research data. By reporting and publishing this data in dental literature, we intend to create an increased awareness of OSA for dental students and dental practitioners.

**Aim**

The aim of this study is to evaluate the epidemiologic profile of patients attending a dental sleep medicine clinic in a university setting.

**Objectives**

To report on:
1. The gender and age profile of patients referred.
2. Type of sleep disordered breathing disorders treated in the DSM clinic.
3. Most common signs and symptoms patients presented with.
4. Presence of OSA associated comorbidities.
5. The number of patients who received an oral appliance.
Materials and Methods

A retrospective chart review was performed for all patients who were presented to the DSM clinic at the College of Dentistry, University of Manitoba, for the period of June 2014 to May 2016. Ethics approval for this retrospective study was obtained from the University of Manitoba Health Research Ethics Board (HREB).

A questionnaire was devised to obtain and filter information from both electronic and paper patient chart resources. The data collected included patient demographics, OSA medical diagnosis and dental clinical diagnostics data. In addition, polysomnography information, OSA symptoms, and the presence of comorbidities were recorded. This questionnaire also recorded previous medical or dental OSA treatment modalities and their reported success. The agreement for dental treatment with oral appliance therapy (OAT) was noted as well.

Information resources for this patient cohort were obtained from firstly, original patient referral forms with their OSA diagnosis and accompanied medical questionnaires from the Sleep Disorder Center at the Misericordia Health Center. Secondly, patient paper charts were used and dental electronic charts were accessed through AxiUm, an electronic chart database. All patient information used in this study was obtained in compliance with the Freedom of Information and Protection of Privacy Act (FIPPA) regulations, omitting all patient identifiable markers.

Statistical Analysis

Categorical data was reported as frequencies and proportions, and continuous variables were reported as means with standard deviations (SDs).

Results

A total of 201 patients were referred to the Dental Sleep Medicine Clinic at the UM College of Dentistry between June 2014 and May 2016. The majority of the referred patients were males (n=123, 61%) and the age of patients ranged from 18 to 80 years old with an average age of 49 (SD = ±11.7).

More than half of the referred patients (n=109, 53%) had a level 3 polysomnography test, meaning a sleep study that was done in the convenience of their homes. Eighty-seven patients (n=87, 43%) had a level 1 sleep study performed, which is a supervised overnight in-hospital study monitored by sleep technicians. For five patients, no information on the level of sleep study performed was available.
The OSA diagnoses that patients presented with are listed in Table 1. Approximately one third of referred patients had a diagnosis of mild OSA (n=66, 32.8%). Thirty-nine patients (19.4%) presented with moderate OSA and forty patients (19.9%) presented with severe OSA. Twenty-eight patients (13.9%) had a diagnosis of Upper Airway Resistance Syndrome (UARS). Twenty-six patients (n=26, 12.9%) presented with primary snoring only and one patients was referred with central sleep apnea (0.5%). A total of 6 patients were referred with a bruxism diagnosis and for the fabrication of a maxillary bruxism splint.

Table 1. Sleep Diagnoses

<table>
<thead>
<tr>
<th>Sleep Diagnosis</th>
<th>Frequency (%)</th>
</tr>
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<tbody>
<tr>
<td>Primary Snoring</td>
<td>26 (12.9%)</td>
</tr>
<tr>
<td>Mild OSA</td>
<td>66 (32.8%)</td>
</tr>
<tr>
<td>Moderate OSA</td>
<td>39 (19.4%)</td>
</tr>
<tr>
<td>Severe OSA</td>
<td>40 (19.9%)</td>
</tr>
<tr>
<td>UARS</td>
<td>28 (13.9%)</td>
</tr>
<tr>
<td>Bruxism</td>
<td>6 (3%)</td>
</tr>
<tr>
<td>Central Sleep Apnea</td>
<td>1 (0.5%)</td>
</tr>
</tbody>
</table>

Figure 1 illustrates the frequencies of self-reported symptoms. For self-reported symptoms, 93.5% of patients (n=188) experienced snoring, 70.1% (n=141) presented with signs and symptoms of excessive daytime sleepiness, 42.3% (n=85) experienced awakening with a sense of choking, 52.7% reporting non-refreshing broken sleep (n=106), and 64.2% reported symptoms of cognitive (n=129).
With regards to OSA comorbidities, 32.8% (n=66) of patients suffered from hypertension, 8% (n=16) had diabetes mellitus, and 8.5% (n=17) had cardiovascular disease. More than two thirds of patients (n=148, 73.6%) also reported a medical diagnosis of high cholesterol, depression, anxiety, and/or symptoms of frequent headaches.

Investigation into previous medical and/or dental treatment for their OSA diagnosis showed that the majority of patients (55.7%, n=112) received no previous treatment (Table 2). One quarter of the patient population (24.4%, n=49) had previous positive airway pressure (cPAP) therapy. Of the group who had previous cPAP therapy, 36 (73.5%) of the 49 patients reported unsuccessful cPAP treatment. This patient self-reported failure in cPAP treatment was directly related to the intolerance and discomfort of the cPAP mask or cPAP apparatus itself. Nine of the patient reported a partial tolerance (18.4%), meaning they could tolerate the CPAP but were looking for an alternative. Only 2 of the 49 patients reported success with cPAP treatment and were interested in an oral appliance for travel purposes. Other OSA treatment modalities reported included surgery (14.9%) and previous oral appliances (14.4%). No detail on the specific type of surgeries was recorded.
Table 2: Previous OSA treatment received

<table>
<thead>
<tr>
<th>Previous treatment received</th>
<th>Frequency (n)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No treatment</td>
<td>112</td>
<td>55.7%</td>
</tr>
<tr>
<td>cPAP treatment</td>
<td>49</td>
<td>24.4%</td>
</tr>
<tr>
<td>Surgery</td>
<td>30</td>
<td>14.9%</td>
</tr>
<tr>
<td>Oral appliance therapy</td>
<td>29</td>
<td>14.4%</td>
</tr>
</tbody>
</table>

Based on patient medical history information, BMI data showed that only 13.9% of patients had a healthy weight (BMI 18.5 to 24.9), one patient as underweight (BMI <18.5), 31.3% with a grade I obesity (BMI 25-29.9) and 50.7% of patients were noted with a grade II obesity (BMI >30). The global average BMI was 31.3. Global collar sizes ranged from 27.7cm-52.0cm with an average neck circumference of 39.9cm. The average male neck circumference measured was 41.0cm, where as the average female neck size measured was 36.6cm. Individuals are considered to be at high risk for OSA with neck circumferences greater than 40cm.\(^\text{16}\)

Based on dental clinical records, the Mallampati score was recorded and available for 66 (33%) patients only. Twenty-one of the 66 patients recorded for airway size had a Mallampati score of 4 and 29 had a Mallampati score of 3.

The global average Epworth Sleepiness Score recorded at clinical presentation was 8.8. Data on dental occlusal relationships were available for a small number of patients only (n=22, 10.9%). Thirteen patients had class I molar relationships, 2 had mixed class I and class II, 5 had class II, and 2 had class III. With regards to canine relationships, 10 had class I, 3 had mixed class I and class II, 4 class II, and 3 class III. It should be noted that we were unable to recover comprehensive details on oral findings due to inconsistencies in record keeping.

Only forty-three (n=43, 21%) of the referred patients (n=201) accepted dental sleep medicine treatment and was fitted with a mandibular advancement device. All 43 patients who accepted treatment were fitted with a Myerson Elastic Mandibular Advancement (EMA) device. Thirty patients (15%) postponed treatment for unknown reasons and 97 (48%) patients declined oral appliance therapy. Of the 97 patients that declined treatment, it was noted that 18.6% declined due to cost. Cases where patients requested a postponed treatment, but failed to return within 12 months, were considered to decline treatment. Thirty nine out of the 43 patients (n=39, 90%) fitted with a MAD device tolerated the treatment well and demonstrated improved in symptoms. Four of the 43 oral appliance therapy cases failed (n=4, 2.3%) either due to poor compliance or not tolerating the appliance well.
Discussion

All the patients who attended the University Dental Sleep Medicine Clinic were referred from the local medical Sleep Disorder Center. This collaboration between the university dental sleep medicine clinic and medical sleep disorder clinic provides a much needed dental treatment center for OSA within the province of Manitoba and supports the educational training of undergraduate dental students. Currently, Manitoba dental students are exposed to approximately 12 hours of sleep medicine education in their training, higher that the 2008/2009 North American average of 3.92 hours. The fact that all patients were referred from the local medical Sleep Disorder Clinic, meant every patient presented with a definitive diagnosis for their sleep breathing disorder. A pretreatment definitive OSA diagnosis by a sleep medicine professional is essential and forms an ethical and legal responsibility for the dentist providing treatment.

Both the Canadian Sleep Society and Canadian Thoracic Society recommends a Level I sleep study as the gold standard for evaluation of SDB and that Level 3 studies can be used to confirm OSA in the presence of high pretest probability for OSA. In our study, more patients (n=107) underwent a Level 3 polysomnography test using home monitoring compared to 84 patients who underwent a Level 1 complete laboratory polysomnography testing. The gold standard of Level 1 testing typically records on average 7 sleep parameters and the complete test are closely monitored by sleep technicians. Level 3 sleep studies are reported to show good diagnostic performance, and are suitable alternatives to be used by treating physicians to diagnose uncomplicated OSA. The fact that this level of testing can be done with portable equipment in the convenience of patients’ home may expedite the OSA diagnosis and reduce costs typically associated with level 1 in-laboratory testing.

A Canadian position paper on OSA show prevalence of obstructive sleep apnea in adult men is nearly double than that of adult women. Similar results of 2:1 male:female ratio are reported in previous studies. Our study showed a similar profile where 123 males (61%) and 78 females (39%) formed this patient group. Being of male gender is a known risk factor for having or developing obstructive sleep apnea. Gender differences in the upper airway geometry, genioglossal muscle activity during the awake state, craniofacial morphology and the pattern of fat deposition have been proposed as etiological factors for this male dominance pattern.

The average patient age in this study was 49 years old. This is in agreement with Canadian national data and other epidemiological data.

This cohort of patients was referred to the dental sleep medicine clinic with the expectation to be clinically evaluated for possible treatment with a mandibular...
advancement device. The indication for a MAD appliance is mild and moderate OSA.18 The fact that more than 50% of this study population had either a diagnosis of mild OSA diagnosis (32%) or moderate OSA (19%) was expected. There were a notable number of patients who were referred with a diagnosis of severe OSA (19%). These cases were referred mainly because of previously failed cPAP therapy or due to patient request for a MAD as an adjunct treatment to their cPAP. Nearly 14% of patients in our study were diagnosed with upper airway resistance syndrome (UARS). UARS is defined as resistance in the upper airway that is significant enough to disrupt the quality of sleep, with the absence of apnea/hypopnea events. Patients that suffer from UARS typically experience a repeated number of arousals a night as well as excessive daytime sleepiness.

Snoring was the most common self-reported symptom, with more than 90% of patients experiencing snoring. This confirms the need to recognize snoring as key risk factor for developing or having OSA. The presence of excessive daytime sleepiness, non-refreshing sleep quality and self-reported symptoms of cognitive decline including memory problems and difficulty concentrating were high in the patient group. These symptoms all affect daily functional living, affecting the quality of life and risk of accidents.21 Evidence supports the fact that obstructive sleep apnea can cause deficits in attention, delayed long-term memory, as well as other cognitive shortcomings.12 Dentists can identify patients at risk for OSA through clinical examinations, risk factor analyses and simple cephalometric analyses.22 Simple screening tools such as the Epworth Sleepiness and/or STOP-BANG questionnaires can assist with identifying risk factors. Clinical examination of the airway size and quality of the tooth structure may show signs indicative of OSA or OSA related health concerns. A large torus mandibularis, Mallampati class 4 and narrow lateral pharyngeal wall keys were identified as key oropharyngeal anatomical risk factors in a Thai population.23 Additionally, OSA has been linked to GERD and bruxism, both of which can be show signs intra-orally.24 Cephalometric analysis to determine upper airway dimensions and mandibular-to-hyoid distances can assist with early diagnosis of OSA.22, 25

The role of oral health care providers in the realm of sleep breathing disorders has been alluded to earlier.26 However, the recommendation for OSA to be included in dental curricula27 and have OSA be part of routine dental screening28 highlights the urgency for interprofessional collaboration in the management of OSA. Health care workers and sleep medicine specialists agree that dentists should play a greater role in the management of OSA.29, 30

This role of oral health care providers can be two-fold; it could be either from a screening triage perspective or a management perspective. Routine OSA screening in a university setting as part of a dental examination can provide a greater student
awareness and facilitate constructive engagement in the management and referral of patients.\textsuperscript{31} In addition, screening for potential OSA was shown to encourage health seeking behavior on the part of the patient.\textsuperscript{28}

The Canadian Thoracic Society recognizes oral appliances as a first line treatment option for mild to moderate cases of OSA with minimal daytime sleepiness.\textsuperscript{18} Although cPAP is more effective in reducing AHI, MAD therapy show to have a higher compliance rates.\textsuperscript{32} Therefore dentists may play a key role in the management of uncomplicated medically diagnosed OSA. With our aging population and a growing demand for comprehensive care for our patients, it is important that dentists be trained to identify and recognize risk factors, refer appropriately or be part of an interdisciplinary team managing signs and symptoms in selective OSA cases and contributing to the overall health care management.

The role of oral health care providers in the identification and management of OSA is well documented.\textsuperscript{15, 33} Dentists diagnose and treat patients with tooth wear and bruxism. Etiologies for tooth wear could be erosive due to gastroesophageal reflux disease (GERD) or attrition due to bruxism. OSA was shown to have associations with both these dental phenomena.\textsuperscript{24} Patients with OSA are reported to have a higher risk of sleep bruxism,\textsuperscript{34} and tooth wear.\textsuperscript{35} A direct correlation between AHI severity and tooth wear\textsuperscript{35} further supports a bruxism and OSA association. Higher periodontal indices and local inflammatory markers have been identified in OSA patients\textsuperscript{36} suggesting OSA may be a risk factor for periodontal disease. Previous studies confirmed a correlation between the presence of chronic periodontitis and OSA and snoring.\textsuperscript{37} The dentist can play an integral role in the early screening and referral of patients with potential OSA and potentially reduce the major health risk outcomes associated with OSA.\textsuperscript{33 30-34}

Conclusion

The epidemiological profile of patients seen at the HSC Dental Sleep Medicine Clinic at the University of Manitoba, College of Dentistry correlates with national statistics as reported by the Public Health Agency Canada (2009).


