Healthcare Utilization in Women with Obstructive Sleep Apnea Syndrome 2 Years After Diagnosis and Treatment

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INTRODUCTION

OBSTRUCTIVE SLEEP APNEA SYNDROME (OSAS) IS A COMMON DISORDER RESULTING FROM REPETITIVE CESSION OF BREATHING DURING SLEEP. OSAS affects approximately 5% of adults, but this figure may underestimate the problem because of the increasing worldwide prevalence of obesity. Men with OSAS have been reported to use more healthcare resources than matched controls, and treatment with continuous positive airway pressure (CPAP) decreases healthcare utilization after diagnosis and treatment intervention. We hypothesize that, as occurs in men, healthcare utilization will decrease in women after diagnosis and treatment of OSAS. We thus compared healthcare utilization in the 5 years before and the 2 years after the diagnosis of OSAS in women and the healthcare utilization of controls selected from the general population.

METHODS

This study was conducted in the Canadian Province of Manitoba. We investigated physician fees and ambulatory physician visits (surrogates of healthcare utilization) in women with OSAS and general population controls by using the Manitoba Health database. This database described in detail elsewhere, allows the tracking of healthcare utilization of individuals and and by diagnoses over very extended time intervals. To ensure the confidentiality, an encrypted health insurance number was used as the only identifier of each individual in the study to construct a final working database that included the complete healthcare utilization data for each patient and the randomly selected matched control subjects (see below). This project was reviewed by the both Human Ethics Committee of the University of Manitoba and the Access and Confidentiality Committee of Manitoba Health.

Patient Selection

We selected all women diagnosed with OSAS based on comprehensive polysomnography at the Sleep Disorders Centre, St. Boniface General Hospital. All the patients had complete healthcare utilization information in the Manitoba Health database during the period under study—5 years before the initial diagnosis of OSAS and 2 years after diagnosis. Patients whose entire healthcare service was not covered by the province of Manitoba or were not permanent residents in Manitoba, had an Indian status, or were military personal (whose health care is covered by the Canadian Federal Government) were excluded. Based on the follow-up, the patients were divided into 3 groups, those who were using continuous positive airway pressure (CPAP) (TC), those who were prescribed but not using CPAP (NCU), and those who were recommended weight loss alone (WL) (see below). The di-
vision into these 3 groups was done before analyzing any of the cost-outcome data. There remained 414 eligible cases for analysis.

Patient Evaluation

All the patients enrolled in the study are Manitoba residents who were referred to our center for the assessment of OSAS. Patients were evaluated in the same sleep disorders center in which they were evaluated with comprehensive polysomnography. They received identical evaluation by one of the authors (MK). The Epworth Sleepiness Scale was used to quantify subjective daytime sleepiness.8

Polysomnography

Comprehensive polysomnography included the monitoring of neurophysiologic variables (electroencephalogram, chin electromyogram, electrooculogram, anterior tibialis electromyogram) and cardiorespiratory variables (chest wall motion, abdominal motion, nasal pressure, oronasal CO2, SpO2, and electrocardiogram). The computer-acquired sleep data was analyzed manually using a 30-second epoch.9 The diagnosis of OSAS was based on the patient’s history and polysomnographic findings, and the apnea-hypopnea index was used as the measure of sleep-apnea severity.10

Evaluation and Follow-up After Polysomnography

The sleep studies were performed by the same set of sleep technologists in the same laboratory and all patients were evaluated by one of the authors (MK). Each patient who was prescribed CPAP was referred to the government program that covered the cost of treatment. All patients received education about sleep apnea and its causes and were provided a CPAP machine. During the time of this study, all patients had regular telephone contact by the staff of Home Care, with repeat evaluation if necessary, and had identical free access to CPAP machines and disposables. The telephone contacts were frequently done (at 1 month and 3 months after patients had the CPAP machine and then at 6-month intervals) to evaluate clinical status, CPAP usage, and change in weight that might indicate that the patients no longer required CPAP. Patients not using their CPAP machine were required to return the machine. Thus, all patients had identical evaluation and were followed identically. The criteria used for an acceptable level of CPAP utilization was defined as more than 5 out of 7 nights.11

Classification of Cases and Selection of Controls

TC Group

This group included patients who, after 2 years, still used CPAP or bilevel positive airway pressure for 5 nights or more per week based on history from the patient or her bed partner, and/or patients who were initially prescribed CPAP but who no longer used it because they lost enough weight to improve their daytime sleepiness and sleep respiration. There were 231 patients in this group; 201 were on CPAP, 12 were on bilevel positive airway pressure, and 18 had returned their CPAP systems because of diminished OSAS related to effective weight loss during the observed period.

NCU Group

This group included 91 patients who used the treatment fewer than 5 nights per week. Ten patients returned the equipment because they were not using it.

WL Group

There were 92 patients who were recommended weight loss but not CPAP because their apnea-hypopnea index and/or subjective daytime sleepiness were not severe enough to treat them with CPAP. All the patients in this group were educated about obesity and were recommended weight loss and diet by one of the authors (MK) at our clinic; referral to a dietician was done by their family physician if required.

Controls

To compensate for differences in variability (standard error of the estimate), it was determined that TC and NCU cases were to be matched to 1 control subject each, whereas, for the WL cases, 10 controls were necessary. Each patient (n = 18) whose OSAS was cured during the observed period in the TC group was also matched with 10 controls. Thus, a total of 1404 controls (393 subjects for the TC group; 91 for the NCU group, and 920 for the WL group) were obtained from the Manitoba Health database. Patients were matched with their controls based on age, sex, and postal code to correct for socioeconomic factors and proximity to healthcare services. For each group, the average of the controls for each patient was used in the analysis as a single virtual control.

Data Analysis

Physician claims and the number of ambulatory clinic visits were used in this study as the measure of healthcare utilization. Costs are presented in Canadian dollars. The difference in the physician claims from the third year before diagnosis to the first year before diagnosis and from the first year before diagnosis to the second year after diagnosis were calculated, and their trends were analyzed to see whether the change over time was statistically significant. Physician claims and ambulatory visits related to OSAS diagnosis, treatment, or follow up were also included in the analysis. Because healthcare utilization may progressively peak about the time an intervention occurs, costs or visits related to diagnosis and intervention were placed into the year after diagnosis to avoid this bias. SAS procedure GENMOD was used to analyze the data. A univariate analysis of variance was used to compare the 3 groups divided by treatment group. Significance of individual differences was evaluated by the Tukey-Kramer test. Significance levels were set at p < .05 or p < .01. SAS software (SAS institute Cary, NC, USA) was used. Continuous values are expressed in mean ± SEM.

RESULTS

The demographics of cases are shown in Table 1. The NCU group had a smaller body mass index than the TC group and the WL group. The apnea-hypopnea index before treatment in the TC group had a smaller body mass index than the NCU group and and that of the WL group.
Table 1—Demographics of Groups Classified by Treatment

<table>
<thead>
<tr>
<th></th>
<th>TC</th>
<th>NCU</th>
<th>WL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>50.3 ± 0.7</td>
<td>51.3 ± 1.3</td>
<td>46.8 ± 1.3</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>40.3 ± 0.6</td>
<td>35.6 ± 1.0⁷</td>
<td>40.0 ± 0.9</td>
</tr>
<tr>
<td>ESS</td>
<td>12.5 ± 0.4</td>
<td>11.9 ± 0.6</td>
<td>10.7 ± 0.6</td>
</tr>
<tr>
<td>AHI, no./h</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>29.7 ± 1.9⁶</td>
<td>21.8 ± 2.6</td>
<td>14.1 ± 1.9</td>
</tr>
<tr>
<td>On CPAP</td>
<td>6.5 ± 0.5</td>
<td>6.5 ± 1.3</td>
<td>5.3 ± 0.7</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SEM. BMI refers to body mass index; ESS, Epworth sleepiness scale; Pre, non-treated sleep apnea-hypopnea index (AHI); CPAP, continuous positive airway pressure.

Significant pairwise differences (adjusted for multiple comparisons by Tukey-Kramer method):
- p<.05 vs treatment-compliant patients (TC) and patients not using continuous positive airway pressure (NCU).
- p<.001 vs TC, p < .01 vs Patients recommended weight loss alone (WL).
- p < .05 vs NCU, p < .001 vs WL.

Table 2—Change in Physician Claims Before and After OSAS Diagnosis

<table>
<thead>
<tr>
<th></th>
<th>Difference between the third and the first year before diagnosis</th>
<th>Difference between the first year before and the second year after diagnosis</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire OSAS</td>
<td>123.43 ± 25.01</td>
<td>-37.96 ± 21.35</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Controls</td>
<td>15.86 ± 6.76</td>
<td>24.68 ± 7.97</td>
<td>NS</td>
</tr>
<tr>
<td>TC</td>
<td>111.22 ± 31.35</td>
<td>-20.96 ± 26.60</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Controls</td>
<td>11.29 ± 11.52</td>
<td>28.11 ± 12.20</td>
<td>NS</td>
</tr>
<tr>
<td>NCU</td>
<td>152.77 ± 59.55</td>
<td>-72.20 ± 45.91</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Controls</td>
<td>64.89 ± 28.99</td>
<td>-21.33 ± 32.94</td>
<td>NS</td>
</tr>
<tr>
<td>WL</td>
<td>125.06 ± 54.64</td>
<td>-46.78 ± 51.83</td>
<td>NS</td>
</tr>
<tr>
<td>Controls</td>
<td>12.95 ± 8.56</td>
<td>27.76 ± 10.48</td>
<td>NS</td>
</tr>
</tbody>
</table>

Values are expressed as mean ± SEM Canadian $; OSAS refers to obstructive sleep apnea syndrome; TC, treatment-compliant patients; NCU, patients not using continuous positive airway pressure; WL, patients recommended weight loss alone.

Physician Claims

Physician claims for the entire group of patients with OSAS increased before OSAS diagnosis and started to drop after evaluation in the sleep clinic (Figure 1). From the third year to the first year before diagnosis, the annual cost increased by $123.43 ± 25.01 and then dropped in the 2 years after the diagnosis by $37.96 ± 21.35 (p < .0001), whereas the control group did not show a significant change in physician claims (Table 2). Further analysis for physician claims in specific subcategories showed a significant change of fees for medical tests (eg, electrocardiogram, radiologic evaluations, blood tests): $36.85 ± 6.57 before diagnosis, $18.77 ± 1.9 after diagnosis (p < .0001); for respiratory disorders: $13.75 ± 4.43 before diagnosis, $8.06 ± 4.61 after diagnosis (p < .01); for symptoms, signs, and ill-defined conditions: $27.87 ± 5.23 before diagnosis, $25.27 ± 5.57 after diagnosis (p < .0001); and in injuries and poisoning: $9.01 ± 3.41 before diagnosis, $6.09 ± 3.46 after diagnosis (p < .05).

In a subsequent evaluation, we repeated the same statistical analysis for each patient group (TC, NCU, and WL group) (Table 2). In the TC group, physician claims peaked in the first year after diagnosis and then dropped (Figure 2). Furthermore, we assessed specific diagnostic categories before and after diagnosis. Annual fees for medical tests mentioned above also significantly increased before diagnosis by $44.91 ± 9.03 and decreased after diagnosis by $16.31 ± 10.42 (p < .001). There were also significant changes of fees in symptoms, signs, and ill-defined conditions—by $34.98 ± 7.22 before diagnosis and by $25.57 ± 6.83 after diagnosis (p < .0001)—and in injuries and poisoning—by $9.78 ± 4.65 before diagnosis and by $7.85 ± 4.41 after diagnosis (p < .05).

The physician claims in the NCU group increased before diagnosis and then decreased after diagnosis (Table 2). The physician claims for symptoms, signs, and ill-defined conditions also increased before diagnosis: $16.04 ± 11.65 and then dropped after diagnosis: $39.66 ± 14.30 (p < .01).

A similar trend of healthcare utilization before and after diagnosis was found in the WL group: increase of fees of $125.06 ± 54.64 before diagnosis and reduction in fees of by $46.78 ± 51.83 after diagnosis; however, this change was not significant.
We assessed the change in the number of ambulatory clinic visits before and after OSAS diagnosis. The ambulatory clinic visits increased in the 2 years before diagnosis by 2.33 ± 0.43 and decreased over the next 2 years after diagnosis by 1.48 ± 0.42 (p < .0001) (Figure 3, Table 3). The entire control subgroup (TC, NCU, or WL) did not show significant change before and after diagnosis in physician claims after OSAS diagnosis was found. The physician claims decreased after diagnosis for the NCU group (p < .01) and WL group (p < .05) (Table 3). The ambulatory clinic visits in each control subgroup did not significantly change before and after diagnosis.

**DISCUSSION**

To our knowledge, this is the first report documenting changes in healthcare utilization related to sleep-clinic evaluation and treatment in women with OSAS. We found increasing trends in utilization before diagnosis and decreasing trends in physician claims and ambulatory clinic visits in female patients with OSAS after assessment in a sleep disorders clinic. Subsequent analysis also showed that physician claims (TC and NCU groups) and ambulatory clinic visits dropped after diagnosis (TC, NCU, and WL groups).

In the entire group and the TC group, a significant reduction of physician claims after OSAS diagnosis was found. The physician claims for diseases of the respiratory systems and “signs and ill-defined conditions” (see below) were significantly reduced after the diagnosis. Peker et al reported reduced hospitalizations due to cardiovascular and pulmonary disease reported in patients with OSAS on CPAP.11 Because the TC group includes subjects who completed effective weight loss with discontinuation of CPAP, the reduction of healthcare utilization may be attributed to the effect of weight loss, which may contribute a reduction of healthcare utilization due to obesity-related conditions.

The healthcare utilization in the NCU group also increased before diagnosis and dropped after diagnosis. Subsequent analysis showed that the physician claims decreased after diagnosis for “signs and ill-defined conditions,” a category that includes symptoms, signs, abnormal results of laboratory or other investigative procedures, and ill-defined conditions not otherwise classifiable. OSAS may cause medical conditions or symptoms that might be investigated by family physicians before they consider the OSAS diagnosis. The similar trends in healthcare utilization in both the TC group and the NCU group may be explained by the following reasons. Because both groups had high levels of healthcare utilization...
zation at a year before a diagnostic study, a regression to the mean may be the explanation for a reduction of healthcare utilization. In contrast, no significant change in control groups was found. It is possible that the failure to see such changes in those groups may be related to lower baseline healthcare use, which may cause less effect of regression to the mean.

Physician claims in the WL group increased before diagnosis and dropped after diagnosis; however, the changes were not significant. It is possible that the subjects might not have lost enough weight to decrease healthcare utilization at this point, although the follow-up data on weight in the 2 years after diagnosis was not available. However, fees for medical tests decreased after diagnosis, and ambulatory clinic visits in the WL group decreased significantly after diagnosis. The subjects received a correct diagnosis of OSAS in a sleep disorders center and an appropriate medical recommendation, which might have contributed to decreased fees of medical tests and ambulatory clinic visits after OSAS diagnosis.

Our study suggests that evaluation and treatment of OSAS reduces physician claims in the entire group. However, our results may have underestimated the cost in patients with OSAS before and after treatment because cost of medications and homecare were not considered. Furthermore, we did not calculate the costs associated with reduced productivity due to cognitive impairment and increased traffic accidents. However, our results showed that there was significant reduction of fees after diagnosis related to injuries and poisoning. Sassani et al reported that most of the costs and deaths associated with motor-vehicle collisions can be prevented with CPAP treatment in patients with OSAS.12 The fee reduction due to injuries after diagnosis might be associated with less injury by accidents that may have been induced by OSAS symptoms (eg, cognitive impairment, daytime sleepiness).

The data of healthcare utilization among the 3 groups were not compared in this study. Although the comparison of healthcare utilization among these groups would be of interest, age, body mass index, and apnea severity were different in the groups at initial presentation. Therefore, it was concluded that it was not appropriate to compare patients using CPAP with those not using CPAP and those who were recommended weight loss alone. The comparison of healthcare utilization adjusted for body mass index and age among the 3 groups is planned to be the topic of a future report.

In conclusion, our results showed that sleep-clinic evaluation (correct diagnosis and recommending treatment) in patients with OSAS may lead to a significant reduction in physician claims and ambulatory clinic visits. Early diagnosis and treatment of OSAS may thus contribute to a significant cost savings to healthcare systems.

ACKNOWLEDGEMENT

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REFERENCES