Risk for Obstructive Sleep Apnea among People with Diabetes

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ABSTRACT

Objective: The aim of this study is to identify people at high risk for Obstructive Sleep Apnea (OSA) and to evaluate the impact of OSA on the control of cardiovascular risk factors.

Design: A Cross-Sectional Study.

Setting: Four Primary Health Care Centers.

Method: Patients attending diabetes clinics in four health centers were screened for OSA by using the Berlin questionnaire. In addition, patients’ medical records were reviewed for age, sex, body mass index (BMI), blood pressure, glycated hemoglobin, lipid profile, antihypertensive, hypoglycemic agents and previous OSA diagnosis.

Result: A total of 455 questionnaires were analyzed. All patients included were type 2. The mean age was 56.6 years. High risk for OSA was present in 173 (38%) patients. It was more common among females (P=0.013). There was no significant age difference (P=0.75). The risk of OSA increased significantly with BMI≥35 (P<0.001). No significant difference was found between low and high risk in the control of glycated hemoglobin, lipid profile, and the number of drugs used. Three (1.7%) patients from the high OSA risk and 2 (0.71%) from the low risk (282) had previous OSA diagnosis.

Conclusion: More than one-third of our patients were high risk for OSA. Screening for OSA among diabetics is lacking despite the presence of high number of at risk patients. Increasing awareness of the treating physicians is needed.

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INTRODUCTION

Obstructive Sleep Apnea (OSA) is a breathing disorder in which the affected person frequently stops breathing during sleep as a result of obstruction of the upper airways due to inadequate motor tone of the tongue and/or airway dilator muscles\(^1\). It is diagnosed by using overnight standardized, facility-based polysomnography to detect the frequency of apnea and hypopnea events. OSA is diagnosed when the apnea and hypopnea index (the number of events per hour) is greater than 15 or greater than 5 in a person who reports any of the following: unintentional sleep
episodes during wakefulness, daytime sleepiness, non-refreshing sleep, fatigue, insomnia, waking up breath holding, gasping, or choking, or the bed partner describing loud snoring, breathing interruptions or both during the patient’s sleep\(^2\).

Obstructive sleep apnea is a common primary health care problem\(^3\)\(^-\)\(^6\). Furthermore, OSA is associated with serious clinical conditions; it could worsen diabetes and blood pressure (BP)\(^7\)\(^,\)\(^8\). In addition, OSA increases the risks for stroke, heart failure, neuropathy, depression, road traffic accidents, cancer and mortality\(^9\)\(^-\)\(^14\).

The relationship between diabetes and OSA is bidirectional. Obstructive sleep apnea is a risk factor for diabetes independent of traditional risk factors\(^15\)\(^,\)\(^16\). Furthermore, it has been found that the level of glycated hemoglobin increases linearly with the severity of OSA in non-diabetic individuals\(^17\). On the other hand, OSA is highly prevalent among people with diabetes\(^4\)\(^,\)\(^5\)\(^,\)\(^18\)\(^-\)\(^20\).

Screening for OSA is important for various reasons. While OSA is common, it remains largely undiagnosed\(^4\)\(^,\)\(^5\)\(^,\)\(^20\)\(^-\)\(^22\). Presentation of OSA could be atypical\(^23\)\(^,\)\(^24\). Furthermore, OSA is commonly associated with known diabetic complications\(^4\)\(^,\)\(^9\)\(^-\)\(^11\)\(^,\)\(^25\)\(^,\)\(^26\). Lastly, screening and initiation of treatment may contribute to prevention and improved control of co-morbid conditions\(^16\)\(^,\)\(^27\)\(^-\)\(^29\).

There are no studies about OSA among people with diabetes in the Kingdom of Bahrain.

The aim of this study is to identify people at high risk for OSA and to evaluate the impact of OSA on the control of cardiovascular risk factors.

**METHOD**

Four health centers were chosen randomly. Patients who attended diabetes clinics between 15 April to 15 July 2013 were invited to participate in the study. Patients were screened by using the Berlin questionnaire. This questionnaire has been validated for OSA screening in primary care and other settings\(^3\)\(^,\)\(^5\)\(^,\)\(^6\)\(^,\)\(^22\)\(^,\)\(^30\)\(^-\)\(^34\). The questionnaire has been validated in patients with diabetes\(^3\)\(^,\)\(^20\). The Arabic version of this questionnaire has recently been used in a similar study; the author has been contacted and permission was granted to use the Arabic version in our study\(^33\).

The questionnaire is a self-report instrument that is focused on a set of known symptoms and clinical features associated with sleep apnea. One introductory question and four follow-up questions concerned snoring, witnessed apneas and the frequency of such events. Three questions addressed daytime sleepiness with a sub-question about drowsy driving. One question asked about history of high BP. Body Mass Index (BMI) is calculated based on self-reported height and weight of the participant. However in this study, we obtained the most recent BMI of the surveyed patients from their medical records.

High risk and lower risk groups for OSA are based on responses. Category 1, a positive score for risk is defined as frequent symptoms (more than three to four times per week or almost every day) in the questions about snoring and witnessed apneas; category 2, a positive score for risk is frequent symptoms in two or more questions about awakening sleepy, wake time sleepiness, and/or drowsy driving; category 3, a positive score for risk is defined as a self-report of high BP
and/or BMI of ≥30 kg/m². To score high for OSA, an individual’s questionnaire must have had positive scores in two of the three categories or in all three. Those patients who denied having symptoms with such frequency, or who qualified in only one category are classified as low risk group³⁰.

In addition, we reviewed the patients’ medical records for age, gender, BMI, BP, lipid profile, glycated hemoglobin (A1C), drugs used for hypertension and medications (oral and injectables) used to treat diabetes. We defined controlled BP, A1C, and lipid parameters according to recent American Diabetes Association (ADA) guidelines³⁶.

Data were analyzed by using SPSS software, version 20. Chi-squared test was used to assess the association between OSA and each of the following factors: age, gender, BMI, level of control of BP, A1C, lipid profile, antihypertensive and hypoglycemic drugs used. Multiple logistic regression model that included all the studied risk factors and OSA status as the dependent variable was set to determine the independent predictors for OSA. P-value less than 0.05 was considered statistically significant.

RESULT

We surveyed 484 patients. Twenty-nine questionnaires were excluded because they were incomplete. A total of 455 questionnaires were analyzed. All patients were type 2. The mean age was 56.6 years. Two hundred sixty-six (58.5%) were females. High risk for OSA was present in 173 (38%) patients, see table 1.

Table 1: Patients’ Age Groups and Gender

<table>
<thead>
<tr>
<th>Age group</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤39</td>
<td>15(8)</td>
<td>16(6)</td>
<td>31(6.8)</td>
</tr>
<tr>
<td>40-49</td>
<td>21(11.1)</td>
<td>50(18.8)</td>
<td>71(15.6)</td>
</tr>
<tr>
<td>50-59</td>
<td>66(34.9)</td>
<td>99(37.2)</td>
<td>165(36.3)</td>
</tr>
<tr>
<td>≥60</td>
<td>87(46)</td>
<td>101(38)</td>
<td>188(41.3)</td>
</tr>
<tr>
<td>Total</td>
<td>189(100)</td>
<td>266(100)</td>
<td>455(100)</td>
</tr>
</tbody>
</table>

There was no significant gender difference between age groups (P value= 0.113). Risk for OSA was more common among females (113/173; 65%) and the association was statistically significant (P=0.013). There was no significant association between risk for OSA and age groups, see table 2.

Table 2: Risk for OSA by Age Groups

<table>
<thead>
<tr>
<th>Age group</th>
<th>High OSA risk</th>
<th>Low OSA risk</th>
<th>Total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤39</td>
<td>11 (6.4)</td>
<td>20 (7.1)</td>
<td>31 (6.8)</td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>31 (17.9)</td>
<td>40 (14.2)</td>
<td>71 (15.6)</td>
<td>0.756</td>
</tr>
<tr>
<td>50-59</td>
<td>65 (37.6)</td>
<td>100 (35.5)</td>
<td>165 (36.3)</td>
<td></td>
</tr>
<tr>
<td>≥60</td>
<td>66 (38.1)</td>
<td>122 (43.2)</td>
<td>188 (41.3)</td>
<td></td>
</tr>
</tbody>
</table>
It was found that 397 (87.3%) patients were having BMI ≥25kg/m² and 264 (58%) were obese (BMI ≥30). One hundred and seventy one (171/264; 64.8%) obese patients were females. Only 25 (25/266; 9.4%) females were having normal BMI (<25). There was statistically significant association between BMI and OSA risk. The risk is lower in normal and overweight. However, it increased significantly with BMI ≥35, see table 3 and figure 1.

Table 3: BMI and OSA risk

<table>
<thead>
<tr>
<th>BMI category(kg/m²)</th>
<th>High risk</th>
<th>Low risk</th>
<th>Total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤24.9</td>
<td>10 (5.8)</td>
<td>32 (11.5)</td>
<td>42 (9.3)</td>
<td>0.00</td>
</tr>
<tr>
<td>25-29.9</td>
<td>38 (22.1)</td>
<td>98 (35.3)</td>
<td>136 (30.2)</td>
<td></td>
</tr>
<tr>
<td>30-34.9</td>
<td>51 (29.6)</td>
<td>93 (33.5)</td>
<td>144 (32)</td>
<td></td>
</tr>
<tr>
<td>35-39.9</td>
<td>44 (25.6)</td>
<td>31 (11.1)</td>
<td>75 (16.7)</td>
<td></td>
</tr>
<tr>
<td>≥40</td>
<td>29 (16.9)</td>
<td>24 (8.6)</td>
<td>53 (11.8)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>172* (100)</td>
<td>278** (100)</td>
<td>450 (100)</td>
<td></td>
</tr>
</tbody>
</table>

*missing data for 1 patient;**missing data for 4 patients

Figure 1: BMI and OSA Risk

Three hundred nine (67.9%) patients were on antihypertensive medications; hypertension was present in 131/173 (75.7%) patients who are at high risk for OSA. Thirty patients out of 309 (9.7%) were having uncontrolled BP (≥140/80); 16 (53.3%) patients were from high risk group. One hundred eight out of 309 (35%) patients were on 3 or more medications. There was no statistically significant difference in the number of antihypertensive medications used between low and high risk groups (P=0.31).

There was no statistically significant difference in A1C and lipid control between low and high OSA risk patients, see table 4.

Table 4: Diabetes, Lipid Control and OSA Risk

<table>
<thead>
<tr>
<th>Indicator</th>
<th>High OSA risk</th>
<th>Low OSA risk</th>
<th>Total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1C&lt;53*(mmol/mol)</td>
<td>73 (42.2)</td>
<td>116 (41.1)</td>
<td>189 (41.5)</td>
<td>0.450</td>
</tr>
<tr>
<td>A1C≥53</td>
<td>100 (57.8)</td>
<td>166 (58.9)</td>
<td>266 (58.5)</td>
<td></td>
</tr>
</tbody>
</table>
There was no significant difference in the number of anti-diabetic medications used between low and high OSA risk patients (P=0.825). Three (1.7%) patients out of 173 from high OSA risk and 2 (0.71%) out of 282 from low OSA risk had previous OSA diagnosis.

In the multiple logistic regressions model, BMI was found to be a significant predictor for OSA [P value<0.001, Odds ratio 0.674 (0.562-0.809)].

**DISCUSSION**

This study showed that over one-third of the patients are at high risk for OSA. It is more common among females. It is associated with moderate and severe obesity, but not with age, diabetes or lipid control. It was also found that OSA is mainly undiagnosed among the patients surveyed.

The prevalence of OSA (37.4%) found in this study is similar to a study using pulse oximetry; however, the prevalence in our study is likely to be underestimated because the prevalence of obesity in our study was 58% compared to 32%37. In a study using the Berlin questionnaire, the prevalence was 48%; most patients (96.8%) were either obese or hypertensive3. Obesity and hypertension are known risk factors for OSA which are prevalent among our study participants18-20,38,39. Indeed, obesity not only predicts OSA, but also its severity40. Furthermore, the presence of co-morbid obesity and hypertension among these patients increase the risk for OSA significantly41. In addition, females who constituted about 58% of our study's participants are more likely to present with atypical symptoms23,39,42.

In this study, OSA was common in females. Male gender is a known risk factor for OSA as found in several studies6,18,32,35,39. The likely explanation for our finding is that most female patients (75.2%) were either peri-menopausal or menopausal (≥50 years), most of the high risk patients (75.7%) were in this age group. Male predominance usually disappears in older age and the risk for OSA increases with menopause39,43-45. In addition, about two-third of the obese patients in the study were females.

In this study, hypertension was present in about two-third of the patients, while 75% of the high risk group were hypertensive. Hypertension is strongly associated with OSA. It is an independent risk factor for OSA and patients with OSA are at higher risk to develop hypertension46,47. OSA was found to be the most common cause of secondary resistant hypertension48. Hence, the presence of resistant hypertension should urge the treating physician to evaluate the patient for OSA.
The study showed that A1C is almost similar between low and high risk group while lipids control was worse in high risk group but did not reach statistical significance. However, the level of control is far from optimal level as found in a recent study\(^{49}\). While some studies found that treatment of OSA improves A1C, the results are inconsistent\(^{7,29,50}\).

The strong association between OSA and metabolic syndrome components on one hand and the presence of mixed results about the efficacy of OSA treatment (especially in mild to moderate cases) highlights the importance of screening\(^{51}\). Unfortunately, this study found that only 2 patients from high risk group had previous OSA diagnosis. However, under-diagnosis is a consistent finding in primary care settings\(^{4,5,21,22,52}\). This could be related to lack of awareness of the treating physicians about OSA and its consequences\(^{53}\).

**CONCLUSION**

More than one-third of our patients were high risk for OSA. Screening for OSA among diabetics is lacking despite the presence of high number of at risk patients. Increasing awareness of the treating physicians is needed.

**Author Contribution:** All authors share equal effort contribution towards (1) substantial contributions to conception and design, acquisition, analysis and interpretation of data; (2) drafting the article and revising it critically for important intellectual content; and (3) final approval of the manuscript version to be published. Yes.

**Potential Conflicts of Interest:** None.

**Competing Interest:** None. **Sponsorship:** None.

**Submission Date:** 16 January 2014. **Acceptance Date:** 10 May 2014.

**Ethical Approval:** Approved by the Research Committee for Primary Healthcare, MOH, Bahrain.
REFERENCES