Sleep quality effects on glycemic control among Sudanese patients with type 2 diabetes -A case-control study

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ABSTRACT

Objectives: To study the prevalence of poor sleep quality and its relation to glycated hemoglobin among patients with type 2 diabetes. Methods; A case-control study was conducted at a diabetic center in Omdurman- Sudan from December 2014 to March 2015. A total of 223 consecutive subjects (102 diabetics, and 121 healthy controls) signed a written informed consent then responded to a structured questionnaire including demographic data and the seven components of the Pittsburg Sleep Quality Index (PSQI); a blood sample was taken for glycated hemoglobin (HbA1c). The local ethical committee approved the research, and the Statistical Package for Social Sciences was used for data analysis. Results: They were 102 diabetic patients and 121 control subjects, their ages were 52.5±10.5, and 52.6±10 respectively. Poor sleep quality was reported in 97.1% of diabetic patients as compared to controls 33.3% (score 11.75±4.32 and 4.56±2.67 respectively) with high significant statistical difference P<0.001. No differences were evident regarding Age, bedtime, and wake up time. No correlation was found between sleep quality score and the glycated hemoglobin. Conclusion; Poor sleep quality was more prevalent among type 2 diabetic patients in Sudan compared to healthy control subjects. No correlation was found between sleep quality and the glycated hemoglobin.

Keywords: Sleep quality, Diabetes mellitus, Sudan

INTRODUCTION

Sleep duration and quality are affected by a wide range of factors, environmental, social, psychological, and cultural. Modern society with long shifting work hours and, staying a long time on social media leads to disturbed sleep with more reporting of fatigue, daytime sleepiness, and tiredness (Akerstedt and Nilson; 2003, Bilwise; 1996). Sleep disturbances were proved to have deleterious effects on different systems, with detectable effects on endocrine, metabolic, and immune systems (Knuston et al., 2007; Taheri et al., 2004; Miller and Cappuccio; 2007). The incidence of diabetes mellitus is increasing all over the globe, with increasing morbidity and mortality mainly

Abbreviations

PSQI: The Pittsburg Quality Index; HbA1c: Glycated hemoglobin; SPSS: Statistical Package for Social Sciences
from its macro-vascular complications, including myocardial infarction and microvascular including, nephropathy, neuropathy, and retinopathy (Simpson et al., 2003) World Health Organization reported that diabetes mellitus is the cause of 2% of all-cause mortality in Sudan (World Health Organization; 2014). Short term observational and laboratory studies, showed that sleep disturbances lead to impaired glucose tolerance, reduced acute insulin response to glucose, and insulin resistance thus predisposing to type 2 diabetes mellitus (Speigel et al., 2009). Poor sleep is common in patients with type 2 diabetes mellitus (Skomro et al., 2001); it is more in this group of patients than in age and sex matched controls. Daytime sleepiness and poor sleep quality, including difficulty in initiating and maintaining sleep have been reported in type 2 diabetic patients (Skomro et al., 2001; Knutson et al., 2006).

The American Diabetes Association recommendation is to target glycated hemoglobin (HGA1c %) to less than 7 to reduce microvascular complications in type 1 and type 2 diabetes. If metformin is used to control diabetes in overweight patients, the risk of myocardial infarction is also reduced (Diabetes Care;,2010; UKPDS Group, 1998).

Sudan is a large country with environmental and social diversity. Health care facilities are lacking in most rural outreaching areas, thus sleep quality and its consequences on diabetes in western countries may not apply to Sudan, so we conducted this study to estimate the prevalence of poor sleep quality and investigate its relation to glycemic control among patients with type 2 diabetes.

Subjects and methods

This case-control study was conducted from December 2014 to March 2015 among 223 consecutive subjects attending an outpatient clinic in Omdurman Sudan, one hundred and two were diabetic patients, and 121 were controls matched for age and sex, others with known chronic diseases as were newly diagnosed diabetic patients (because they might not be well controlled) were excluded. The Pittsburgh sleep quality index (PSQI) a well-validated questionnaire (Epstein et al., 1998) was used for sleep quality measurement and a blood sample was taken for glycated hemoglobin measurement to assess diabetes control (the reagent set from Pointe Scientific Inc (Bates, 1978) was used for analysis). The HbA1c% reflects average plasma glucose over several months, so it was measured for the degree of diabetes control (Griffin et al.,1999), patients with HbA1c of < 8 were regarded as accepted control (Brown et al., 2003)

The (PSQI) includes nine questions to evaluate sleep quality in the previous month, with seven components each score from 0-3 with 3 indicating the greatest dysfunction and zero indicates no dysfunction, a score of 5 or more out of 21 indicates bad sleep quality (Buysse et al., 1988). All participants signed a written informed consent then the Pittsburgh sleep quality index was filled by the researcher. Information collected include; bed and wakeup time, sleep duration, sleep latency, sleep efficiency as measured from the total night sleeping hours versus hours staying in bed, sleep trouble, overall sleep quality rating, use of sleep medications, and daytime dysfunction

Statistical analysis

Data was analyzed by using the Statistical Package for Social Sciences software (SPSS version 20). The chi-square and t-test were used for testing the statistical significance, data were presented as percentages or mean± SD, and a P-value of less than 0.05 was considered as statistically significant, an approval letter was obtained from the local ethical committee to carry this research.

RESULTS

Two hundred and twenty-three subjects were included, 102 diabetic patients and 121 controls matched for age and sex. The mean age was 52.5±10.5 for diabetic patients and 52.6±10 years for controls P-value=0.909. Thirty-four (33.3%) of diabetic patients were males, and 44 (36.3%) of controls were males P-value=0.641. Ninety-nine (97.1%) of diabetic patients had poor sleep quality as compared to controls (33.1%), (P<0.001). Snoring or a cough was detected in 61 (59.8%) and 44 (36.3%) of diabetic patients and controls, respectively (P <0.001). Subjective rating of bad sleep was found in 44.1% and 7.4% of diabetic patients and controls respectively, Use of sleep medications was observed in 20.1% of diabetic patients and 3.3% of control subjects. Daytime dysfunction was detected in 38.2% of diabetic patients and 3.3% of healthy controls. While sleeping less than 6 hours/night was observed in 55.9% and 14.8% of diabetic patients and 3.3% of control subjects, respectively, Use of sleep medications was observed in 44.1% and 7.4% of diabetic patients and controls respectively, Use of sleep medications was observed in 20.1% of diabetic patients and 3.3% of control subjects. Daytime dysfunction was detected in 38.2% of diabetic patients and 3.3% of healthy controls. While sleeping less than 6 hours/night was observed in 55.9% and 14.8% of patients and controls respectively. Table 1 showed sleep characteristics of the study groups. Table 2 depicted the comparison between diabetic and controls in which the overall sleep quality score was (11.75±4.32) in patients with type 2 diabetes and (4.56±2.67) in controls with a high significant statistical difference P-value=0.000. bedtime was (10.33±1.4) PM in diabetic patients and (10.20±2.3) in control subjects P-value=0.641, sleep latency was (31.7±30.3) in diabetic patients and (8.9±12.8) minutes in controls P-value=0.000. Wake up time was (5.4±1.1) and (5.7±1.1) AM in diabetic and control subjects respectively P-value=0.062. Total
Table 1. Characteristics of sleep from the PSQI for the diabetic and controls groups

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Diabetes (%)</th>
<th>Controls (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor sleep quality</td>
<td>97.1</td>
<td>33.1</td>
<td>0.000</td>
</tr>
<tr>
<td>Bedtime later than midnight</td>
<td>60.7</td>
<td>45.5</td>
<td>0.606</td>
</tr>
<tr>
<td>Snoring or coughing</td>
<td>59.8</td>
<td>36.3</td>
<td>0.000</td>
</tr>
<tr>
<td>Subjective rating of bad sleep</td>
<td>44.1</td>
<td>7.4</td>
<td>0.000</td>
</tr>
<tr>
<td>Use of sleep medications</td>
<td>20.5</td>
<td>3.3</td>
<td>0.000</td>
</tr>
<tr>
<td>Daytime dysfunction</td>
<td>38.2</td>
<td>3.3</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 2. Characteristics of sleeping from the PSQI for diabetic and control subjects

<table>
<thead>
<tr>
<th>Parameter (mean± SD)</th>
<th>Diabetes</th>
<th>Controls</th>
<th>P-value</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>52.5±10.5</td>
<td>52.6±10</td>
<td>0.909</td>
<td>-2.63-2.95</td>
</tr>
<tr>
<td>Bedtime</td>
<td>10.20±2.3</td>
<td>10.33±1.4</td>
<td>0.641</td>
<td>-0.42-0.68</td>
</tr>
<tr>
<td>Sleep latency</td>
<td>31.7±30.3</td>
<td>8.9±12.8</td>
<td>0.000</td>
<td>(29.6-16.1)</td>
</tr>
<tr>
<td>Wake up time</td>
<td>5.4±1.1</td>
<td>5.7±1.1</td>
<td>0.062</td>
<td>(-0.01-0.57)</td>
</tr>
<tr>
<td>Sleep duration</td>
<td>5.5±1.2</td>
<td>6.5±0.9</td>
<td>0.040</td>
<td>0.73-1.3</td>
</tr>
<tr>
<td>Daytime dysfunction</td>
<td>1.37±0.92</td>
<td>0.16±0.4</td>
<td>0.000</td>
<td>(1.12-0.71)</td>
</tr>
<tr>
<td>Sleep trouble (by pain, etc.)</td>
<td>1.38±0.87</td>
<td>0.31±0.51</td>
<td>0.000</td>
<td>(1.19-0.86)</td>
</tr>
<tr>
<td>Subjective sleep rating</td>
<td>136±0.07</td>
<td>0.36±0.52</td>
<td>0.000</td>
<td>(1.19-0.81)</td>
</tr>
<tr>
<td>Sleep medications use</td>
<td>1.35±0.27</td>
<td>0.05±0.21</td>
<td>0.003</td>
<td>(0.36-0.07)</td>
</tr>
<tr>
<td>Sleep quality score</td>
<td>11.75±4.32</td>
<td>4.45±2.67</td>
<td>0.000</td>
<td>8.12-6.25</td>
</tr>
</tbody>
</table>

Table 3. PSQI correlation with subject’s characteristics

<table>
<thead>
<tr>
<th>Character</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.66</td>
</tr>
<tr>
<td>Sex</td>
<td>0.30</td>
</tr>
<tr>
<td>HbA1c%</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Sleep disturbances are common among patients with type 2 diabetes mellitus. Poor sleep quality, daytime sleepiness, and difficulty in initiating and maintaining sleep are more common among diabetic patients than age and sex- matched controls (Skomro et al., 2001; Knutson et al., 2006).

In the present study poor sleep quality was reported in 99 (97.1%) of diabetic patients and is higher than the study conducted in the United States (Luyster and Dunbar-Jacob: 2011), in which poor sleep quality was detected in (55%) of diabetic patients. A study conducted by (Tasi et al., 2012) in Taiwan concluded that poor sleep quality was present in (34.8%) of type 2 diabetic patients and is lower than our results, this may be explained by the small sample size of the previous study.

Previous literature documented the association between diabetes mellitus, short sleep duration, and failure to initiate sleep and in agreement with the current data in which high significant statistical difference was found between diabetic patients and controls regarding sleep duration and sleep latency (Cappuccio et al., 2010).

Habitual snoring a feature of obstructive sleep apnea is more common among diabetic patients than healthy subjects (Levinson et al., 1993). A study of diabetic

**DISCUSSION**

Diabetes mellitus is a common disease, causing a lot of morbidity and mortality due to both microvascular complications including; nephropathy, neuropathy, and retinopathy, and macro-vascular complications like myocardial infarction, stroke, and peripheral vascular disease (Deshpande et al., 2008).

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Patients using a validated clinical measurement and questionnaire concluded that 56% of those questioned reported snoring and at high risk of (OSA), this echoes the result of this study in which snoring was detected in (59.8%) of diabetic patients (Mc Dermott, 2010).

In the present study, no correlation was found between sleep quality and HbA1c, similarly (Noma et al., 2008) concluded that bad sleep quality is common among diabetic patients but not correlated with HGA1c%. Similar to this study is the study conducted by Knutson et al., (2006) who concluded that glycemic control was associated with perceived sleep debt but not with PSQI in patients without diabetic complications.

Tasi et al. (2012) stated in his study: apart from sleep efficiency, no other significant associations were found with any other components of the PSQI, contradicting the present findings and can be explained by the small sample of Tasi et al. (2012) (46 subjects). These results call for larger studies to assess different causes of poor sleep quality such as daytime sleepiness, obstructive sleep apnea, and restless legs syndrome among diabetic patients.

The present study had some limitations. First: The small number of the study groups. Second; the study was conducted at diabetic center so generalization cannot be ensured. Also, we were not able to control for potential confounders such as depression, daytime sleepiness, and restless legs syndrome.

CONCLUSION

Patients with type2 diabetes mellitus had higher prevalence of poor sleep quality, short sleep duration, and failure to initiate sleep than their healthy counterparts. No correlation was present between sleep quality and HbA1c. Larger multicenter studies looking for causes of poor sleep quality are needed. Screening for sleep disturbances, and management when indicated, could be part of routine diabetic care.

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