Depression, anxiety, and daytime sleepiness among type 2 diabetic patients and their correlation with the diabetes control: A case-control study

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Abstract

Objectives: Diabetes mellitus, depression, and excessive daytime sleepiness (EDS) are common health disorders that are associated with significant mortality and morbidity. When observed together, these disorders precipitate the other’s deleterious effects. In this study, we aimed to study depression, anxiety, EDS, and their relation with diabetes control among patients with type 2 diabetes mellitus in Tabuk, KSA.

Methods: This case-control study was conducted in a diabetes centre in Tabuk during March to June 2015. One hundred and seventy-eight diabetic and one hundred control patients signed a written informed consent. These participants were then interviewed using the Arabic versions of Beck Depression Inventory (BDI), Epworth Sleepiness Scale (ESS), and Hamilton Anxiety Scale (HAS). The Statistical Package for Social Sciences (SPSS) was used for data analysis.

Results: Depression was evident in 61.8% of diabetic patients vs. 30% in controls. EDS was found in 6.7% of diabetic patients and was not reported in controls (P-value < 0.05), whereas anxiety was reported in 4.3% of patients and controls with no statistically significant difference. No differences were evident between patients with depression, EDS, and anxiety and those without these disorders in terms of diabetes control and body mass index.

Conclusion: In this study, depression and EDS were common among diabetic patients, although there was no difference with the prevalence of anxiety between diabetic and control patients. In addition, no differences were
found between patients with poor diabetes control and those who attempted to control their depression, EDS, and anxiety.

**Keywords:** Anxiety; Depression; KSA; Sleepiness; Type 2 diabetes

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**Introduction**

The global prevalence of diabetes is expected to rise from the current number of 285 million people to 438 million by the year 2030, with Asian countries suffering the bulk of the total diabetes epidemic. The KSA is among the countries with the highest prevalence of diabetes mellitus (17.6%). Major depression is a common chronic recurrent disease; it is associated with morbidity, mortality, and reduced quality of life. According to World Health Organization, major depression is ranked the 4th leading cause of disability worldwide and is projected to be the second leading cause by the year 2020. There is wide variation in the prevalence across countries with the highest rates being reported in high-income countries. Additionally, the disease is more common among women. The twelve-month prevalence varied from 9.3% to 23% in subjects with chronic morbid diseases and 3.2% in those without co-morbid diseases.

Depression is a common co-morbidity with diabetes mellitus in particular as well as other chronic medical illnesses. Depression in diabetic patients occurs as a direct consequence of neurochemical changes with diabetes, and the complex interaction between genetic and bio-psycho-social factors. The prevalence of depression in patients with diabetes mellitus was found to be 11% in a meta-analysis of 42 published studies that included 21,351 adults.

A study conducted in Eastern KSA among patients with diabetes mellitus concluded that nearly half of patients (49.6%) were depressed.

Although depression and anxiety are common worldwide, the majority are in developing countries and are associated with high morbidity and mortality in patients with diabetes mellitus. The presence of depression in patients with diabetes substantially reduces patient self-care and functional abilities with harmful effects on patient health.

In comparison to diabetic patients without depression, depressed diabetic patients are less likely to adhere to self-management and medication use resulting in poor glycemic control and higher complications aggravating their depression.

Despite its association with frequent co-morbidity in patients with diabetes mellitus, anxiety is usually insufficiently studied and most studies focused on depression; the previous study reported a prevalence of 11% among type 2 diabetic patients compared to 6.1% of the general population.

Excessive daytime sleepiness is often attributed to sedentary lifestyle or laziness whereas it may be a manifestation of serious disorders such as depression, diabetes, and obstructive sleep apnoea. The relationship between these diseases is complex and multi-directional because each disorder may exacerbate the other. Repetitive hypoxia and sleep fragmentation lead to the release of tumour necrosis factor and fatigue related cytokines that affect diabetes control. Additionally, daytime sleepiness leads to an impaired mood state that may impede diabetes management. The relationship between the glycated haemoglobin and diabetes mellitus prognosis has been established in large prospective cohorts. Good glycaemic control is essential for the maintenance and reduction of retinopathy, nephropathy, neuropathy, and cardiovascular diseases, the glycated haemoglobin (HbA1c) is the primary target for glycaemic control. The American Diabetes Association recommends an HbA1c of 7%. Diabetic patients with psychiatric disorders have poorer treatment outcomes than those without. Therefore, active case finding and management of depression, anxiety, and daytime sleepiness in diabetic patients can contribute to diabetes control alleviating patient suffering and reducing the costs of patient management. Thus, we conducted this research to study depression, anxiety, and daytime sleepiness among patients with type 2 diabetes mellitus and their relationship with diabetes control in Tabuk, KSA.

**Materials and Methods**

This case-control study conducted at the Diabetes Center at King Khalid Hospital in Tabuk during the period from March to June 2015. A systematic random sampling technique was used to select one hundred and seventy-eight patients with the diagnosis of type 2 diabetes according to the American Diabetes Association guidelines: (HbA1c% ≥ 6.5, or fasting plasma sugar ≥ 125 mg/dl, or 2 h after oral glucose tolerance test ≥ 200 mg/dl. Patients with classic symptoms of hyperglycaemia or hyperglycaemic crisis random plasma sugar ≥ 200 mg/dl) who attended the diabetes centre for follow-up, and one hundred control subjects (matched for age). A ratio of 1:1 was used for subjects. The controls subjects were randomly selected from the co-patients (spouses, neighbours, and friends) attending the diabetes centre. The control subjects were selected in this way to address confounding factors such as educational and socioeconomic differences. Co-patients known to have diabetes mellitus were not included. All subjects were asked to sign a written informed consent form and interviewed using a standard questionnaire based on the Arabic versions of Beck Depression Inventory (BDI), Hamilton Anxiety Scale, and The Epworth Sleepiness Scale (ESS). Patients with rheumatic disorders or other chronic diseases and those on antidepressant medications for neuropathic pain were not included in the study. The BDI has been previously validated for the diagnosis of depression and has a high sensitivity and specificity for detecting severe depression. There is also evidence of utility and sensitivity of this measure for use in patients with diabetes mellitus. The BDI consists of 21 items including emotional, behavioural, and somatic

symptoms. Each symptom is scored from 0 to 3 with 0 = “no” and 3 = “the greatest dysfunction”. Mild, moderate, and severe depression has a rating of (10–18), (19–29) and (≥30), respectively. The Arabic version of the Epworth Sleepiness Scale (ESS): a well-validated self-reported scale for testing daytime sleepiness asks “how likely are you to doze or fall asleep?” in 8 typical situations: Watching TV, sitting and reading, sitting inactive in public places, as a passenger in a car for one hour without a break, lying down to rest in the afternoon when circumstances permit, sitting talking to someone, sitting quietly after a lunch without alcohol, and in a car, while stopped for a few minutes in traffic. Each component score from 0 to 3 with 0 = “no tendency to doze” and 3 = “severe tendency to doze.” A total score of 10 out of 24 is regarded as having “daytime sleepiness”. The Hamilton Anxiety Scale measures feelings of anxiety with fourteen components (1–6 and 14 items measuring the more subjective affective and cognitive symptoms of anxiety) and is useful for assessing the severity of anxiety disorder, and somatic anxiety (7–13 items for features of general anxiety disorder such as cardiovascular, gastrointestinal, and autonomic arousal). Each component rating from 0 to 4 with four indicating the greatest dysfunction, a score of fourteen or more is regarded as anxiety. The collected information included demographic data, duration of diabetes if diagnosed with depression or antidepressant medications, height, weight, and body mass index (BMI) as calculated by the formula: body mass index = weight/(height in metres). A blood sample was taken for glycated haemoglobin estimation for the degree of control using a HbA1C glycol haemoglobin reagent set from Siemens Healthcare Diagnostics Newark, DE 19714, USA. A glycated hemoglobin of ≤ eight was considered to be acceptable glycaemic control.

The Statistical Package for Social Sciences (SPSS Inc., Chicago, IL., version 20) was used for data analysis. The chi-square test was used to compare categorical data. Data were reported as the mean ± sd or percentages unless otherwise specified, with a P-value of <0.05 being considered significant.

Results

Out of 278 subjects 178 were diabetics, their ages ranged from 28 to 75 years with a mean of 47.6 ± 12.32, the average duration of hours of sleep per night was 7.44 ± 1.19 h; the Epworth Sleepiness Score was 5.48 ± 2.45, and duration of diabetes was 6.72 ± 5.86 years. Table 1 illustrated other patient characteristics.

Table 2 depicted the characteristics of the control subjects. The mean age was 45.94 ± nine years, the mean night-time hours of sleep was 7.78 ± 1.15; Epworth Sleepiness Score was 2.56 ± 1.24; the average depression score was 7.76.9 ± 5.6, and the average anxiety score was 5.39 ± 3.32.

In the present study, depression was evident in 61.8% of diabetic subjects vs. 25% of control subjects, while excessive daytime sleepiness was observed among 9.8% and 6.3% of acceptable vs. poor diabetes control, respectively (P-value = 0.50), Table 3.

In the current data, mild depression was found in 35.9% of diabetic patients vs. 25% of control subjects, moderate depression in 24.8% vs. 5% of controls, while severe depression was evident in 11.8% of diabetic patients vs. 1% of control subjects, Table 4.

On comparing diabetic patients with acceptable diabetes control against those with poor diabetes control, depression was evident in 71.7% of patients with acceptable diabetes control and 76.6% of those with poor control with no significant difference (P-value = 0.293), anxiety was found in 43.3% for both groups (P-value = 0.980), while excessive daytime sleepiness was observed among 9.8% and 6.3% of acceptable vs. poor diabetes control, respectively (P-value = 0.50), Table 5.

In the present study, depression was present in 14.6% of the normal weight subjects, 23% of the overweight subjects, 21% of obese subjects, and in 2.8% of morbidly obese patients with no significant difference (P-value = 0.48). Table 6 illustrated the relationship of depression, EDS, and HbA1 to the body mass index.

In the current data, 100% of patients with excessive daytime sleepiness were depressed vs. 59% of those without EDS with significant differences (P-value = 0.011) Figures 1 and 2.

### Table 1: Characteristics of 178 patients with type 2 diabetes.

<table>
<thead>
<tr>
<th>Character</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>47.6 ± 12.32</td>
</tr>
<tr>
<td>Sleeping hours/night</td>
<td>7.44 ± 1.19</td>
</tr>
<tr>
<td>ESS</td>
<td>5.48 ± 2.45</td>
</tr>
<tr>
<td>BMI</td>
<td>28.93 ± 5.75</td>
</tr>
<tr>
<td>Duration of diabetes</td>
<td>6.72 ± 5.86</td>
</tr>
<tr>
<td>HbA1c</td>
<td>12.5 ± 6.2</td>
</tr>
<tr>
<td>Depression score</td>
<td>11.69 ± 6.1</td>
</tr>
<tr>
<td>Anxiety score</td>
<td>7.41 ± 3.78</td>
</tr>
</tbody>
</table>

### Table 2: Characteristics of 100 control subjects.

<table>
<thead>
<tr>
<th>Character</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>45.94 ± 9</td>
</tr>
<tr>
<td>Sleeping hours/night</td>
<td>7.78 ± 1.15</td>
</tr>
<tr>
<td>ESS</td>
<td>2.56 ± 1.24</td>
</tr>
<tr>
<td>Depression score</td>
<td>7.76.9 ± 5.6</td>
</tr>
<tr>
<td>Anxiety score</td>
<td>5.39 ± 3.32</td>
</tr>
</tbody>
</table>

### Table 3: Comparison between diabetic patients and control subjects regarding depression, anxiety and sleep character.

<table>
<thead>
<tr>
<th>Character</th>
<th>Diabetic No = 178</th>
<th>Controls No = 100</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>110 (61.8%)</td>
<td>30 (30%)</td>
<td>0.000</td>
</tr>
<tr>
<td>Anxiety</td>
<td>6 (3.3%)</td>
<td>5 (5%)</td>
<td>0.504</td>
</tr>
<tr>
<td>Daytime sleepiness</td>
<td>12 (6.7%)</td>
<td>0 (0%)</td>
<td>0.008</td>
</tr>
</tbody>
</table>
Discussion

In the present study, depression was found in 61.8% of diabetic patients and 30% of control subjects (who had not been previously diagnosed). Consistent with our findings, a study conducted in Gasim KSA reported depression in nearly half of the patients with type 2 diabetes. Similarly, Palizqir et al. in Iran reported depression in 70% of diabetic patients. The current prevalence in this study was higher than previously reported studies conducted in KSA and Zabol which reported depression in 31.1% and 34%, respectively. A researcher from Riyadh KSA in his research on diabetic patients (type 1, type 2, and gestational diabetes) reported a lower rate of depression (37.9% in type 2 diabetes). One plausible explanation is the relatively small size of his study (39 type 2 diabetic patients). In the current study, mild, moderate, and severe depression were evident in 35.9%, 24.8%, and 1.1%, respectively, consistent with the present finding from Mirghani et al. who reported that mild and moderate depression were more common than severe depression among Sudanese diabetic patients.

In the current study, no statistically significant difference was reported between depressed and non-depressed diabetic patients with regards to glycated haemoglobin. Similar studies from Germany indicated that no relationship between affective disorders and glycated haemoglobin after controlling for socio-demographic data, mental health utilization, and personality characteristics. In contrast to the present data Almahalli conducted a study in Eastern KSA and found that depressed patients with type 2 diabetes had poor glycaemic control. In addition, previous studies reported poor diabetes control among patients with moderately severe/severe depression. This can be explained by the fact that only a minority (1.1%) of the current sample had severe depression. Similarly, researchers from Japan reported a significant relationship between severity of depression and diabetes complications among elderly patients.

The present data showed that excessive daytime sleepiness was evident in 6.7% of diabetic patients and was not detected in control subjects with significant difference. This is consistent with the present finding by Ramtahal et al. which reported that 11.3% of diabetic patients had poor glycaemic control. In addition, previous studies reported poor diabetes control among patients with moderately severe/severe depression. This can be explained by the difference in the number of hours of sleep and the small study sample size. In the present study, we found no statistically significant difference between patients with and without excessive daytime sleepiness with regards to diabetes control. Similarly researchers from Korea reported that excessive daytime sleepiness was present in 8.5% of diabetic patients but not related to the degree of diabetes control.

In the present study anxiety was reported in 3.3% of diabetic patients and 5% of control subjects with no statistically significant difference, in contrast Kruse et al. reported a significant difference between patients with diabetes and controls with regards to anxiety. This may be explained by the different methods used (i.e., the Hamilton

Table 4: The severity of depression among patients with type 2 diabetic patients and control subjects.

<table>
<thead>
<tr>
<th>Severity</th>
<th>Patients No = 178</th>
<th>Controls No = 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>35.9%</td>
<td>24%</td>
</tr>
<tr>
<td>Moderate</td>
<td>24.8%</td>
<td>5%</td>
</tr>
<tr>
<td>Severe</td>
<td>1.1%</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>61.8%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Table 5: relationship of HbA1c to various parameters.

<table>
<thead>
<tr>
<th>Character</th>
<th>HbA1c &lt; 8 No = 92 (%)</th>
<th>HbA1c &gt; 8 No = 47 (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>66 (71.7%)</td>
<td>36 (76.6%)</td>
<td>0.293</td>
</tr>
<tr>
<td>Anxiety</td>
<td>4 (4.3%)</td>
<td>2 (4.3%)</td>
<td>0.980</td>
</tr>
<tr>
<td>Daytime sleepiness</td>
<td>9 (9.8%)</td>
<td>3 (6.3%)</td>
<td>0.500</td>
</tr>
</tbody>
</table>

Table 6: The relationship of depression, EDS, and HbA1c to body mass index (BMI).

<table>
<thead>
<tr>
<th>Character</th>
<th>Normal weight</th>
<th>Overweight</th>
<th>Obesity</th>
<th>Morbid obesity</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>14.6%</td>
<td>23%</td>
<td>21.3%</td>
<td>2.8%</td>
<td>0.481</td>
</tr>
<tr>
<td>EDS</td>
<td>1.1%</td>
<td>3.3%</td>
<td>2.2%</td>
<td>0%</td>
<td>0.764</td>
</tr>
<tr>
<td>HbA1c ≤ 8</td>
<td>8.4%</td>
<td>22.5%</td>
<td>0%</td>
<td>1.6%</td>
<td>0.191</td>
</tr>
</tbody>
</table>

* Percentages were calculated out of the 178 diabetic patients.

Figure 1: Depression among Diabetic Patients with EDS.

Figure 2: Depression among Diabetic Patients without EDS.
Anxiety Scale versus the Composite International Diagnostic interview used in the Kruse study). In addition age, occupation, and income may be different between the two samples.

Previous studies\(^3\) have linked excessive daytime sleepiness, overweight, and obesity to incident depression. In the current study, depression was more common among patients with excessive daytime sleepiness. In agreement with the previously mentioned observation, no significant differences were evident between normal weight, overweight, and obese patients regarding, EDS, depression, and glycated haemoglobin. This may be explained by the smaller sample size of the current study, or differences in age, gender, and menopausal status between the groups.\(^3\)

In the present study less than a quarter of diabetic patients \(33/139 = 23.7\%\) met the American Diabetes Association (ADA) guidelines for the glycated haemoglobin (HbA1c) targets \((HbA1c 12.5 \pm 6.2)\). Similar studies from KSA\(^3\) reported that only 24.2\% of diabetic patients met the goals for HbA1c. Researchers from Riyadh KSA\(^3\) reported a rate of 18—35\% achievement of HbA1c targets which is in agreement with the current data.

In conclusion: Depression and excessive daytime sleepiness were more common among patients with type 2 diabetes in Tabuk, KSA. We found no difference in anxiety rate between diabetic patients and control subjects. No significant differences were observed in patients with depression, daytime sleepiness, and anxiety with regards to HbA1c and body mass index. Low rate of achievement of the HbA1c targets was reported.

The current study has many limitations: First the small size of the survey sample, secondly it was conducted at a single diabetic centre. In addition we were unable to control for confounding factors such as diabetic complications because the glycated haemoglobin was not measured for control subjects to exclude undiagnosed diabetes mellitus or prediabetic cases.

Recommendations: Screening for depression and excessive daytime sleepiness should be part of holistic diabetes care for early detection and treatment when appropriate. Larger multicentre studies are needed to investigate predictors of high glycated haemoglobin (HbA1c). Measures to improve the diabetes control in Tabuk, KSA are strongly recommended. Physicians looking for patients with diabetes need to follow the guidelines for the management of diabetes.

Conflict of interest

The authors have no conflict of interest to declare.

Authors’ contributions

HOM conceived and designed the study, conducted research, data acquisition, interpretation, and manuscript drafting. ASE substantial contribution regarding conception and design, data analysis, and manuscript writing. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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