Prevalence and Correlation of Depressive Disorders in Elderly with Type 2 Diabetes in Primary Health Care Settings

Shehatah A [1], Rabie M[2], Al-Shahry A[3]

[1]Department of Geriatric, Ain-Shams University, Cairo, Egypt.
[2]Institute of Psychiatry, Ain-Shams University, Cairo, Egypt.
[3]Primary Health Care Centers, Industrial Jubail, Royal Commission, KSA.

ABSTRACT

Background: Depression is associated with poor glycemic control and complications in people with type 2 diabetes (T2DM). **Objective:** We assessed the prevalence of depressive symptoms and antidepressant medication use among elderly with and without T2DM and the association between depression and diabetes complications. **Subjects and methods:** In 2004-2006, the primary health care research in T2DM study applied the Beck Depression Inventory II (BDI-II) to 458 participants with T2DM (47% male, aged 65±8.9 years, T2DM duration 19 ± 8.7 years) and 546 participants without diabetes (non diabetic group) (51% male, aged 59 ± 8.7 years). Use of antidepressant medication was self-reported. Depressive disorder was defined as a BDI-II score >14 and/or use of antidepressant medication. Occurrence of diabetes complications (retinopathy, blindness, neuropathy, diabetes-related amputation, and kidney or pancreas transplantation) was self-reported. **Results:** Mean BDI-II score, adjusted for age and sex, was significantly higher in participants with type 2 diabetes than in non diabetic participants (least-squares mean ± se: 7.4±0.3 vs. 5.0±0.3; p<0.0001). The prevalence of depressive disorder (as defined by BDI-II>14 and/or antidepressant use) in participants with T2DM was significantly higher than that of age- and sex-adjusted non diabetic participants (32.1 vs. 16.0%, p<0.0001). T2DM participants reported using more antidepressant medications (20.7 vs. 12.1%, p=0.0003). More type 2 diabetic than non diabetic participants were classified as depressed by BDI-II cut scores (17.5 vs. 5.7%, p<0.0001) or by either BDI-II cut score or antidepressant use (32.1 vs. 16.0%, p<0.0001). Participants reporting diabetes complications (n=209) had higher mean BDI-II scores than those without complications (10.7±9.3 vs. 6.4±6.3, p<0.0001). **Conclusion:** Depression is highly prevalent in T2DM and requires further study on assessment and treatment.

Key words: Depressive disorders, Type 2 Diabetes, Primary Care, Egypt.

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INTRODUCTION

Type 2 diabetes (T2DM) is a chronic illness that requires continuing medical care, education, and diligent patient self-management to prevent acute complications and to reduce the risk of long-term complications. Yet many patients do not achieve glycosylated hemoglobin (GHb) levels <7.0%, the American Diabetes

Association goal to prevent complications[1]. Depression is a modifiable risk factor whose treatment could improve glycemic control and health outcomes in patients with T2DM.

In people with diabetes, depression has been associated with hyperglycemia[2-3]; lower levels of diabetes self-care[3]; complications, including cardiovascular disease[4-5], neuropathy[6-7], and retinopathy[2, 6] and increased mortality[8]. However, few data are available regarding prevalence of depression in individuals with T2DM compared with the general population. A meta-analysis done led to the conclusion that the prevalence of depression in adults with any type of diabetes is double that of individuals without diabetes[9]. Since then, results from the 2006 Behavioral Risk Factor Surveillance System[10] have found the age-adjusted prevalence of major depression in individuals with diabetes to be 8.3%. These findings must be interpreted carefully; however, many studies on the subject of depression and diabetes have methodological limitations such as lack of control group, small sample size, and failure to distinguish between type 1 diabetes (T1DM) and T2DM[9, 11]. Where there is no control group, recruitment bias can limit generalizability. Since T1DM and T2DM differ considerably in terms of age of onset, duration, day-to-day management, presence of co morbid conditions, and nature and onset of complications, depression may affect the two conditions differently and different processes may be involved in the development of depression in individuals with T1DM and T2DM. Therefore, inferences from combined groups may not represent diabetes type-specific prevalence of depression. As an example, of 42 studies analyzed in the Anderson meta-analysis, 22 (52%) did not use a control group, and of 20 controlled studies, only 3 reported separate results for T1DM and T2DM[9].

In this study, we aimed to assess the prevalence of depressive disorders defined by self-reported questionnaire and/or antidepressant drug use in a cohort of adults with and without T2DM. We also aimed to confirm previous findings suggesting that depressive disorders are associated with elevated GHb, and diabetes complications in adults with T2DM.

SUBJECTS AND METHODS

The data presented in this study were collected as part of the usual refilling visits in the Primary Care Centers of Royal Commission in Industrial Jubail City from 2004 to 2006. At the time of this analysis, 1,130 elderly attendants had completed the monthly visit. Participants without diabetes were recruited from the community and include spouses, neighbors, and friends of T2DM participants to reduce potential differences in socioeconomic and educational factors. Questionnaires were completed by 1,004 participants (88.9% of second-visit participants), including 458 T2DM participants (47% male, aged 65±8.9 years, T2DM duration 19±8.7 years) and 546 non diabetic participants (51% male, aged 59±8.7 years).

The Beck Depression Inventory II (BDI-II) is a 21-item self-report instrument that assesses the severity of depressive symptomatology in adolescents and adults. It is a revised version of the original BDI[12], updated to correspond to criteria from the *Diagnostic and Statistical Manual of Mental Disorders*[13]. Each of the 21 items measures the presence and severity of a somatic or cognitive symptom of

depression, rated on a 4-point scale ranging from 0 to 3. The ratings are summed, yielding a total score that can range from 0 to 63. The BDI-II has been validated as a sensitive, specific, and predictive tool for measuring depression[14]. Despite the fact that the somatic symptoms of preexisting medical conditions such as diabetes may overlap those of depression, studies have shown that the somatic items do not interfere with the discriminative capacity of the BDI-II in primary-care settings[15] or in participants with diabetes[7]. The BDI-II has also been shown to be sensitive and specific at any phase of a depressive disorder[16].

Use of antidepressant medication was self-reported (participants brought their medications to the study visit for verification) and included use of selective serotonin reuptake inhibitors, norepinephrine/dopamine reuptake inhibitors, selective norepinephrine reuptake inhibitors (SNRIs), tetracyclic antidepressants, and tricyclic antidepressants.

Depressive disorder was defined as use of at least one antidepressant medication and/or, a BDI-II score >14. Occurrence of diabetes complications (retinopathy, blindness, neuropathy, diabetes-related amputation, and kidney or pancreas transplantation) was self-reported. Descriptive statistics were reported as means and frequencies with *P* values for differences between groups.

ANCOVA, independent-sample *T* tests, and Pearson correlations were used for hypothesis testing for continuous outcomes, and the $[CHI]^2$ test of independence and logistic regression were used for hypothesis testing for categorical outcomes. A $P<0.05$ was considered statistically significant. SAS 9.1 was used for all statistical analysis.

RESULTS

Characteristics of the 1,004 participants in this study were as follows: 458 T2DM patients (47% male, aged 65±8.9 years, T2DM duration 19 8.7 years) and 546 non diabetic participants (51% male, aged 59±8.7 years) (table 1).

Table 1: Participant's characteristics

	T2DM subjects	Non diabetic subjects
n	458	546
Age (years)	65+/-8.9	59+/-8.7
Male sex	214(46.7%)	277(50.8%)
Diabetes duration (years)	19+/-8.7	
GHb (%)	7.9+/-1.2	5.6+/-0.5
BMI(Kg/m²)	26.8+/-4.8	26.6+/-4.8
BDI-2 score	7.4+/-7.3	5.0+/-5.4
Antidepressant medication use	93(20.7%)	65(12.1%)
Length of time on antidepressant medications (years)	3.65+/-3.37	2.88+/-3.08
Complications(total)	209(45.7%)	
Retinopathy	166(36.5%)	
Blindness	27(6%)	
Neuropathy	97(21.4%)	
Amputation	6(1.3%)	
Transplantation	6(1.3%)	

In our sample, the prevalence of depressive disorders (as defined by BDI-II >14 and/or antidepressant use) in participants with T2DM was significantly higher than that of age- and sex-adjusted non diabetic participants (32.1 vs. 16.0%, P<0.0001). A BDI-II score >14 was seen in 17.5% of type 2 diabetic participants compared with 5.7% in non diabetic participants (P<0.0001). Antidepressant use was reported in 20.7% of type 2 diabetic participants compared with 12.1% of non diabetic participants (P=0.0003). The length of antidepressant use was 3.65±3.37 years among those with diabetes and 2.88±3.08 years for control subjects (P=0.15). Among those being

treated for depression, 69.9% of T2DM participants and 84.6% of non diabetic participants had BDI-II scores <=14 at the time of the study (P=0.03). Participants with T2DM were 3.52 (2.28-5.43) times more likely to have a BDI-II score >14, were 2.48 (1.83-3.36) times more likely to have a past history of depression than non diabetic participants (P<0.0001 for each), and were 1.89 (1.34-2.67) times more likely to be on antidepressant medications than non diabetic participants (P=0.0003) in unadjusted analyses. In logistic regression adjusted for age and sex, participants with T2DM were 3.66 (2.35-5.71) times more likely to have a BDI-II score >14, were 2.60 (1.90-3.56) times more likely to have a past history of depression than non diabetic participants (P <0.0001 for each), and were 1.99 (1.39-2.84) times more likely to be on antidepressant medications than non diabetic participants (P=0.0002). Participants with diabetes were also more likely to have (at least) moderate depression (BDI-II >=20) than those without diabetes (6.1 vs. 2.4%, P=0.003; odds ratio 2.65 [95% CI 1.34-5.23], P=0.005.)

Data are percent, unless otherwise indicated. * P<0.0001 for men with type 2 diabetes vs. men without. † P<0.0001 for women with type 2 diabetes vs. women without. ‡ P<0.0001 for all with T2DM compared with all control subjects. Ξ P=0.003 for women with type 2 diabetes vs. women without. ∏ P=0.0003 for all with T2DM compared with all control subjects.

Mean BDI-II score, adjusted for age and sex, was significantly higher in participants with T2DM than in non diabetic participants (least-squares means ± SE: 7.4±0.3 vs. 5.0±0.3; P<0.0001). Depressive disorders by BDI-II cut score and/or antidepressant use was more prevalent in women with T2DM (37.9%) than in non diabetic women (20.5%, P<0.0001) and in men with T2DM than in non diabetic men (25.5 vs. 11.6%, P<0.0001) (table 2). Within type 2 diabetes participants, there was still a difference between men (25.5%) and women (37.9%) in the frequency of depressive disorders by BDI-II cut score and/or antidepressant use (P=0.005) but not when depressive disorders was defined only by a BDI-II score (14.5% for men vs. 20.1% for women, P=0.12). Depressive disorders defined by BDI-II score alone was more prevalent in women with T2DM than in non diabetic women (20.1 vs. 7.8%, P<0.0001) and in men with T2DM than in non diabetic men (14.5 vs. 3.6%, P<0.0001). Women with T2DM had higher BDI-II scores than non diabetic women (7.6±7.3 vs. 5.7±5.9, P = 0.0012), and men with type 2 diabetes had higher BDI-II scores compared with non diabetic men (7.1±7.3 vs. 4.3±4.8, P<0.0001). However, BDI scores were similar among men and women with T2DM (7.1±7.3 vs. 7.6±7.3, P= 0.50).

Table 2: Prevalence of depressive disorders by sex and diabetes

	Men	Women	P	All
Type 2 DM				
BDI-2 ≥ 14	14.5*	20.1†	0.12	17.5‡
Antidepressant use	13.7	26.8Ξ	0.0007	20.7‡
BDI-2 ≥ 14 or medications	25.5*	37.9†	0.005	32.1 ∏
No diabetes				
BDI-2 ≥ 14	3.6	7.8	0.032	5.7
Antidepressant use	8.4	16.0	0.007	12.1
BDI-2 ≥ 14 or medications	11.6	20.5	0.005	16.0

Data are percent, unless otherwise indicated. aP=0.0016 for T2DM w/o complications versus Non-DM controls. bP=0.0053 for T2DM w/o complications

versus Non-DM controls. cP=0.0001 for T2DM w/o complications versus Non-DM controls.

Current GHb was not correlated with BDI-II score in type 2 diabetic participants (r=0.07, P=0.14); however, type 2 diabetic participants with a history of depression had slightly higher GHb than those without depression (8.1±1.2 vs. 7.8±1.1%, P=0.013). Type 2 diabetic participants reporting the presence of at least one complication (n=209) had significantly higher BDI-II scores than those without complications (8.8±8.2 vs. 6.1±6.1, P<0.0001) and were more likely to be depressed by BDI-II cut score (23.4%) than type 2 diabetic participants without complications (12.1%, P=0.002) (Table 3). Both those with (8.8 ± 8.2) and those without (6.1±6.1) complications had significantly higher BDI-II scores than control subjects (5.0±5.4, P<0.05 both), had higher prevalence of depressive disorders by BDI-II scores, BDI-II or antidepressant use, and antidepressant use alone. Among those with diabetes, the number of complications was positively correlated with BDI-II total scores (R=0.25, P<0.0001).

Table 3: Prevalence of depressive disorders by complication status

	T2DM w/o Complications	T2DM with Complications	Non-DM	p-value
Depressed by BDI-II > 14	12.1a	23.4	5.7	< 0.0001
Antidepressant use	19.7b	21.8	12.1	0.0010
BDI or Medications	27.9c	36.7	16.0	< 0.0001

DISCUSSION

Despite published data on depression and diabetes, these results are some of the first to specifically demonstrate an increased prevalence of depressive disorders among elderly with T2DM compared with age- and sex-matched control subjects. We have shown that elderly with T2DM are more than twice as likely as elderly without diabetes to have depressive disorders as assessed by BDI-II >14 and/or current antidepressant use. In this sample, those with T2DM were more than three times as likely to have a clinically significant score on the BDI-II and almost twice as likely to be on antidepressant medication as non diabetic subjects.

Previous literature has estimated the rate of depression in diabetes to be between 3.8 and 27.3%[10]. In this large cohort, the prevalence of depressive disorders in type 2 diabetes was 32.1% defined by either BDI-II score >14 or antidepressant medication use. Previous studies have used a wide variety of measures and criteria for diagnosing depression, and BDI-II scores of >14 are considered indicative of mild depression. Another possible explanation is that depressive disorders may be more common in T2DM than in T1DM, since previous studies have mainly reported on a mixed sample of T1DM and T2DM. In addition, the inclusion of current antidepressant medication use as an indicator of depression in this study may capture individuals successfully treated for

depressive disorders that may no longer score high on depression assessment tools.

Findings regarding the association between depressive disorders and hyperglycemia have been inconsistent in the literature. Although GHb was not significantly correlated with BDI-II score in all participants with T2DM, we found a significant relationship between GHb and a history of depression among participants with T2DM. This could be due in part to the data being cross-sectional. This lack of significant correlation has been seen in previous studies[17], although a significant correlation has been found elsewhere[3, 18].

Our data confirm previous findings regarding the association of depression with complications of diabetes. Type 2 diabetic participants reporting the presence of at least one diabetes complication scored significantly higher on the BDI-II than participants with no complications.

The etiology of the relationship between T2DM and depression is likely to be multifactorial. First, depressive symptomatology may be a response to the psychosocial stress caused by living with the demands and constraints imposed by T2DM. Second, biological processes specific to diabetes, such as insulin resistance, changes in brain structures such as the hippocampus, and inflammatory processes, may be related to psychological symptoms[4]. Third, because both conditions are prevalent, they may coexist coincidentally. Further research into the mechanisms involved in the observed relationship is needed.

There are several important strengths of this study. As previously discussed, this is the first large-scale assessment of depressive disorders in a T2DM-specific population that uses a control group composed of friends, neighbors, and spouses to reduce the potential for selection bias in socioeconomic status and related factors. Also, the use of both a well-validated depression assessment tools and antidepressant medication use as indicators of depressive disorders improves ascertainment of cases to include both currently treated and untreated depression.

This study has several limitations. First, the use of a self-report questionnaire is cost- and time-effective, but the preferred method of psychological diagnosis is generally by diagnostic interview with a psychiatrist. It has been suggested that self-report questionnaires may overestimate prevalence of depression compared with diagnostic interview[9,11] and it may be more appropriate to use the term “clinically significant levels of depressive symptoms” in the context of this study. However, diagnostic interviews identify major depressive disorder but may exclude other clinically relevant presentations. The presence of depressive symptomatology in general may be better assessed with a tool such as the BDI-II. Another limitation of this study is its cross-sectional nature, meaning that cause-effect relationships cannot be determined. Since symptoms and therefore measurements related to both diabetes and depression can fluctuate significantly over time, a longitudinal design may give a more accurate picture of this relationship. In T2DM participants, for example, GHb captured at a specific point in time may reflect a number of mediating circumstances and is not as informative as GHb pattern over long periods of time. It is possible that a stronger correlation between glycemic control and depressive disorders in type 2 diabetes would be found with a longitudinal study design.

Depressive symptomatology can severely compromise day-to-day functioning and, in the absence of treatment, tends to follow a chronic or relapsing course[7]. In addition to the detrimental effects on essential daily self-care behaviors, there are significant health care costs associated with depression in patients with diabetes[19]. Screening patients with type 2 diabetes for depressive symptoms is vital. Our data also suggest that appropriate intervention is especially important in patients with complications of diabetes, as they are especially likely to suffer from depressive symptoms according to our data. Treatment of depression should be accompanied by prospective assessment of its efficacy in improving mental health symptoms as well as diabetes health outcomes.

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Address of correspondence:

Rabie M. Lecturer of Psychiatry**,** Institutet of Psychiatry**,** Faculty of Medicine**,** Ain-Shams University, Cairo, Egypt.