Depressive symptoms and disorders in type 2 diabetes mellitus

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Purpose of review
To examine developments in the understanding of certain aspects of depression in diabetes mellitus patients with a special focus on diabetes distress, screening of depression and its management in persons with type 2 diabetes mellitus.

Recent findings
Recent studies reviewed indicate an increasing trend of both major and minor depression in patients with diabetes. Depression is also reported to be persistent and chronic in diabetes patients. There is a bidirectional link between depression and diabetes. Diabetes-related distress independently increases the diabetes-related complications. Collaborative care is both applicable and helpful in managing depression in diabetes.

Summary
Although a significant number of patients with diabetes suffer from depression or diabetes-related distress, majority of them remain undiagnosed and untreated. This treatment gap suggests the need for routine screening for depression and distress in patients with diabetes. Studies have confirmed that treatment focussing on diabetes may alleviate depressive symptoms. Diabetes-specific psychological interventions may prove useful in improving diabetes self-management in depressed diabetes patients. Effect of specific psychopharmacological and psychological interventions in treating depression in diabetes patients should be examined in future studies.

Keywords
depression, diabetes distress, management, screening, type 2 diabetes mellitus

INTRODUCTION

Depressive disorders and diabetes are interrelated, widely prevalent across the world and contribute to the major disease burden globally. Persons with diabetes may suffer from emotional distress related to diabetes. Presence of depressive symptoms or distress is associated with poor medication adherence, poor lifestyle and unhealthy eating habits with low exercise rate, which in turn increases the possibility of medical complications and mortality [1▪▪]. Further, depression remains poorly recognized and inadequately managed in patients with diabetes. In this review, we have described the recent epidemiology, risk factors, bidirectionality of relationship between diabetes and depression, diabetes distress, screening and management of depression in type 2 diabetes mellitus.

DEPRESSION IN DIABETES

Epidemiology

Recent reports indicate that the rate of depression in type 2 diabetes mellitus (T2DM) patients is increasing [2,3▪]. The recently completed multicentre study across 14 countries, International Prevalence and Treatment of Diabetes and Depression (INTERPRET-DD), found the prevalence of depression in diabetes to be 10.6%; and moderate-to-severe depressive symptoms, as per Patient Health Questionnaire-9 (PHQ-9), to be 17%. Depression was significantly more often reported by women, those who had low exercise activity, lower level of education, higher distress score and past history of depressive episodes [4▪▪]. Another study reported that minor depression was equally prevalent as major depression in patients with T2DM [5]. Subthreshold

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KEY POINTS

- Depression is common in diabetes, and this association between diabetes and depression is bidirectional. Numerous mechanisms are considered to underlie this association between diabetes and depression.
- Depression often goes undetected and untreated in persons with diabetes and adversely affects adherence to the management of diabetes.
- Collaborative interdisciplinary care is recommended with diabetes-specific psychological interventions and psychopharmacological interventions in the management of depression in diabetes.

depression in patients with T2DM was reported to be 11.6% in another study from a developing country [6▪]. A recent meta-analysis from India showed the pooled prevalence of depression in T2DM patients to be 38% [95% confidence interval (CI): 31–45%] [7]. Lotfaliany *et al.* [8▪] found odds of developing depression in diabetes patients to be 1.47 (95% CI: 1.24, 1.75). Study on hospitalized patients with diabetes found depression in up to half of the patients and among half of them, the severity of depression was moderate to severe. Older age, low income and nephropathy were significantly associated with depressive symptomatology in these populations [9]. Depression was noted to be more prevalent in recent onset diabetes compared to long duration diabetes [10] and women [11]. The relationship of depression and duration of diabetes is unique, with more cases of depression soon after diagnosis, and then the incidence decreases with time, again to rise at late stage with the development of complications of diabetes [1▪▪]. The prevalence of depression in T2DM is summarised in Table 1 [4▪▪,6▪].

Course of depression in patients with diabetes varies, and some may have recurrent depression (4.6% in INTERPRET DD study) [4▪▪]. A recent 5-year follow up study found three trajectories of depression in patients with diabetes. Majority had long standing depression with continuous course (85.2% in a recent cohort study), some had gradually worsening at first then improving course (7.3%) and others have gradually improving then worsening course (7.5%). Younger age, women and a lifetime history of major depressive disorder were associated with greater risk of persistent depressive symptoms [12]. However, most cases of depression in persons with diabetes remain undiagnosed [8▪]. INTERPRET-DD found that among cases who were diagnosed at interview as having depression, only negligible number were detected at their primary treatment setting or receiving any treatment for their depression [4▪▪].

Table 1. Prevalence of depression and depressive symptoms in diabetes

• Major depression–10.6% [4▪▪]
• Moderate-to-severe depressive symptoms–17% [4▪▪]
• Subthreshold depression–11.6% [6▪]
• Diabetes distress–12.8%

Table 2. Pathophysiology of depression in diabetes

• Lifestyle factors
• HPA axis dysregulation
• Immune and inflammatory mechanism
• Shared genetic factors
• Brain insulin resistance
• Circadian rhythm dysregulation

Pathophysiology of depression in diabetes (Table 2)

Depression can occur as a reaction to lifestyle modifications and dietary restrictions [13]. In a recent cohort study, a less authoritative parenting style, lower parent collaborative involvement and greater diabetes-related conflict were associated with baseline depression, whereas latter two factors were longitudinally associated with depression in youth with T1DM at 2 year of follow-up [14].

HPA axis dysregulation, being a common mechanism for depression and insulin resistance, may be a critical link in the high prevalence of coexistent depression and diabetes [15]. Immune system has also been linked with co-occurrence of diabetes and depression. Higher baseline CCL2 level, longitudinal changes in inflammatory markers (hsCRP, IL-18 and IL-1RA) have been found to be associated with lower rates of depression in T2DM but not in type 1 diabetes. These findings may indicate difference in pathophysiological mechanism of depression in different types of diabetes [16]. Although there are independent association of low-grade inflammation with both depression and diabetes mellitus, its role in co-occurrence of the two conditions has not been studied adequately [17]. However, S100B, a glial protein which is found to be associated with depression in many patients, was found to be unrelated to depression in T2DM patients [18].

Genetic studies have found that depression may be causally linked with diabetes. Thirty four single nucleotide polymorphisms (SNPs) on various chromosomes have been found to be associated with

diabetes, and higher score of these SNPs was found to be associated with the presence of depression. The T2D_Genetic Risk score was found to be associated with depression with an odds ratio of 1.21 (95% CI: 1.07–1.37) after adjustments for age, sex, BMI, current smoking and drinking, physical activity, education and marital status [19▪].

Previously, it was thought that brain is insulin insensitive, but recent findings indicate that insulin and insulin signalling are associated with neuromodulation, neuroprotection and neurotransmission of various key neurotransmitters. Brain insulin resistance, which may be secondary to peripheral insulin resistance, has been linked to depressive symptoms through changes in neuronal functions [20].

Circadian rhythm has been found to be linked with glucose homeostasis and mood regulation and its disruption is noted to be associated with insulin resistance and diabetes, as well as depression [21].

Bidirectional relationship

There seems to be a bidirectional relationship between depression and diabetes mellitus. A meta-analysis by Zhuang *et al.* [22] showed that the risk of developing depression in diabetes patients compared to nondiabetes patients is similar to the risk of developing diabetes in depressed patients compared to nondepressed patients. Another cohort study observed a positive association between past year major depressive episode and risk of T2DM. The association was independent of other major diabetes risk factors [23▪]. The bidirectional link between depression and diabetes may be explained by shared mechanism of pathogenesis of both disorders. Inflammation, dysregulation of hypothalamo–pituitary–adrenal (HPA) axis, leptin and shared genetic factors, such as MC4R, NR3C1 and NR3C2 genes, are linked to cause both the disorders [24▪]. Ca2+ signalling and its dysregulations have also been involved in the pathogenesis of both diabetes and depression, hence providing a 'bidirectional link' for these diseases [25▪].

Diabetes distress

Diabetes-related emotional distress or diabetes distress is a relatively newly recognized clinical concept. Diabetes distress affects 12–25% of patients with diabetes [4▪▪,26]. Patients with diabetes can develop this distress that mimics the presentation of depression. It is associated with the challenges of living with diabetes [27]. The burden of self-management, living with diabetes-related complications (or the risk of their development) and managing difficult social situations have the potential to cause considerable emotional distress [28]. Diabetes distress remains persistent over time and is found to be distinct from clinical depression related to disease management. Previous reports had suggested that most patients with high depressive affect are not necessarily clinically depressed, but rather they are suffering from high levels of diabetes-related distress. It was found that 17.2% of patients with diabetes without diabetes distress at initial assessment reported high diabetes distress during the following 18 months. It is not only burdensome itself, but it can also impede the self-caring behaviour of patients, thereby compromising glycaemic control as compared to those who are nondepressed and nondistressed [29]. One specific domain of diabetes-related distress relates to the burden of management. Patients, prescribed a multipronged treatment plan, show more distress in their first year following diagnosis, but patients undergoing fewer intensive treatments may not develop distress for several years after diagnosis. Levels of distress increase with the burden of management [1▪▪]. Distress related to diabetes is found to be associated with depression in prospective studies. Reduction in diabetes distress score is associated with increased odds of reduction of depressive symptoms as well as remission [30]. The management of diabetes distress and depression is different. Diabetes distress needs validation of patient's concerns from clinician side, counselling reassurance, encouraging discussion and help in behavioural changes [1▪▪].

Impact of depression on diabetes

Psychosocial impact

Depression affects dietary habits in type 1 diabetes patients, with higher depression score indicating a 'sweet' pattern of diet and lower score indicates more healthy diet [31]. Depression was associated with lesser likelihood to avoid saturated fat and higher chance of physical inactivity in patients with T2DM [32]. Depression was associated with poorer self-efficacy in patients with T2DM [33]. Depression or depressive symptoms have been associated with adverse clinical profiles, including erratic eating habits and poor exercise adherence in those with T2DM [1▪▪]. There is significant medication nonadherence in patients with depression as compared to nondepressed in patients with T2DM, which leads to poorer diabetes control [34]. Depression and diabetes distress are also related to poorer health literacy regarding diabetes and poorer self-care in patients with diabetes [35].

Metabolic impact

Depression has been found to be associated with poor glycaemic control [1▪▪] and higher HbA1c [32]. Women with depression have been reported to have higher HbA1c values, reflecting poorer metabolic control as compared to male patients, in whom no association was found with depression and metabolic control. This suggests that women are more vulnerable than men for depression whenever there is poor glycaemic control [36▪]. On the contrary, another study found that poor glycaemic control increased the depressive symptoms severity by increasing diabetes distress and depression itself does not influence glycaemic control [37].

Other impacts

In a recent study, the severity of depressive symptoms was significantly associated with all-cause mortality after adjustment for potential confounders including severe hypoglycaemia. Severe depressive symptoms may be a risk factor for death independent of severe hypoglycaemia in T2DM. In addition, the risk of death increased slowly at the lower level of total Center for Epidemiologic Studies Depression Scale (CES-D) scores and increased acceleratingly at higher levels in patients with T2DM [38]. Depression also predicts higher chance of cardiac failure in patients with diabetes mellitus in long term in elderly people [39].

Depression increases the risk for cognitive dysfunction and dementia in patients with diabetes and this association is more than just additive effect of both disorders. Depression also increases the risk of macrovascular complications like coronary artery disease and stroke in diabetes patients [1▪▪].

Screening for depression

Several guidelines have put emphasis on screening for depression in patients with diabetes [40]. The American Diabetes Association (ADA) guidelines recommend psychological and social assessment as part of diabetes management, including screening for depression and diabetes-related distress. The ADA guidelines recommend that patients with diabetes be routinely screened for psychosocial problems (e.g. depression) with the Patient Health Questionnaire (PHQ)-2, PHQ-9 (as follow-up if the PHQ-2 is positive), or another validated screening tool [27]. Other self-report screening questionnaires used in T2DM include the following: Center for Epidemiologic Studies Depression Scale (CES-D), Beck Depression Inventory (BDI), World Health Organization (WHO) Well Being Index and Edinburgh Depression Scale (EDS), among others. Self-report scales are used commonly in T2DM [1▪▪]. Diabetes MILES-Australia study found WHO 5 (wellbeing index) as valid and reliable screening tool when cut-off score is less than 13, (sensitivity/specificity is 0.79/0.79, respectively) irrespective of diabetes type or treatment [41]. For measuring diabetes distress, INTERPRET DD used Problem Areas in Diabetes (PAID) scale [4▪▪]. Another scale used to measure diabetes distress is Diabetes Distress Scale 17 (DDS 17) [1▪▪]. Healthcare providers should be encouraged to use both screening tools on patients with suspected depression or diabetes distress during initial and follow-up visits to monitor for changes in depressive symptoms and to monitor the patients' perceived emotional well being over time [27].

Management

The secondary analysis of DIAMOS (Diabetes Motivation Strengthening) study has found that reduction of depressive symptoms predicts improved glycaemic control. More the reduction in depression score, the better is the outcome in HbA1c score, and HbA1c score may reach target level (<7.5%) at follow-up if there is significant reduction in depressive score [42]. Therefore, treating depression in diabetes is necessary for both better control of diabetes and better quality of life. The Care of Mental, Physical and Substance use Syndromes (COMPASS) initiative in United States has shown better care for depression as well as diabetes and cardiovascular risks and laid emphasis in collaborative care for these disorders together and has also shown its applicability across various healthcare settings [43].

Pharmacological intervention

Treatment targeting insulin resistance may have a role in reducing cognitive defects and anhedonia in patients with depression in diabetes mellitus. Several treatment options have been explored including, intranasal insulin, intranasal insulin like growth factor and insulin sensitizing agents, such as peroxisome proliferator-activated receptor γ agonists and dipeptidyl peptidase 4 inhibitors [20]. There are few randomized clinical trials on the use of antidepressants in diabetes. A recent systematic review concluded that it is better to choose a selective serotonin reuptake inhibitor (SSRI) if possible, to treat a depression among patients with diabetes. If treatment with a tricyclic antidepressant is needed, closer glycaemic monitoring is recommended. There is a possible risk of hypoglycaemia when using SSRIs. Agomelatine and bupropion have shown promising results, but need more evidence of their efficacy [44].

Psychosocial intervention

Problem-solving therapy has been reported to improve metabolic parameters like HbA1c, and cholesterol in patients with diabetes mellitus and comorbid depression or anxiety. But this study had a limitation of lesser number of completers [45]. When compared to standard cognitive behaviour therapy (CBT) and diabetes-specific CBT (additional training in working with T2DM patients for general practitioner and clinical health psychologist), both groups had a reduction in depression and anxiety levels, with diabetes-specific group achieving more glycaemic control, better foot care and dietary control. This indicates that modified intervention is better as compared to standard psychological intervention in the management of depression in diabetes [46]. CBT has shown to reduce insulin resistance [20]. Compared with nurse led tele-health disease management, pharmacist led support has shown greater medication adherence in people with diabetes mellitus but overall reduction in depression score remains same [47]. Augmenting religious belief in patients with diabetes may reduce depressive symptoms [48]. Exercise also improves anhedonia and depression score probably through mechanisms like reducing insulin resistance [20].

Future researches are needed to identify specific risk factors for the development of depression in diabetes. Suitable preventive approaches, both psychosocial behavioural and psychopharmacological, need to be attempted using stringent randomized controlled trials.

CONCLUSION

Bidirectional relationship between diabetes and depression may account for their more than 'by chance' co-occurrence. Whatever the reason may be, this leads to poorer outcome of both diabetes and depression. Recent findings suggest that subsyndromal depression is equally common as major depression and there are overlapping symptoms with diabetes distress. This makes diagnosing and managing depression in diabetes challenging. Screening for depression in diabetes people should be a routine practice. Moreover, clinicians should be proactive in assessing for diabetes-related distress and discussing with patients. Both pharmacotherapy and psychological therapies are indicated for the management of depression and collaborative interdisciplinary care for the patients leads to better outcome.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES AND RECOMMENDED READING

Papers of particular interest, published within the annual period of review, have been highlighted as:
- ■ of special interest
- ■■ of outstanding interest

1. ■■ Darwish L, Beroncal E, Sison MV, Swardfager W. Depression in people with type 2 diabetes: current perspectives. Diabetes Metab Syndr Obes 2018; 11:333–343.

This recent narrative review talks about current perspective about diabetes and depression, relationship between them, implication for screening and management.

2. Chima CC, Salemi JL, Wang M, *et al.* Multimorbidity is associated with increased rates of depression in patients hospitalized with diabetes mellitus in the United States. J Diabetes Complications 2017; 31:1571–1579.
3. ■ Huang CJ, Hsieh HM, Tu HP, *et al.* Major depressive disorder in patients with type 2 diabetes mellitus: prevalence and clinical characteristics. J Affect Disord 2018; 227:141–148.

This large population-based study has looked into the prevalence and risk factors of depression in diabetes.

4. ■■ Lloyd CE, Nouwen A, Sartorius N, *et al.* Prevalence and correlates of depressive disorders in people with Type 2 diabetes: results from the International Prevalence and Treatment of Diabetes and Depression (INTERPRET-DD) study, a collaborative study carried out in 14 countries. Diabetic Med 2018; 35:760–769.

This multinational study has looked for the prevalence of depression in diabetes, cultural variation and correlates of depression in diabetes. It has also looked in to treatment gap in the management of depression in diabetes patients.

5. Golden SH, Shah N, Naqibuddin M, *et al.* The prevalence and specificity of depression diagnosis in a clinic-based population of adults with type 2 diabetes mellitus. Psychosomatics 2017; 58:28–37.
6. ■ Wang D, Shi L, Li L, *et al.* Subthreshold depression among diabetes patients in Beijing: cross-sectional associations among sociodemographic, clinical, and behavior factors. J Affect Disord 2018; 237:80–86.

This cross-sectional study from a developing country has looked for subthreshold depression, that is milder form of depression in diabetes patients, and also looked for correlation of subthreshold depression in diabetes.

7. Hussain S, Habib A, Singh A, *et al.* Prevalence of depression among type 2 diabetes mellitus patients in India: a meta-analysis. Psychiatry Res 2018; 270:264–273.
8. ■ Lotfaliany M, Bowe SJ, Kowal P, *et al.* Depression and chronic diseases: co-occurrence and communality of risk factors. J Affect Disord 2018; 241:461–468.

This cross-sectional study is a part of WHO Study on global AGEing and adult health (SAGE) Wave 1, in developing country. It has looked for the association of depression with various noncommunicable diseases.

9. AlBekairy A, AbuRuz S, Alsabani B, *et al.* Exploring factors associated with depression and anxiety among hospitalized patients with type 2 diabetes mellitus. Med Princ Pract 2017; 26:547–553.
10. Rathmann W, Kuß O, Anderson D, *et al.* Increased depression symptom score in newly diagnosed type 2 diabetes patients. Psychiatry Res 2018; 261:259–263.
11. Glick BA, Hong KM, Obrynba K, *et al.* Identifying depressive symptoms among diabetes type and the impact on hemoglobin A1C. J Pediatr Endocrinol Metab 2018; 31:39–44.
12. Whitworth SR, Bruce DG, Starkstein SE, *et al.* Depression symptoms are persistent in Type 2 diabetes: risk factors and outcomes of 5-year depression trajectories using latent class growth analysis. Diabetic Med 2017; 34:1108–1115.
13. Réus GZ, dos Santos MA, Strassi AP, *et al.* Pathophysiological mechanisms involved in the relationship between diabetes and major depressive disorder. Life Sci 2017; 183:78–82.
14. Dempster KW, Liu A, Nansel TR. Depression and parenting in youth with type 1 diabetes: are general and diabetes-specific parenting behaviors associated with depressive symptoms over a 2-year period? J Behav Med 2019; Available at: https://doi.org/10.1007/s10865-019-00011-w. [Accessed 13 May 2019]
15. Joseph JJ, Golden SH. Cortisol dysregulation: the bidirectional link between stress, depression, and type 2 diabetes mellitus. Ann NY Acad Sci 2017; 1391:20–34.
16. Herder C, Schmitt A, Budden F, *et al.* Longitudinal associations between biomarkers of inflammation and changes in depressive symptoms in patients with type 1 and type 2 diabetes. Psychoneuroendocrinology 2018; 91:216–225.

17. van Sloten T, Schram M. Understanding depression in type 2 diabetes: a biological approach in observational studies. F1000Research 2018; 7: Available at: https://doi.org/10.12688/f1000research.13898.1. [Accessed 13 May 2019].

18. Katsanou P, Tentolouris N, Perrea D, *et al.* S100B levels in patients with type 2 diabetes mellitus and co-occurring depressive symptoms. Depress Res Treat 2018; 2018: Available at; https://doi.org/10.1155/2018/5304759. [Accessed 13 May 2019].

19. ■ Xuan L, Zhao Z, Jia X, *et al.* Type 2 diabetes is causally associated with depression: a Mendelian randomization analysis. Front Med 2018; 12:678–687.

This study specifically looked for the association of genetic factors, which are known risk for diabetes, with depression.

20. Hamer JA, Testani D, Mansur RB, *et al.* Brain insulin resistance: a treatment target for cognitive impairment and anhedonia in depression. Exp Neurol 2019; 315:1–8.

21. Karthikeyan R, Spence DW, Brown GM, Pandi-Perumal SR. Are type 2 diabetes mellitus and depression part of a common clock genes network? J Circadian Rhythms 2018; 16:4.

22. Zhuang QS, Shen L, Ji HF. Quantitative assessment of the bidirectional relationships between diabetes and depression. Oncotarget 2017; 8:23389–23400.

23. ■ Meng R, Liu N, Yu C, *et al.* Association between major depressive episode and risk of type 2 diabetes: a large prospective cohort study in Chinese adults. J Affect Disord 2018; 234:59–66.

This study has looked for the risk of developing diabetes in patients with depression.

24. ■ Alzoubi A, Abunaser R, Khassawneh A, *et al.* The bidirectional relationship between diabetes and depression: a literature review. Korean J Fam Med 2018; 39:137.

This narrative review has discussed the various pathophysiological mechanisms for the reciprocal relationship between diabetes and depression.

25. ■ Bergantin LB. Debating the 'bidirectional link' between diabetes and depression through the Ca2+/cAMP signalling: off-label effects of Ca2+ channel blockers. Pharmacol Res 2019; 141:298–302.

This review has looked for the role of calcium signalling pathway as a proposed mechanism for bidirectional relationship between diabetes and depression, by analyzing the off-label effects of calcium channel blockers.

26. Schmidt CB, van Loon BP, Vergouwen AC, *et al.* Systematic review and meta-analysis of psychological interventions in people with diabetes and elevated diabetes distress. Diabet Med 2018; 35:1157–1172.

27. Ramasamy C, Parusuraman S. Diabetes related distress and depression: an emerging threat to human health. J Young Pharm 2018; 10:250–251.

28. Dennick K, Sturt J, Speight J. What is diabetes distress and how can we measure it? A narrative review and conceptual model. J Diabetes Complications 2017; 31:898–911.

29. Gahlan D, Rajput R, Gehlawat P, Gupta R. Prevalence and determinants of diabetes distress in patients of diabetes mellitus in a tertiary care centre. Diabetes Metab Syndr 2018; 12:333–336.

30. Reimer A, Schmitt A, Ehrmann D, *et al.* Reduction of diabetes-related distress predicts improved depressive symptoms: a secondary analysis of the DIAMOS study. PLoS One 2017; 12:e0181218.

31. Ahola AJ, Forsblom C, Groop PH, *et al.* Association between depressive symptoms and dietary intake in patients with type 1 diabetes. Diabetes Res Clin Pract 2018; 139:91–99.

32. Naicker K, Øverland S, Johnson JA, *et al.* Symptoms of anxiety and depression in type 2 diabetes: associations with clinical diabetes measures and self-management outcomes in the Norwegian HUNT study. Psychoneuroendocrinology 2017; 84:116–123.

33. Sympa P, Vlachou E, Kazakos K, *et al.* Depression and self-efficacy in patients with type 2 diabetes in Northern Greece. Endocrine, metabolic & immune disorders-drug targets (formerly current drug targets-immune). Endocr Metab Disord 2018; 18:371–378.

34. Hoogendoorn CJ, Shapira A, Roy JF, *et al.* Depressive symptom dimensions and medication nonadherence in suboptimally controlled type 2 diabetes. J Diabetes Complications 2019; 33:217–222.

35. Schinckus L, Dangoisse F, Van den Broucke S, Mikolajczak M. When knowing is not enough: emotional distress and depression reduce the positive effects of health literacy on diabetes self-management. Patient Educ Couns 2018; 101:324–330.

36. ■ Góis C, Duarte TA, Paulino S, *et al.* Depressive symptoms are associated with poor glycemic control among women with type 2 diabetes mellitus. BMC Res Notes 2018; 11:38.

This study has looked into the effect of depression on glycaemic control in diabetes patients and explored the role of sex differences in this respect.

37. Murri MB, Mamberto S, Briatore L, *et al.* The interplay between diabetes, depression and affective temperaments: a structural equation model. J Affect Disord 2017; 219:64–71.

38. Matsunaga S, Tanaka S, Fujihara K, *et al.* Association between all-cause mortality and severity of depressive symptoms in patients with type 2 diabetes: analysis from the Japan Diabetes Complications Study (JDCS). J Psychosom Res 2017; 99:34–39.

39. Wang Y, Yang H, Nolan M, *et al.* Association of depression with evolution of heart failure in patients with type 2 diabetes mellitus. Cardiovasc Diabetol 2018; 17:19.

40. Siu AL. Screening for depression in children and adolescents: US Preventive Services Task Force recommendation statement. Ann Intern Med 2016; 164:360–366.

41. Halliday JA, Hendrieckx C, Busija L, *et al.* Validation of the WHO-5 as a first-step screening instrument for depression in adults with diabetes: results from Diabetes MILES–Australia. Diabetes Res Clin Pract 2017; 132: 27–35.

42. Schmitt A, Reimer A, Ehrmann D, *et al.* Reduction of depressive symptoms predicts improved glycaemic control: secondary results from the DIAMOS study. J Diabetes Complications 2017; 31:1608–1613.

43. Rossom RC, Solberg LI, Magnan S, *et al.* Impact of a national collaborative care initiative for patients with depression and diabetes or cardiovascular disease. Focus 2017; 15:324–332.

44. Roopan S, Larsen ER. Use of antidepressants in patients with depression and comorbid diabetes mellitus: a systematic review. Acta Neuropsychiatr 2017; 29:127–139.

45. Villamil-Salcedo V, Vargas-Terrez BE, Caraveo-Anduaga J, *et al.* Glucose and cholesterol stabilization in patients with type 2 diabetes mellitus with depressive and anxiety symptoms by problem-solving therapy in primary care centers in Mexico City. Prim Health Care Res Dev 2018; 19:33–41.

46. Wroe AL, Rennie EW, Sollesse S, *et al.* Is cognitive behavioural therapy focusing on depression and anxiety effective for people with long-term physical health conditions? A controlled trial in the context of type 2 diabetes mellitus. Behav Cogn Psychother 2018; 46:129–147.

47. Cohen LB, Taveira TH, Wu WC, Pirraglia PA. Pharmacist-led telehealth disease management for patients with diabetes and depression. J Telemed Telecare 2019; Available at: https://doi.org/10.1177/1357633X18822575. [Accessed 13 May 2019]

48. Kiani F, Hesabi N. The relationship between the religious beliefs of the diabetic patients and depression in a diabetes clinic in Iran. J Relig Health 2017; 56:1311–1316.