Acta Diabetologica (2019) 56:631–650
https://doi.org/10.1007/s00592-019-01295-9

REVIEW ARTICLE

The prevalence of comorbid depression in patients with type 2 diabetes: an updated systematic review and meta-analysis on huge number of observational studies

Mohammad Khaledi[1] · Fahimeh Haghighatdoost[2,3] · Awat Feizi[1,4] · Ashraf Aminorroaya[1]

Received: 11 October 2018 / Accepted: 2 February 2019 / Published online: 22 March 2019

Abstract

Aims Depression is a common co-morbidity in patients with type 2 diabetes mellitus (T2DM). Untreated depression in these patients adversely affects self-care activities and other diabetes complications. The aim of this study is to estimate the prevalence of depression among patients with T2DM by conducting a meta-analysis of observational studies.

Methods MEDLINE, Web of Science, Science Direct, and Google Scholar databases were searched for all observational studies that assessed depression in T2DM. Relevant articles were searched using the combination of Medical Subject Heading (MeSH) terms of "depression", "depressive disorder", and "diabetes mellitus" published between January 2007 and July 2018. Random effects model was used to estimate the weighted prevalence rates and 95% CI using "metaprop program in STATA 11".

Results In total, the 248 included studies (with 273 reported prevalence) identified 83,020,812 participants; of them, 23,245,827 (28%; 95% CI 27, 29) suffered from different severity levels of depressive disorders. The prevalence of depression was separately reported in 137,372 males and 134,332 females. Of them, 31,396 males (23%, 95% CI: 20, 26) and 45,673 females (34%, 95% CI: 31, 38) were depressed. Compared with global estimate, depression prevalence was lower in Europe (24%) and Africa (27%), but higher in Australia (29%) and Asia (32%). The prevalence in America was equal to the estimated prevalence in the world (28%). Depression was more common in subjects younger than 65 compared with elderlies (31% vs. 21%).

Conclusion Our findings demonstrated that almost one in four adults with T2DM experienced depression. Given the high prevalence of depressive disorders in diabetic patients, screening these patients for co-morbid depression and its relevant risk factors is highly recommended.

Keywords Co-morbidity · Depression · Prevalence · Type 2 diabetes mellitus

Introduction

In 2017, the International Diabetes Federation (IDF) estimated that 425 million individuals worldwide were suffering from diabetes mellitus (DM), and it is expected that the number rise to 629 million in 2045 [1]. Diabetes is one of the most relevant causes of economic loss, morbidity, and early

Managed by Antonio Secchi.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00592-019-01295-9) contains supplementary material, which is available to authorized users.

✉ Ashraf Aminorroaya
aminorroaya@med.mui.ac.ir

[1] Isfahan Endocrine and Metabolism Research Center, Isfahan University of Medical Sciences, Isfahan, Iran

[2] Food Security Research Center, Isfahan University of Medical Sciences, Isfahan, Iran

[3] Department of Community Nutrition, School of Nutrition and Food Science, Isfahan University of Medical Sciences, Isfahan, Iran

[4] Biostatistics and Epidemiology Department, School of Health, Isfahan University of Medical Sciences, Isfahan, Iran

mortality in the world [2]. The per capita cost burden associated with diabetes is 2–4-fold greater than non-diabetic patients [3] and it is estimated that managing of co-morbid conditions accounts for a substantial proportion of the costs [3]. Diabetes is associated with several complications such as mental health-related disorders, particularly depressive disorders, which can potentially decrease the quality of life in diabetic patients [4].

The global prevalence of depression increased by 17.8% between 2005 and 2015 [5]. According to reports by the World Health Organization (WHO), 322 million people were living with depression worldwide, with a prevalence rate as high as 4.4% in 2015 [6]. Depressive disorders are defined as a persistent condition for at least 2 weeks which is accompanied by losing interest or pleasure in activities that are normally enjoyable or uncomfortable or despairing and finally lead to inability to perform daily activities [7]. According to the severity of depression symptoms, it might be mild, moderate, or severe. The estimated prevalence of co-morbid depression by self-report tools is much higher than the reported prevalence of major depressive disorders in diabetic patients (31% vs. 11.4%), indicating that a large number of patients suffer from milder depressive disorders [8]. Patients with type 2 diabetes mellitus (T2DM) are almost treble as likely to be affected by depression as the general population [8]. A meta-analysis in 2006 revealed that the prevalence of depression in diabetic patients was considerably higher than non-diabetic subjects (17.6% vs. 9.8%, respectively) and patients had higher risk for affecting by depression (OR 1.6, 95% CI 1, 2.0) [9]. The great increase in the risk of co-morbid depression in diabetic patients might be attributed to the psychosocial burden of disease (e.g., having no current job), poor social support, awareness of having a chronic diseases or its related complications and disabilities, and their consequent psychological burden [10–13].

According to the Global Burden of Diseases (GBD) reports in 2015, both diabetes and depressive disorders are among the ten leading causes of disability and diabetes rose from position eight to six and depressive disorders are the fourth leading cause of disability [5]. Unrecognized and untreated depression in diabetic patients leads to higher prevalence of depression with probably greater severity which altogether causes poor glycemic control, lower adherence to medication, higher treatment cost, and higher mortality rate [14]. Determining the number of patients suffering from concurrence T2DM and depression would be relevant for the governments and health-care providers to plan appropriate treatment strategies and decrease economic burden of disease. The aim of this study was to estimate the prevalence of depression among patients with T2DM by conducting a meta-analysis of observational studies and update the results of earlier meta-analysis in this regard published in 2006 [9]. Due to differences in psychological and physiological experiences in patients with type 1 and type 2 diabetes, the current systematic review and meta-analysis is confined to T2DM.

Materials and methods

Search strategy

This systematic review and meta-analysis was prepared and presented in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) [15]. To find potentially relevant published articles, a comprehensive search was conducted in PubMed/MEDLINE, Web of Science, Science Direct, and Google Scholar before April 2018. We did not include articles published before the year 2007, because a meta-analysis assessing the prevalence of depressive disorders in diabetic patient was published in 2006. All searches were updated using MEDLINE's alert system up to July 2018. The reference lists of relevant identified articles were reviewed for gray literature. Identified studies by our search strategies were imported into Endnote X7 (Thomson Reuters, Philadelphia, PA, USA) software and managed. Relevant articles were searched using the following combination of Medical Subject Heading (MeSH) terms and text words in PubMed: ("depression"[MeSH] OR "depression"[tiab] OR "depressions"[tiab] OR "depressive"[tiab] OR "depressive disorder"[MeSH] OR "depressive disorders"[tiab] OR "Melancholia"[tiab]) AND ("Diabetes Mellitus"[MeSH] OR "Diabetes Mellitus"[tiab] OR "diabetes"[tiab] OR "diabetic"[tiab] OR "prediabetic"[tiab] OR "glucose intolerance"[tiab]). The search terms were separated or combined using Boolean operators such as "OR" or "AND". Totally, 8306 citations were retrieved using the search strategy (Fig. 1).

Study selection and eligibility criteria

The process of study selection was performed by two independent reviewers (FH and MKH). Potentially, relevant articles were first determined using a preliminary evaluation of the titles and abstracts and then were further assessed using the full text of articles. Irrelevant citations were excluded applying the following criteria: (1) no original research (case reports, reviews, and letters); (2) failing to determine type of diabetes or provide prevalence of depression by type of diabetes, even if the prevalence of type 1 was very low in the study population; and (3) non-English articles when the prevalence rate of depressive disorder could not be extracted from the abstract. When there were different publications from a large observational study, only the study with the largest sample size was included.

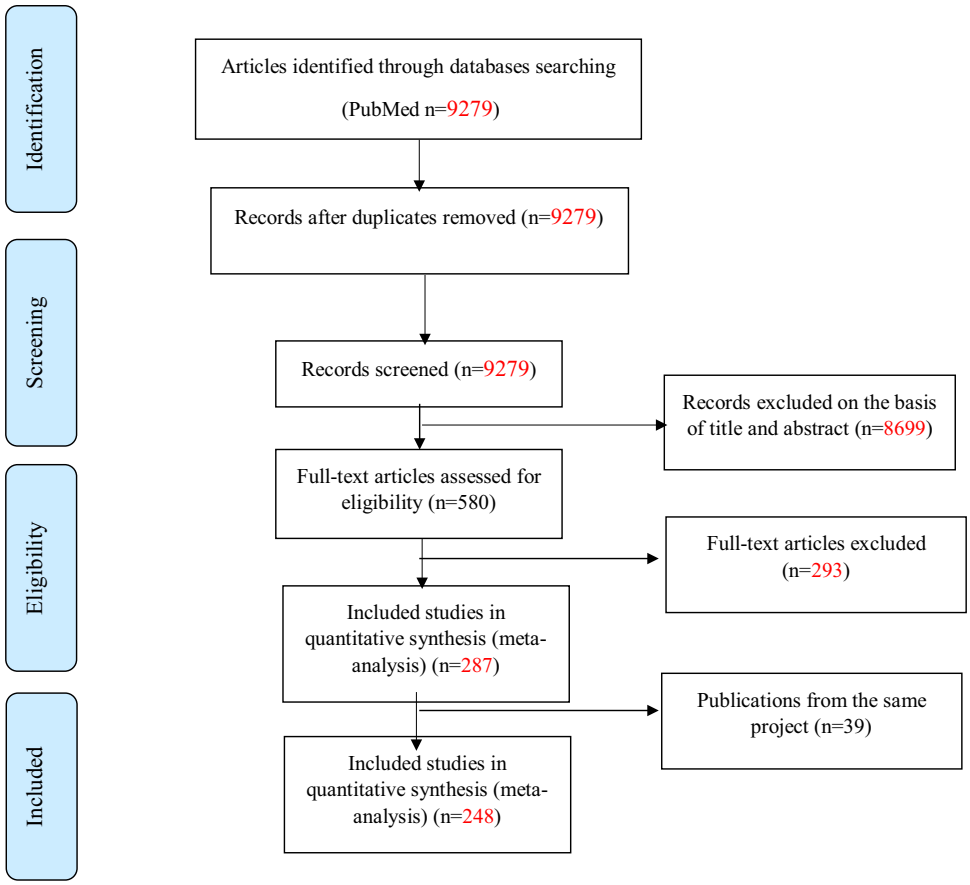

Fig. 1 Flow diagram of database searches and study selection

We included articles if they were original observational studies (cross section, case–control, and cohort) reporting the current or lifetime prevalence of depressive disorders identified through self-report or using validated instruments. In case–control studies, the prevalence of depressive disorders was extracted from the case group, and in cohort studies, data were extracted if the prevalence of depression was reported at baseline or other timepoints at the follow-up period. The method used to diagnosis of diabetes (self-report or medical record) was not considered as an eligibility criterion, since earlier studies have shown the reliability for self-reported diabetes as a medical record report [16]. When different articles were published from a same study, the article with the largest sample size was included in our analysis.

Data extraction and quality assessment

Two independent reviewers extracted following information from the studies which met the inclusion criteria: the first author's name, year of publication, country, sample size, number of depressed individuals, sex, number of male and female, mean or range of age, the instrument used to identify depression, number of depressed males and females (if available), and number of depressed cases in different categories of depression severity (if available). In studies with no report regarding the number of depressed individuals, it was calculated manually via multiplying the prevalence of depressive disorders by the total number of study population. When the prevalence of depression was not reported in the whole population, but was separately reported in men and women, the overall prevalence was computed using weighted mean proportion. Three studies had assessed the prevalence of depression using two different validated instruments [17–19]. Since all applied instruments were highly valid and reliable, and they only varied in the classification of depression severity [20–22], which was not the aim of this study, the mean of two prevalence values was recorded as the prevalence rate for these studies. When the prevalence of depression was reported using both diagnostic method and self-reported questionnaire, values based on diagnostic method were recorded and included in analysis [213].

Two independent investigators assessed the quality of included studies. Investigators discussed their controversies and any disagreements were resolved finally by discussion and reevaluation and the decision from third investigator independently.

Statistical analysis

To estimate pooled prevalence and corresponding 95% confidence interval (CI), weighted prevalence rates were calculated using "metaprop program" [23] in STATA version 14.0 (STATA, College Station, TX, USA). Heterogeneity of the included studies was assessed using Higgins' I^2 statistic and Cochran Q test and expressed as percentage. Values of 25%, 50%, and 75% for I^2 were considered as low, medium, and high levels of heterogeneity, respectively [24]. Data were pooled using random effects model due to high levels of heterogeneity among included studies [25].

Possible sources of heterogeneity were explored by sensitivity as well as subgroup analyses.

Publication bias was tested using Egger's and Begg's test and visual inspection of funnel plot [26]. In the existence of a bias, trim and fill analysis was conducted to detect the contribution of the bias to the overall effect.

Results

Search results and studies' characteristics

The literature search (May 2005 to June 2018) identified 9279 articles. We limited our search strategy to this mentioned time, because Ali et al. have reported the prevalence of comorbid depression in patients with T2DM in their meta-analysis [9]. After excluding studies according to their title and abstract, 278 studies were retrieved for more evaluation using their full text and 248 studies met our inclusion criteria and included in the meta-analysis (Fig. 1) [10–12, 17–19, 27–271]. The characteristics of included studies and the extracted information are summarized in Supplementary Table 1. Sample size of studies ranged from 29 [101] to 82,232,151 [217]. Some eligible studies had reported more than one prevalence, and therefore, in overall, 273 reported prevalence were extracted from all 248 included studies. These studies comprised 83,020,812 participants; of them, 23,245,827 subjects suffered from different severity levels of depressive disorders. A variety of instruments were used to evaluate depression status. Most effect sizes were estimated using Personal Health Questionnaire (PHQ) ($n=74$), whilst Beck's Depression Inventory (BDI), Center for Epidemiologic Studies Depression Scale (CESD), and Hospital Anxiety and Depression Scale (HADS) were used in 44, 39, and 20 studies, respectively. Other studies assessed depression status using other validated questionnaires such as geriatric depression scale (GDS), Self-Rating Depression Scale (SDS), Kessler-10 Psychological Distress, Harvard Department of Psychiatry/National Depression Screening Day Scale (HANS), DSM IV or V, ICD, Mini-International Neuropsychiatric Interview, validated DASS-21 questionnaire (depression, anxiety and stress), Euro-D score, Major Depression Inventory (MDI), Short-CARE depression scale, Hamilton Depression Rating Scale, the Yesavage depression scale, MCS, Edinburgh Depression Scale (self-reported), Zung Self-rating Depression Scale, and WHO Five-Item Well-Being Index. Of the 273 reported prevalence, 105 reported prevalences were in Asia, 70 in Europe, 79 in America, 11 in Australia, and 7 in Africa. Three reported prevalences were extracted from abstract and the regions of studies were not identifiable [95, 183, 213]. Six studies enrolled only women [45, 108, 117, 154, 175, 197], whilst others enrolled both men and women.

Meta-analysis and data synthesis

In the current meta-analysis, the lowest and highest prevalences were 2% (95% CI 1, 7) and 88% (95% CI 79, 93) reported in the studies by Maia et al. [158] and Czech et al. [105], respectively. The 273 included reported prevalence demonstrated that a pooled prevalence of depression among patients with T2DM in the world was 28.0% (95% CI 27, 29). To identify the potential sources of heterogeneity, subgroup analyses were done for estimating the prevalence of depression in the following categories: gender, the region of original study (based on the continent), age (<65 vs. ≥65 years), the method to assess depression status (clinical diagnosis vs. self-report), instruments used to estimate depression prevalence, in insulin- and non-insulin-dependent subjects. Nevertheless, none of these factors were identified to be statistically heterogeneity source.

The prevalence of depression was estimated to be 23%, 95% CI 20, 26% for male and 34%, 95% CI 31, 38% for female.

The prevalence of depression in Asia (prevalence = 32%; 95% CI 28, 37, $I^2=99.4\%$) and Australia (prevalence = 29%; 95% CI 21, 39, $I^2=98.8\%$) was higher than the world prevalence, whereas in Europe (prevalence = 24%; 95% CI 21, 26, $I^2=99.8\%$) and Africa (prevalence = 27%; 95% CI 19, 36, $I^2=99.8\%$), the prevalence rate was lower than the world-pooled prevalence (Fig. 2). In the USA, the prevalence of co-morbid depression was equal to the estimated prevalence in the world (prevalence = 28%; 95% CI 25, 31, $I^2=99.7\%$). Co-morbid depression was more prevalent among diabetic females (prevalence = 34%; 95% CI 31, 38, $I^2=99.3\%$) (Fig. 3) compared with males (prevalence = 23%; 95% CI 20, 26, $I^2=98.9\%$) (Fig. 4). Subgroup analysis based on participants' age demonstrated higher prevalence rate in patients younger than 65 years (prevalence = 31%; 95% CI 27, 34, $I^2=99.5\%$) (Fig. 5) compared with those older than 65 years (prevalence = 21%; 95% CI 19, 24, $I^2=99.9\%$) (Fig. 6). The estimated prevalence of depression was higher in studies which used self-reported methods (prevalence = 30%; 95% CI 28, 32, $I^2=98.8\%$) in comparison with those used

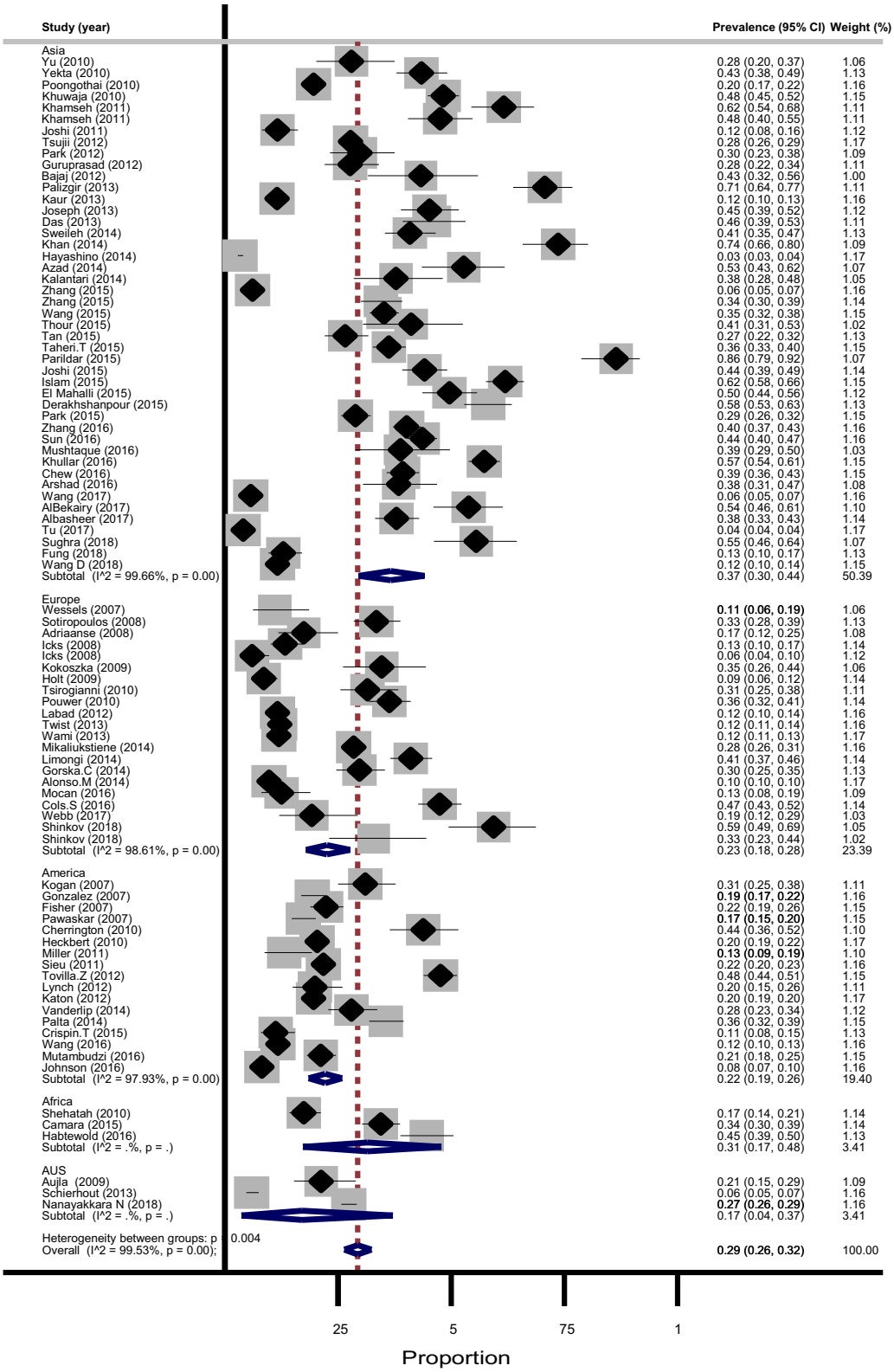

Fig. 2 Prevalence of comorbid depression in patients with type 2 diabetes stratified by the continents

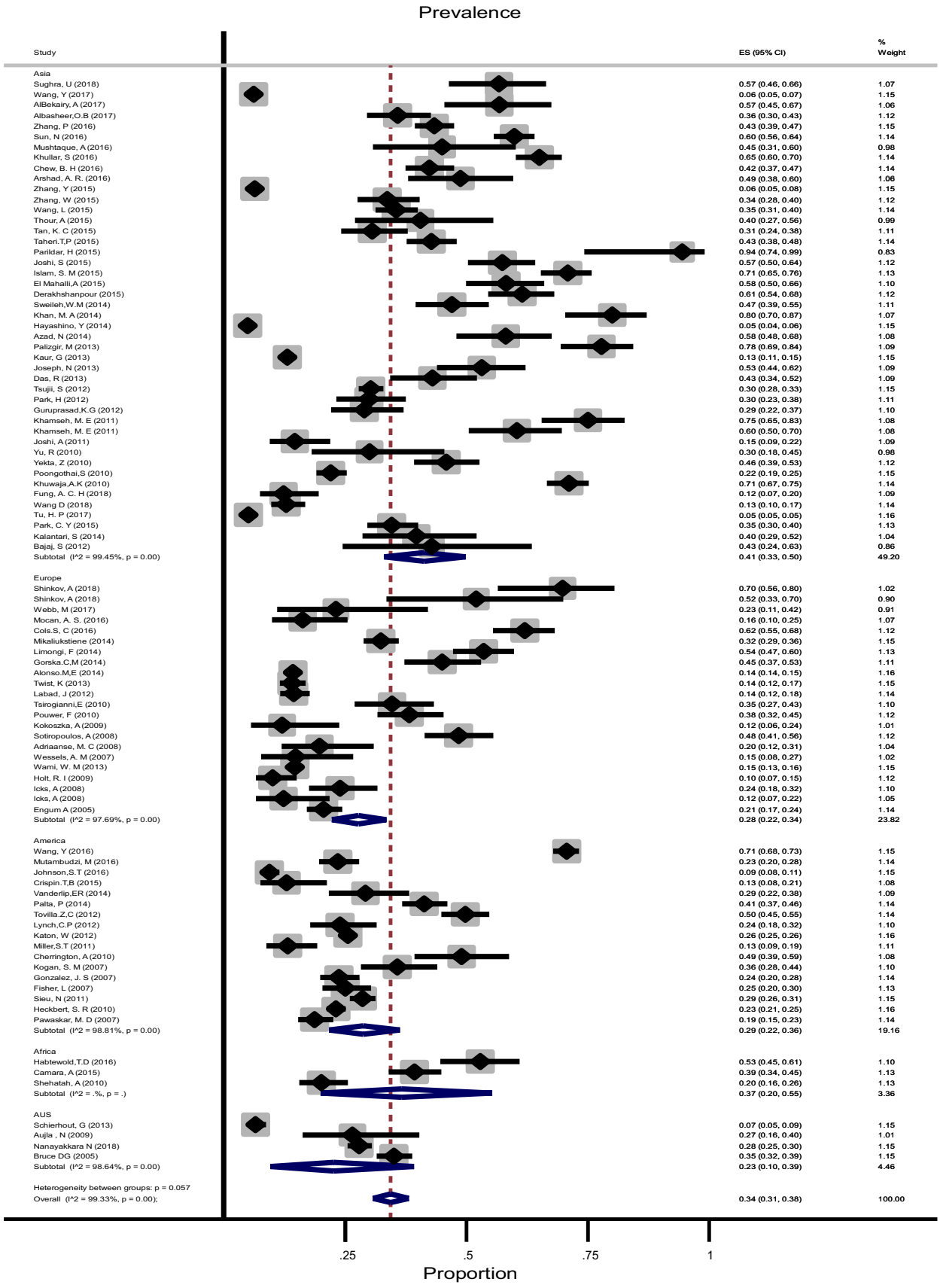

Fig. 3 Prevalence of comorbid depression in female patients with type 2 diabetes stratified by the continents

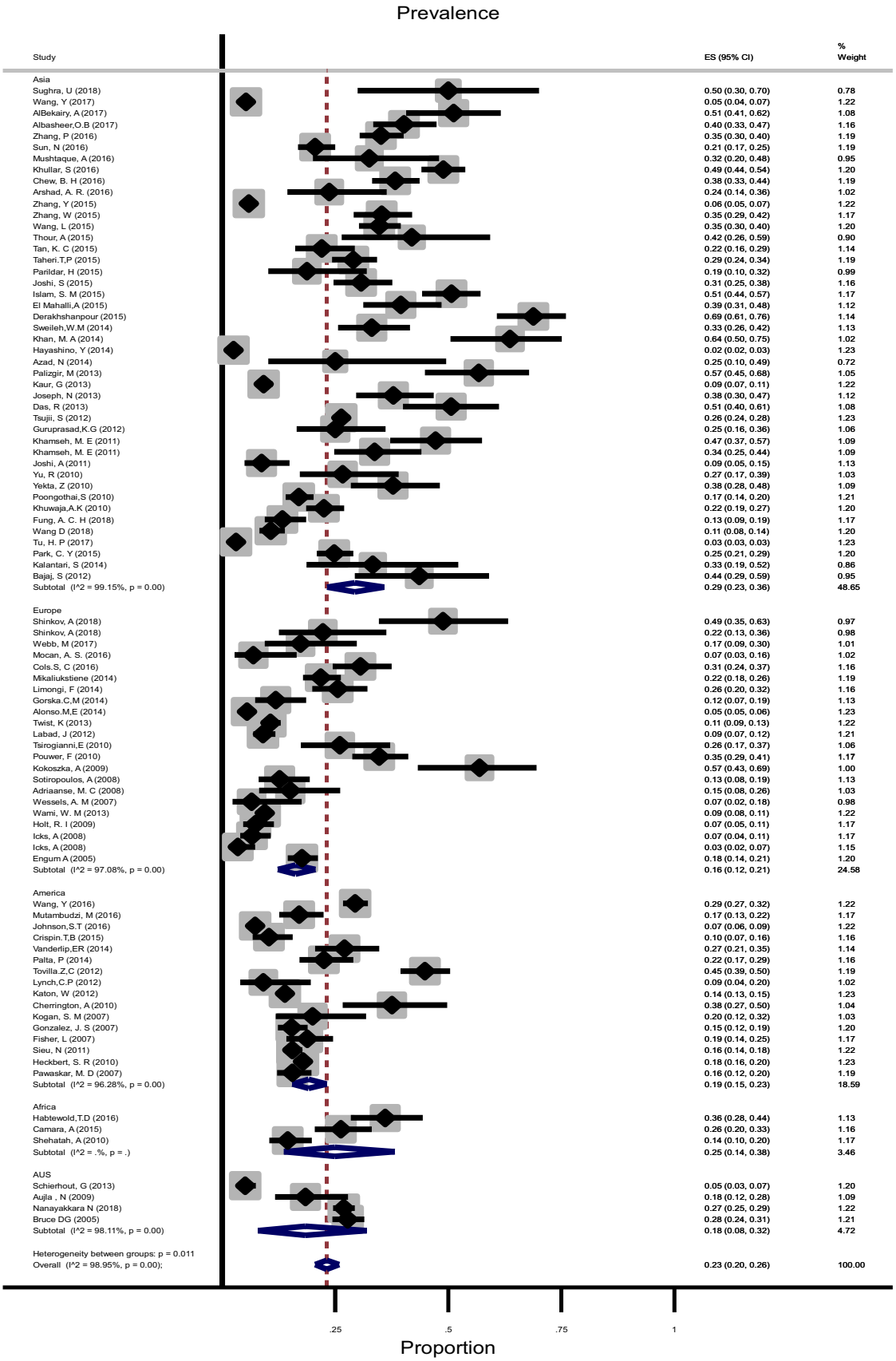

Fig. 4 Prevalence of comorbid depression in male patients with type 2 diabetes stratified by the continents

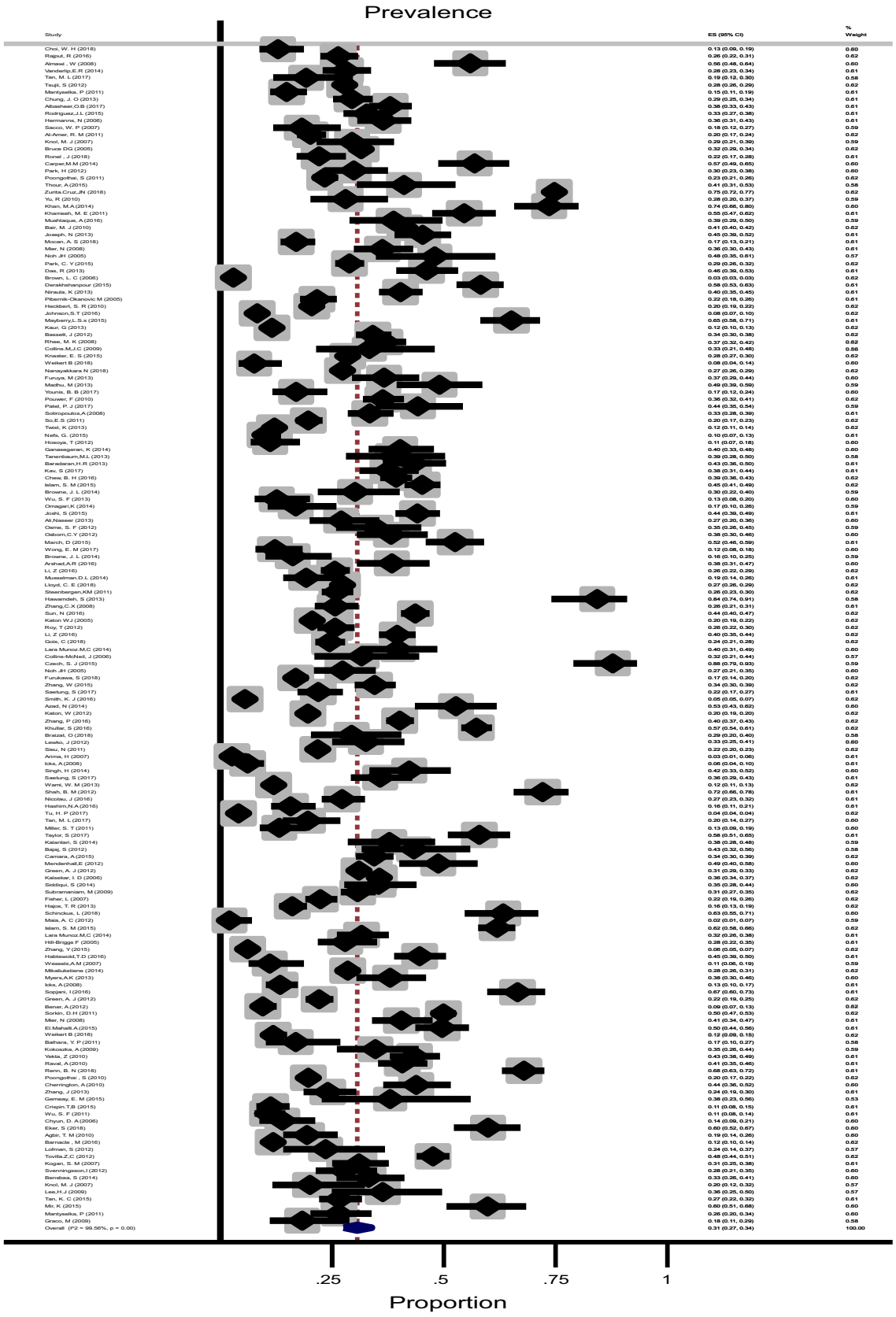

Fig. 5 Prevalence of comorbid depression in patients with type 2 diabetes younger than 65 years

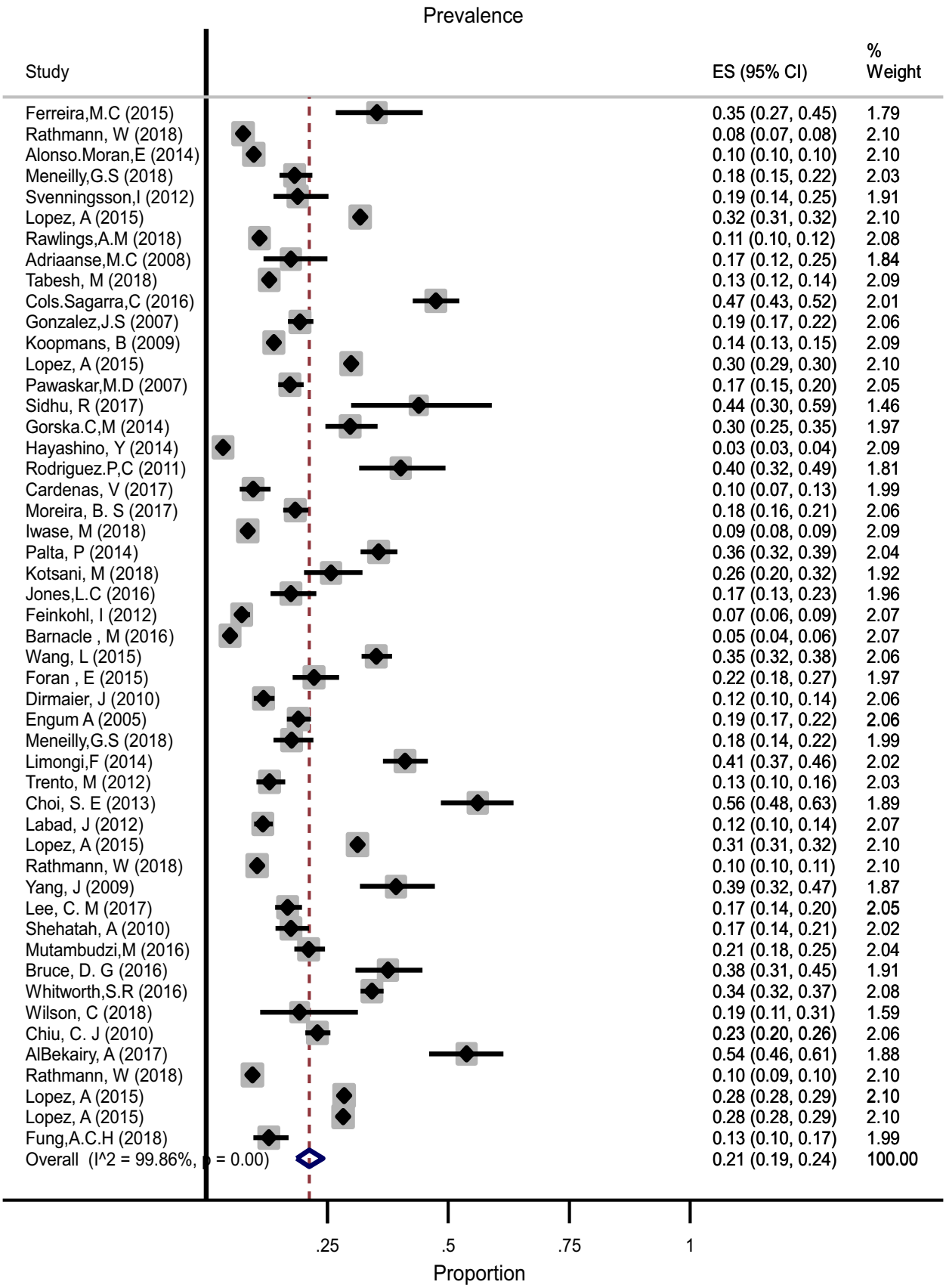

Fig. 6 Prevalence of comorbid depression in patients with type 2 diabetes older than 65 years

clinical diagnosis method (prevalence = 22%; 95% CI 19, 24, $I^2 = 99.9\%$). Subgroup analysis based on instruments used to identify depressive disorders could not explain heterogeneity. The estimated pooled prevalence derived by PHQ, CESD, BDI, HADS, DSM, and other instruments was 25% (95% CI 22, 28), 28% (95% CI 24, 33), 40% (95% CI 34, 47), 28% (95% CI 23, 34), 12% (95% CI 6, 20), and 27% (95% CI 25, 29).

In the subgroup analyses based on regions and sex (Figs. 3, 4), both Asian males (prevalence = 29%; 95% CI 23, 36, $I^2 = 99.1\%$) and females (prevalence = 41%; 95% CI 33, 50, $I^2 = 99.4\%$) had the highest prevalence rate, whereas European men (prevalence = 16%; 95% CI 12, 21, $I^2 = 97.1\%$) and Australian women (prevalence = 23%; 95% CI 10, 39, $I^2 = 98.6\%$) had the lowest prevalence (Table 1). In subgroup analysis based on both age and continent, prevalence of depression was higher in younger patients than elderlies in all continents; nevertheless, in Europe, the prevalence in both age categories was approximately the same (24% in young patients and 21% in elderlies) (Table 1).

Table 1 Subgroup analysis for the prevalence of comorbid depression based on sex and age in patients with type 2 diabetes in different continents

	No. of reported effect sizes	Prevalence	95% confidence interval
Asia	45	37	30, 44
Males	44	29	23, 36
Females	45	41	33, 50
< 65 years	75	32	27, 38
≥ 65 years	7	22	12, 33
Europe	21	23	18, 28
Males	22	16	12, 21
Females	22	28	22, 34
< 65 years	32	24	20, 28
≥ 65 years	23	21	17, 25
America	17	22	19, 26
Males	16	19	15, 23
Females	17	29	22, 36
< 65 years	49	32	26, 39
≥ 65 years	16	21	16, 27
Australia	3	17	4, 37
Males	4	18	8, 32
Females	3	23	10, 39
< 65 years	5	35	27, 44
≥ 65 years	3	27	11, 47
Africa	3	31	17, 48
Males	3	25	14, 38
Females	4	37	20, 55
< 65 years	4	33	24, 43
≥ 65 years	1	17	14, 21

In subgroup analysis based on insulin use, the prevalence of comorbid depression in insulin-dependent subjects was 11% (95% CI 8, 13, $I^2 = 97.9\%$), whilst in non-insulin-dependent subjects was considerably higher (prevalence = 12%; 95% CI 9, 15, $I^2 = 98.6\%$). Subgroup analysis among depressed subjects showed that 45% of depressed subjects were insulin-dependent (95% CI 40, 51%). Meta-regression on the mean duration of having diabetes was not related to the prevalence of depression (β coefficient = − 0.0001594, $P = 0.971$), whilst on the number of insulin-dependent patients was slightly and inversely related (β coefficient = − 0.0001577, $P = 0.0.003$).

Publication bias and sensitivity analysis

Visual inspection of funnel plot suggests an asymmetrical distribution of articles. Consistently, the presence of publication bias was confirmed also by Egger's ($P < 0.0001$) test. Results of trim and fill analysis showed that adjusted values (0.28, 95% CI 0.27, 0.29) did considerably differ with the original pooled estimates (0.20, 95% CI 0.19, 0.21). Excluding studies with the smallest sample size [101] and the highest prevalence of co-morbid depression [105] from analysis did not change the pooled estimate (prevalence = 28%, 95% CI 27, 29).

Discussion

The current meta-analysis aimed to estimate the prevalence of depressive disorders in patients with T2DM. Our results indicate that nearly one in four diabetic patients suffer from co-morbid depression. This prevalence rate is higher than the values reported by Ali et al. in 2006, who showed that 17.6% patients with T2DM had depression [9]. Another meta-analysis summarized the prevalence of co-morbid depression among Bangladeshi outpatients with type 2 diabetes mellitus [18]. They identified that when the symptoms were assessed by PHQ and WHO-5, 34% and 36% of patients suffered from depression, respectively. In line with the earlier meta-analysis, our findings revealed higher prevalence rate of depression in female diabetic patients than males; however, a considerable increase was observed in the prevalence rate in both females and males compared with the estimates in 2006 [9]. Although there is numerous literature on this topic, we are aware of no update meta-analysis summarizing the overall prevalence rate of depression in patients with T2DM around the world, since such a review was performed by Ali et al. in 2006 [9].

In the previous meta-analysis, investigators aimed to compare the prevalence of co-morbid depression in patients with T2DM with non-diabetic patients and included only 12 studies in their review. Nevertheless, we did not do such

comparison and included all published studies which provided the prevalence of depressive disorders in their study sample either as the primary or secondary outcomes. In addition, the number of studies assessing depression prevalence separately in males and females was quiet small in the earlier meta-analysis ($n=4$), suggesting that publication bias may influence their results. Although the method of depression assessment could not explain the heterogeneity between studies and did not identify considerable differences between instruments, the potential bias suggested for different instruments cannot be totally eliminated. Further analysis based on instruments revealed that the prevalence of depression was higher in studies which have used self-report instruments compared with those which have used diagnostic criteria. Our pooled estimate for self-report prevalence of comorbid depression is similar to earlier report by Anderson in 2001, but the estimated prevalence based on diagnostic criteria in our study is considerably greater than theirs (23% vs. 11.4%) [8]. This finding may suggest an increase in the prevalence of major depression in patients with diabetes over the years. However, only a few studies have used diagnostic criteria and there is still need for future studies applying standardized diagnostic interviews for depression.

Although depression is highly treatable in diabetic patients [272], it remains unrecognized and untreated approximately in two-thirds of patients [273]. Untreated depressive disorders are associated with poor diabetes self-care activities such as regular physical activity and adherence to a healthy diet or medication regimens, and adversely affect diabetes complications such as retinopathy, nephropathy, neuropathy, sexual dysfunction, and coronary heart disease [273]. Moreover, it has been suggested when routine medical treatments fail to control glycemic status, depression should be taken into account as a possible cause [273]. Therefore, routine screening in terms of depression in patients with diabetes by trained health-care professionals is suggested [273].

There are several lines of evidence, indicating that the association between depression and diabetes might be bidirectional. Indeed, diagnosis of diabetes is associated with increased risk of developing depression and in contrast, and depressed subjects are at higher risk for diabetes [274]. Several mechanisms may explain the link between diabetes and depression. First, elevated levels of blood glucose and insulin resistance are associated with increased risk of diabetes *per se* [275, 276]. Second, depression is probably a somatic burden of diabetes, since it has been shown that psychological disorders are more common among diabetic patients rather than prediabetic and undiagnosed diabetic patients [277, 278]. In addition, there is evidence, suggesting that the increased risk of depression in prediabetic and undiagnosed diabetic patients might be attributed to cardiovascular diseases; nevertheless, depression–diabetes association in previously diagnosed T2DM was slightly influenced by cardiovascular diseases which indicates the potential role of other risk factors [279]. Third, elevated serum concentrations of some common inflammatory biomarkers such as the C-reactive protein (CRP) and interleukin (IL)-6 have been implicated in the pathogenesis of both diseases [278]. Fourth, depression is associated with activation of the hypothalamic–pituitary–adrenal (HPA) axis and causes increased levels of cortisol and catecholamine hormones which lead to insulin resistance [274, 280].

Some limitations should be taken into account when interpreting the findings of the current stud. Due to using secondary data of a study assessing a different primary outcome, measurement bias and residual confounding will inevitably influence the results of this meta-analysis. Almost in all studies, the reported prevalence of depression was not adjusted for various relevant confounders such as age, socioeconomic status, and comorbid conditions such as cardiovascular diseases which may mediate the relationship between diabetes and depressive disorders [211, 281]. Furthermore, included studies in the current meta-analysis used a large variety of self-rating instruments to assess depression status rather than the clinical diagnostic criteria which may cause between studies heterogeneity. In addition, the prevalence of "elevated depressive symptoms" is estimated higher based on self-rating instruments that may suggest that milder depressive disorder is prevalent among a large number of diabetic patients. Nevertheless, we run a subgroup analysis based on the depression scales used as well as self-report vs. clinical-interview methods, to reduce the heterogeneity and potential bias. The main strengths of our meta-analysis were that we included a large sample of diabetic patients with different age ranges through the world in our analysis and conducted subgroup analysis based on some relevant factors. In addition, like other systematic reviews, a comprehensive review of available literatures provides a systematic identification of gaps and limitations which can lead to improved designs of future research. Although based on I^2 test, there was considerable heterogeneity between studies, this might not be clinically relevant when the number of studies and sample size is large [282].

In summary, our current meta-analysis revealed that more than one in four (28%) adults with T2DM experienced depression. The corresponding value in diabetic females is 34%, whilst in males is 23%. The greatest prevalence was observed in Asian countries, whereas the lowest prevalence was found in Europe. Increasing level of information and knowledge of diabetic patients in terms of controlling their diseases can delay progression or prevent depression in patients with T2DM. In addition, given the high prevalence of depressive disorders in diabetic patients, it is suggested screening these patients for co-morbid depression and its relevant risk factors. Conversely, due to bidirectional link

between depression and diabetes, and considering that diabetes is an age-related chronic disease, screening depressed elderlies for diabetes is suggested.

Acknowledgements This work was supported by grants from Endocrine and metabolism research center, Isfahan University of Medical Sciences, Isfahan, Iran (no: 397089).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interests.

Statement of human and animal rights This study is a meta-analysis of other studies where all procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Informed consent For this type of study consent form is not required.

References

1. Federation ID (2017) IDF diabetes atlas. Brussels: International Diabetes Federation.. http://diabetesatlas.org/resources/2017-atlas.html. Accessed 17 July 2018
2. van Dieren S, Beulens JW, van der Schouw YT, Grobbee DE, Neal B (2010) The global burden of diabetes and its complications: an emerging pandemic. Eur J Cardiovasc Prev Rehabil 17(Suppl 1):S3–S8
3. Zimmet P (2003) The burden of type 2 diabetes: are we doing enough? Diabetes Metab 29(4 Pt 2):6s9–18
4. Eren I, Erdi O, Sahin M (2008) The effect of depression on quality of life of patients with type II diabetes mellitus. Depress Anxiety 25(2):98–106
5. Vos T, Allen C, Arora M et al (2016) Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 388(10053):1545–1602
6. Organization World Health (WHO) (2017) Depression and other common mental disorders: global health estimates. Available from: https://www.who.int/mental_health%2Fmanagement%2Fdepression%2Fprevalence_global_health_estimates%2Fen%2F. Accessed Feb 2019
7. American Psychiatric Association (2018) Diagnostic and statistical manual of mental disorders (DSM-5®). Available from: https://dsm.psychiatryonline.org/pb-assets/dsm/update/DSM5Update_October2018.pdf. Accessed Feb 2019
8. Anderson RJ, Freedland KE, Clouse RE, Lustman PJ (2001) The prevalence of comorbid depression in adults with diabetes: a meta-analysis. Diabetes Care 24(6):1069–1078
9. Ali S, Stone MA, Peters JL, Davies MJ, Khunti K (2006) The prevalence of co-morbid depression in adults with Type 2 diabetes: a systematic review and meta-analysis. Diabetes Med 23(11):1165–1173
10. Sweileh WM, Abu-Hadeed HM, Al-Jabi SW, Zyoud SH (2014) Prevalence of depression among people with type 2 diabetes mellitus: a cross sectional study in Palestine. BMC Public Health 14:163
11. Joshi S, Dhungana RR, Subba UK (2015) Illness perception and depressive symptoms among persons with type 2 diabetes mellitus: an analytical cross-sectional study in clinical settings in Nepal. J Diabetes Res 2015:908374
12. Shehatah A, Rabie MA, Al-Shahry A (2010) Prevalence and correlates of depressive disorders in elderly with type 2 diabetes in primary health care settings. J Affect Disord 123(1–3):197–201
13. Habtewold TD, Islam MA, Radie YT, Tegegne BS (2016) Comorbidity of depression and diabetes: an application of biopsychosocial model. Int J Ment Health Syst 10:74
14. Oladeji BD, Gureje O (2013) The comorbidity between depression and diabetes. Curr Psychiatry Rep 15(9):390
15. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotzsche PC et al (2009) The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. J Clin Epidemiol 62(10):e1–e34
16. Harlow SD, Linet MS (1989) Agreement between questionnaire data and medical records. The evidence for accuracy of recall. Am J Epidemiol 129(2):233–248
17. Svenningsson I, Bjorkelund C, Marklund B, Gedda B (2012) Anxiety and depression in obese and normal-weight individuals with diabetes type 2: a gender perspective. Scand J Caring Sci 26(2):349–354
18. Roy T, Lloyd CE, Parvin M, Mohiuddin KG, Rahman M (2012) Prevalence of co-morbid depression in out-patients with type 2 diabetes mellitus in Bangladesh. BMC Psychiatry 12:123
19. Khamseh ME, Baradaran HR, Javanbakht A, Mirghorbani M, Yadollahi Z et al (2011) Comparison of the CES-D and PHQ-9 depression scales in people with type 2 diabetes in Tehran, Iran. BMC Psychiatry 11:61
20. Milette K, Hudson M, Baron M, Thombs BD, Canadian Scleroderma Research Group (2010) Comparison of the PHQ-9 and CES-D depression scales in systemic sclerosis: internal consistency reliability, convergent validity and clinical correlates. Rheumatology (Oxford) 49(4):789–796
21. Loosman WL, Siegert CE, Korzec A, Honig A (2010) Validity of the hospital anxiety and depression scale and the beck depression inventory for use in end-stage renal disease patients. Br J Clin Psychol 49(Pt 4):507–516
22. Cameron IM, Crawford JR, Lawton K, Reid IC (2008) Psychometric comparison of PHQ-9 and HADS for measuring depression severity in primary care. Br J Gen Pract 58(546):32–36
23. Nyaga VN, Arbyn M, Aerts M (2014) Metaprop: a Stata command to perform meta-analysis of binomial data. Arch Public Health 72(1):39
24. Higgins JP, Thompson SG, Deeks JJ, Altman DG (2003) Measuring inconsistency in meta-analyses. BMJ 327(7414):557–560
25. Harris R, Bradburn M, Deeks J, Harbord R, Altman D, Sterne J (2008) Metan: fixed-and random-effects meta-analysis. Stata J 8(1):3
26. Sterne JA, Egger M, Smith GD (2001) Systematic reviews in health care: investigating and dealing with publication and other biases in meta-analysis. BMJ 323(7304):101–105
27. Wilson C, Twigg G (2003) Pharmacist-led depression screening and intervention in an underserved, rural, and multi-ethnic diabetic population. J Am Pharm Assoc 58(2):205–209
28. Tabesh M, Shaw JE, Zimmet PZ, Soderberg S, Koye DN et al (2018) The association between type 2 diabetes and disability: what is the contribution of diabetes risk factors and diabetes complications? J Diabetes 10(9):744–752
29. Sughra U, Imran M (2018) Co-morbid depression in individuals with type 2 diabetes mellitus. J Pak Med Assoc 68(1):109–111
30. Shinkov A, Borissova AM, Kovatcheva R, Vlahov J, Dakovska L, Atanassova I et al (2018) Increased prevalence of depression and anxiety among subjects with metabolic syndrome and known type 2 diabetes mellitus - a population-based study. Postgrad Med 130(2):251–257

31. Schinckus L, Dangoisse F, Van den Broucke S, Mikolajczak M (2018) When knowing is not enough: Emotional distress and depression reduce the positive effects of health literacy on diabetes self-management. Patient Educ Couns 101(2):324–330
32. Saman KA, Massad S, Ibaid AA, Anan H, Daher M, Salman R et al (2018) Factors associated with depression in patients with type 2 diabetes in the Gaza Strip: a cross sectional study. Lancet 391(Suppl 2):S19
33. Renn BN, Obetz V, Feliciano L. Comorbidity of depressive symptoms among primary care patients with diabetes in a federally qualified health center. J Health Psychol. 2018:1359105318755260
34. Rawlings AM, Sharrett AR, Golden SH, Windham BG, Selvin E (2018) Prevalence and correlates of depressive symptoms in older adults across the glycaemic spectrum: the Atherosclerosis Risk in Communities (ARIC) study. Diabetes Med 35(5):583–587
35. Purewal R, Fisher PL (2018) The contribution of illness perceptions and metacognitive beliefs to anxiety and depression in adults with diabetes. Diabetes Res Clin Pract 136:16–22
36. Mocan AS, Iancu SS, Baban AS (2018) Association of cognitive-emotional regulation strategies to depressive symptoms in type 2 diabetes patients. Rom J Intern Med 56(1):34–40
37. Meneilly GS, Berard LD, Cheng AYY, Lin PJ, MacCallum L, Tsuyuki RT et al (2018) Insights into the current management of older adults with type 2 diabetes in the Ontario primary care setting. Can J Diabetes 42(1):23–30
38. Ma Y, Li X, Zhao D, Wu R, Sun H, Chen S et al (2018) Association between cognitive vulnerability to depression—dysfunctional attitudes and glycaemic control among in-patients with type 2 diabetes in a hospital in Beijing: a multivariate regression analysis. Psychol Health Med 23(2):189–197
39. Lloyd CE, Nouwen A, Sartorius N, Ahmed HU, Alvarez A, Bahendeka S et al (2018) 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. Diabetes Med 35(6):760–769
40. Kotsani M, Chatziadamidou T, Economides D, Benetos A (2018) Higher prevalence and earlier appearance of geriatric phenotypes in old adults with type 2 diabetes mellitus. Diabetes Res Clin Pract 135:206–217
41. Gois C, Duarte TA, Paulino S, Raposo JF, do Carmo I, Barbosa A (2018) Depressive symptoms are associated with poor glycemic control among women with type 2 diabetes mellitus. BMC Res Notes 11(1):38
42. Furukawa S, Sakai T, Niiya T, Miyaoka H, Miyake T, Yamamoto S et al (2018) Nocturia and prevalence of depressive symptoms in Japanese adult patients with type 2 diabetes mellitus: the DOGO study. Can J Diabetes 42(1):51–55
43. Eker S (2018) Prevalence of depression symptoms in diabetes mellitus. Open Access Maced J Med Sci 6(2):340–343
44. Choi WH, Seo YM, Ha Y (2018) Evaluation of factors related to glycaemic control among South Korean patients with type 2 diabetes. Int J Nurs Pract 24(1):e12616
45. Braizat O, Feinn R, Abbott G, Wagner J (2018) Relationship style and glycaemic control in women with type 2 diabetes: the mediating role of psychological distress. Stress Health 34(3):462–467
46. Younis BB, Arshad R, Yousuf H, Salman F, Masood J, Khurshid S (2017) Impact of type 2 diabetes mellitus on quality of life in people with diabetespresenting to a specialist diabetes clinic. Turk J Med Sci 47(1):123–126
47. Wong EM, Afshar R, Qian H, Zhang M, Elliott TG, Tang TS (2017) Diabetes distress, depression and glycemic control in a canadian-based specialty care setting. Can J Diabetes 41(4):362–365
48. Webb M, Davies M, Ashra N, Bodicoat D, Brady E, Webb D et al (2017) The association between depressive symptoms and insulin resistance, inflammation and adiposity in men and women. PloS One 12(11):e0187448
49. Wang Y, Yang H, Meng P, Han Y (2017) Association between low serum 25-hydroxyvitamin D and depression in a large sample of Chinese patients with type 2 diabetes mellitus. J Affect Disord 224:56–60
50. Taylor S, McDermott R, Thompson F, Usher K (2017) Depression and diabetes in the remote Torres Strait Islands. Health Promot J Aust 28(1):59–66
51. Tan ML, Tan CS, Griva K, Lee YS, Lee J, Tai ES et al (2017) Factors associated with diabetes-related distress over time among patients with T2DM in a tertiary hospital in Singapore. BMC Endocr Disord 17(1):36
52. Sidhu R, Tang TS (2017) Diabetes distress and depression in south Asian Canadians with type 2 diabetes. Can J Diabetes 41(1):69–72
53. Shin N, Hill-Briggs F, Langan S, Payne JL, Lyketsos C, Golden SH (2017) The association of minor and major depression with health problem-solving and diabetes self-care activities in a clinic-based population of adults with type 2 diabetes mellitus. J Diabetes Compl 31(5):880–885
54. Patel PJ, Hayward KL, Rudra R, Horsfall LU, Hossain F, Williams S et al (2017) Multimorbidity and polypharmacy in diabetic patients with NAFLD: Implications for disease severity and management. Medicine (Baltimore) 96(26):e6761
55. Naicker K, Overland S, Johnson JA, Manuel D, Skogen JC, Sivertsen B et al (2017) Symptoms of anxiety and depression in type 2 diabetes: Associations with clinical diabetes measures and self-management outcomes in the Norwegian HUNT study. Psychoneuroendocrinology 84:116–123
56. Moreira BS, Sampaio RF, Diz JB, Bastone AC, Ferriolli E, Neri AL et al (2017) Factors associated with fear of falling in community-dwelling older adults with and without diabetes mellitus: findings from the Frailty in Brazilian Older People Study (FIBRA-BR). Exp Gerontol 89:103–111
57. Lee CM, Chang CF, Pan MY, Hsu TH, Chen MY (2017) Depression and its associated factors among rural diabetic residents. J Nurs Res 25(1):31–40
58. Kav S, Yilmaz AA, Bulut Y, Dogan N (2017) Self-efficacy, depression and self-care activities of people with type 2 diabetes in Turkey. Collegian 24(1):27–35
59. Golden SH, Shah N, Naqibuddin M, Payne JL, Hill-Briggs F, Wand GS et al (2017) The prevalence and specificity of depression diagnosis in a clinic-based population of adults with type 2 diabetes mellitus. Psychosomatics 58(1):28–37
60. Gahlan D, Rajput R, Gehlawat P, Gupta R (2018) Prevalence and determinants of diabetes distress in patients of diabetes mellitus in a tertiary care centre. Diabetes Metab Syndr 12(3):333–336
61. Cardenas V, Mausbach BT, Sommerfeld D, Jimenez D, von Kanel R, Ho JS et al (2017) Depression is associated with increased risk for metabolic syndrome in latinos with type 2 diabetes. Am J Geriatr Psychiatry 25(6):646–653
62. AlBekairy A, AbuRuz S, Alsabani B, Alshehri A, Aldebasi T, Alkatheri A et al (2017) Exploring factors associated with depression and anxiety among hospitalized patients with type 2 diabetes mellitus. Med Princ Pract 26(6):547–553
63. Albasheer OB, Mahfouz MS, Solan Y, Khan DA, Muqri MA, Almutairi HA et al (2018) Depression and related risk factors among patients with type 2 diabetes mellitus, Jazan area, KSA: a cross-sectional study. Diabetes Metab Syndr 12(2):117–121
64. Zhang P, Lou P, Chang G, Chen P, Zhang L, Li T et al (2016) Combined effects of sleep quality and depression on quality of life in patients with type 2 diabetes. BMC Fam Pract 17:40

65. Whitworth SR, Bruce DG, Starkstein SE, Davis WA, Davis TM, Bucks RS (2016) Lifetime depression and anxiety increase prevalent psychological symptoms and worsen glycemic control in type 2 diabetes: the Fremantle Diabetes Study Phase II. Diabetes Res Clin Pract 122:190–197
66. Wang Y, Lopez JM, Bolge SC, Zhu VJ, Stang PE (2016) Depression among people with type 2 diabetes mellitus, US National Health and Nutrition Examination Survey (NHANES), 2005–20126. BMC Psychiatry 16:88
67. Urrutia-Aliano D, Segura ER (2016) [Depressive symptoms and type 2 diabetes mellitus in outpatients of an Armed Forces hospital in Lima, Peru, 2012: a cross-sectional study]. Medwave 16(3):e6435
68. Sun N, Lou P, Shang Y, Zhang P, Wang J, Chang G et al (2016) Prevalence and determinants of depressive and anxiety symptoms in adults with type 2 diabetes in China: a cross-sectional study. BMJ Open 6(8):e012540
69. Sopjani I, Vehapi S, Gorani D, Imeri M, Vitoja S, Tahiri S (2016) The relation between depressive symptoms and self-care in patients with diabetes mellitus type 2 in Kosovo. Med Arch 70(6):425–428
70. Sehlo MG, Alzahrani OH, Alzahrani HA (2016) Illness invalidation from spouse and family is associated with depression in diabetic patients with first superficial diabetic foot ulcers. Int J Psychiatry Med 51(1):16–30
71. Mut-Vitcu G, Timar B, Timar R, Oancea C, Citu IC (2016) Depression influences the quality of diabetes-related self-management activities in elderly patients with type 2 diabetes: a cross-sectional study. Clin Interv Aging 11:471–479
72. Mutambudzi M, Chen NW, Markides KS, Al Snih S (2016) Effects of functional disability and depressive symptoms on mortality in older mexican-american adults with diabetes mellitus. J Am Geriatr Soc 64(11):e154–e159
73. Mushtaque A, Gulati R, Hossain MM, Azmi SA (2016) Prevalence of depression in patients of type 2 diabetes mellitus: a cross sectional study in a tertiary care centre. Diabetes Metab Syndr 10(4):238–241
74. Li Z, Guo X, Jiang H, Sun G, Sun Y, Abraham MR (2016) Diagnosed but not undiagnosed diabetes is associated with depression in rural areas. Int J Environ Res Public Health 13(11):1136
75. Khullar S, Dhillon H, Kaur G, Sharma R, Mehta K, Aggarwal R et al (2016) The prevalence and predictors of depression in type 2 diabetic population of Punjab. Community Ment Health J 52(4):479–483
76. Jones LC, Clay OJ, Ovalle F, Cherrington A, Crowe M (2016) Correlates of depressive symptoms in older adults with diabetes. J Diabetes Res 2016:8702730
77. Johnson ST, Al Sayah F, Mathe N, Johnson JA (2016) The relationship of diabetes-related distress and depressive symptoms with physical activity and dietary behaviors in adults with type 2 diabetes: a cross-sectional study. J Diabetes Compl 30(5):967–970
78. Hashim NA, Ariaratnam S, Salleh MR, Said MA, Sulaiman AH (2016) Depression and associated factors in patients with type 2 diabetes mellitus. East Asian Arch Psychiatry 26(2):77–82
79. Habtewold TD, Alemu SM, Haile YG (2016) Sociodemographic, clinical, and psychosocial factors associated with depression among type 2 diabetic outpatients in Black Lion General Specialized Hospital, Addis Ababa, Ethiopia: a cross-sectional study. BMC Psychiatry 16:103
80. Cols-Sagarra C, Lopez-Simarro F, Alonso-Fernandez M, Mancera-Romero J, Perez-Unanua MP et al (2016) Prevalence of depression in patients with type 2 diabetes attended in primary care in Spain. Prim Care Diabetes 10(5):369–375
81. Chew BH, Vos R, Mohd-Sidik S, Rutten GE (2016) Diabetes-related distress, depression and distress-depression among adults with type 2 diabetes mellitus in Malaysia. PloS One 11(3):e0152095
82. Birhanu AM, Alemu FM, Ashenafie TD, Balcha SA, Dachew BA (2016) Depression in diabetic patients attending University of Gondar Hospital Diabetic Clinic, Northwest Ethiopia. Diabetes Metab Syndr Obes 9:155–162
83. Arshad AR, Alvi KY (2016) Frequency of depression in type 2 diabetes mellitus and an analysis of predictive factors. J Pak Med Assoc 66(4):425–429
84. Zhang Y, Ting RZ, Yang W, Jia W, Li W, Ji L et al (2015) Depression in Chinese patients with type 2 diabetes: associations with hyperglycemia, hypoglycemia, and poor treatment adherence. J Diabetes 7(6):800–808
85. Zhang W, Xu H, Zhao S, Yin S, Wang X, Guo J et al (2015) Prevalence and influencing factors of co-morbid depression in patients with type 2 diabetes mellitus: a General Hospital based study. Diabetol Metab Syndr 7:60
86. Wang L, Song R, Chen Z, Wang J, Ling F (2015) Prevalence of depressive symptoms and factors associated with it in type 2 diabetic patients: a cross-sectional study in China. BMC Public Health 15:188
87. Thour A, Das S, Sehrawat T, Gupta Y (2015) Depression among patients with diabetes mellitus in North India evaluated using patient health questionnaire-9. Indian J Endocrinol Metab 19(2):252–255
88. Tan KC, Chan GC, Eric H, Maria AI, Norliza MJ, Oun BH et al (2015) Depression, anxiety and stress among patients with diabetes in primary care: a cross-sectional study. Malays Fam Physician 10(2):9–21
89. Taheri Tanjani P, Moradinazar M, Esmail Mottlagh M, Najafi F (2015) The prevalence of diabetes mellitus (DM) type II among Iranian elderly population and its association with other age-related diseases, 2012. Arch Gerontol Geriatr 60(3):373–379
90. Rodriguez Calvin JL, Zapatero Gaviria A, Martin Rios MD (2015) Prevalence of depression in type 2 diabetes mellitus. Rev Clin Esp 215(3):156–164
91. Parildar H, Cigerli O, Demirag NG (2015) Depression, coping strategies, glycemic control and patient compliance in type 2 diabetic patients in an endocrine outpatient clinic. Pak J Med Sci 31(1):19–24
92. Okumiya K, Fujisawa M, Sakamoto R, Wada T, Chen WL, Imai H et al (2015) Effect of early diagnosis and lifestyle modification on depressive symptoms in community-dwelling elderly adults with glucose intolerance: 5-year longitudinal study. J Am Geriatr Soc 63(2):393–395
93. Nefs G, Donga E, van Someren E, Bot M, Speight J, Pouwer F (2015) Subjective sleep impairment in adults with type 1 or type 2 diabetes: Results from Diabetes MILES—The Netherlands. Diabetes Res Clin Pract 109(3):466–475
94. Mishra SR, Sharma A, Bhandari PM, Bhochhibhoya S, Thapa K (2015) Depression and health-related quality of life among patients with type 2 diabetes mellitus: a cross-sectional study in Nepal. PloS One 10(11):e0141385
95. Mir K, Mir K, Malik I, Shehzadi A (2015) The prevalence of co-morbid depression in diabetic population. J Ayub Med Coll Abbottabad 27(1):99–101
96. Mayberry LS, Egede LE, Wagner JA, Osborn CY (2015) Stress, depression and medication nonadherence in diabetes: test of the exacerbating and buffering effects of family support. J Behav Med 38(2):363–371
97. March D, Williams J, Wells S, Eimicke JP, Teresi JA, Almonte C et al (2015) Discrimination and depression among urban hispanics with poorly controlled diabetes. Ethn Dis 25(2):130–137
98. Knaster ES, Fretts AM, Phillips LE (2015) The association of depression with diabetes management among urban American

Indians/Alaska Natives in the United States, 2011. Ethn Dis 25(1):83–89
99. Islam SM, Rawal LB, Niessen LW (2015) Prevalence of depression and its associated factors in patients with type 2 diabetes: a cross-sectional study in Dhaka, Bangladesh. Asian J Psychiatr 17:36–41
100. Hapunda G, Abubakar A, Pouwer F, van de Vijver F (2015) Diabetes mellitus and comorbid depression in Zambia. Diabetes Med 32(6):814–818
101. Gemeay EM, Moawed SA, Mansour EA, Ebrahiem NE, Moussa IM, Nadrah WO (2015) The association between diabetes and depression. Saudi Med J 36(10):1210–1215
102. Foran E, Hannigan A, Glynn L (2015) Prevalence of depression in patients with type 2 diabetes mellitus in Irish primary care and the impact of depression on the control of diabetes. Ir J Med Sci 184(2):319–322
103. El Mahalli AA (2015) Prevalence and predictors of depression among type 2 diabetes mellitus outpatients in eastern province, Saudi Arabia. Int J Health Sci (Qassim) 9(2):119–126
104. Derakhshanpour F, Vakili MA, Farsinia M, Mirkarimi K (2015) Depression and quality of life in patients with type 2 diabetes. Iran Red Crescent Med J 17(5):e27676
105. Czech SJ, Orsillo SM, Pirraglia PA, English TM, Connell AJ (2015) Association between specific depression symptoms and glycemic control among patients with comorbid type 2 diabetes and provisional depression. Prim Care Companion CNS Disord. https://doi.org/10.4088/PCC.14m01754
106. Crispin-Trebejo B, Robles-Cuadros MC, Bernabe-Ortiz A (2015) Association between depression and glycemic control among type 2 diabetes patients in Lima, Peru. Asia Pac Psychiatry 7(4):419–426
107. Camara A, Balde NM, Enoru S, Bangoura JS, Sobngwi E, Bonnet F (2015) Prevalence of anxiety and depression among diabetic African patients in Guinea: association with HbA1c levels. Diabetes Metab 41(1):62–68
108. Zheng Y, Sun Q, Chen K, Yan W, Pan C, Lu J et al (2014) Waist-to-hip ratio, dyslipidemia, glycemic levels, blood pressure and depressive symptoms among diabetic and non-diabetic Chinese women: a cross-sectional study. PloS One 9(10):e109765
109. Vanderlip ER, Katon W, Russo J, Lessler D, Ciechanowski P (2014) Depression among patients with diabetes attending a safety-net primary care clinic: relationship with disease control. Psychosomatics 55(6):548–554
110. Pearson S, Nash T, Ireland V (2014) Depression symptoms in people with diabetes attending outpatient podiatry clinics for the treatment of foot ulcers. J Foot Ankle Res 7(1):47
111. Palta P, Golden SH, Teresi JA, Palmas W, Trief P, Weinstock RS et al (2014) Depression is not associated with diabetes control in minority elderly. J Diabetes Compl 28(6):798–804
112. Omagari K, Sakaki M, Tsujimoto Y, Shiogama Y, Iwanaga A, Ishimoto M et al (2014) Coffee consumption is inversely associated with depressive status in Japanese patients with type 2 diabetes. J Clin Biochem Nutr 55(2):135–142
113. Musselman DL, Ziemer DC, McNutt MD, Seay JS, Royster EB, Larsen B et al (2014) Depression, deficits in functional capacity, and impaired glycemic control in urban African Americans with type 2 diabetes. J Psychiatr Res 52:21–27
114. Mikaliukstiene A, Zagminas K, Juozulynas A, Narkauskaite L, Salyga J, Jankauskiene K et al (2014) Prevalence and determinants of anxiety and depression symptoms in patients with type 2 diabetes in Lithuania. Med Sci Monit 20:182–190
115. Martinez Hernandez F, Tovilla Zarate CA, Lopez Narvaez L, Juarez Rojop IE, Jimenez Santos MA, Gonzalez Gutierrez CP et al (2014) [Prevalence and gravity of depression and anxiety in patients with obesity and type 2 diabetes: a study in the population of Tabasco, Mexico]. Gac Med Mex 150(Suppl 1):101–106
116. Limongi F, Noale M, Crepaldi G, Maggi S (2014) Prevalence of diabetes and depressive symptomatology and their effect on mortality risk in elderly Italians: the Italian Longitudinal Study on Aging. Diabetes Metab 40(5):373–378
117. Lara Munoz Mdel C, Jacobs EA, Escamilla MA, Mendenhall E (2014) Depression among diabetic women in urban centers in Mexico and the United States of America: a comparative study. Rev Panam Salud Publica 36(4):225–231
118. Khan MA, Sultan SM, Nazli R, Akhtar T, Khan MA, Sher N et al (2014) Depression among patients with type-II diabetes mellitus. J Coll Physicians Surg Pak 24(10):770–771
119. Jafari N, Farajzadegan Z, Loghmani A, Majlesi M, Jafari N (2014) Spiritual well-being and quality of life of Iranian adults with type 2 diabetes. Evid Based Compl Alternat Med 2014:619028
120. Hayashino Y, Mashitani T, Tsujii S, Ishii H (2014) Elevated levels of hs-CRP are associated with high prevalence of depression in japanese patients with type 2 diabetes: the Diabetes Distress and Care Registry at Tenri (DDCRT 6). Diabetes Care 37(9):2459–2465
121. Gorska-Ciebiada M, Saryusz-Wolska M, Ciebiada M, Loba J (2014) Mild cognitive impairment and depressive symptoms in elderly patients with diabetes: prevalence, risk factors, and comorbidity. J Diabetes Res 2014:179648
122. Ganasegeran K, Renganathan P, Manaf RA, Al-Dubai SA (2014) Factors associated with anxiety and depression among type 2 diabetes outpatients in Malaysia: a descriptive cross-sectional single-centre study. BMJ Open 4(4):e004794
123. Dismuke CE, Hernandez-Tejada MA, Egede LE (2014) Relationship of serious psychological distress to quality of life in adults with diabetes. Int J Psychiatry Med 48(2):135–146
124. Carper MM, Traeger L, Gonzalez JS, Wexler DJ, Psaros C, Safren SA (2014) The differential associations of depression and diabetes distress with quality of life domains in type 2 diabetes. J Behav Med 37(3):501–510
125. Bensbaa S, Agerd L, Boujraf S, Araab C, Aalouane R, Rammouz I et al (2014) Clinical assessment of depression and type 2 diabetes in Morocco: Economical and social components. J Neurosci Rural Pract 5(3):250–253
126. Azad N, Gondal M, Abbas N, Shahid A (2014) Frequency of depression and anxiety in patients attending a diabetes clinic. J Ayub Med Coll Abbottabad 26(3):323–327
127. Alonso-Moran E, Satylganova A, Orueta JF, Nuno-Solinis R (2014) Prevalence of depression in adults with type 2 diabetes in the Basque Country: relationship with glycaemic control and health care costs. BMC Public Health 14:769
128. Zhang J, Xu CP, Wu HX, Xue XJ, Xu ZJ, Li Y et al (2013) Comparative study of the influence of diabetes distress and depression on treatment adherence in Chinese patients with type 2 diabetes: a cross-sectional survey in the People's Republic of China. Neuropsychiatr Dis Treat 9:1289–1294
129. Yu MK, Katon W, Young BA (2013) Diabetes self-care, major depression, and chronic kidney disease in an outpatient diabetic population. Nephron Clin Pract 124(1–2):106–112
130. Wu SF, Young LS, Yeh FC, Jian YM, Cheng KC, Lee MC (2013) Correlations among social support, depression, and anxiety in patients with type-2 diabetes. J Nurs Res 21(2):129–138
131. Twist K, Stahl D, Amiel SA, Thomas S, Winkley K, Ismail K (2013) Comparison of depressive symptoms in type 2 diabetes using a two-stage survey design. Psychosom Med 75(8):791–797
132. Tanenbaum ML, Ritholz MD, Binko DH, Baek RN, Shreck MS, Gonzalez JS (2013) Probing for depression and finding diabetes: a mixed-methods analysis of depression interviews with adults treated for type 2 diabetes. J Affect Disord 150(2):533–539
133. Schierhout G, Nagel T, Si D, Connors C, Brown A, Bailie R (2013) Do competing demands of physical illness in type 2

diabetes influence depression screening, documentation and management in primary care: a cross-sectional analytic study in Aboriginal and Torres Strait Islander primary health care settings. Int J Ment Health Syst 7(1):16
134. Palizgir M, Bakhtiari M, Esteghamati A (2013) Association of depression and anxiety with diabetes mellitus type 2 concerning some sociological factors. Iran Red Crescent Med J 15(8):644–648
135. Niraula K, Kohrt BA, Flora MS, Thapa N, Mumu SJ, Pathak R et al (2013) Prevalence of depression and associated risk factors among persons with type-2 diabetes mellitus without a prior psychiatric history: a cross-sectional study in clinical settings in urban Nepal. BMC Psychiatry 13:309
136. Myers AK, Grannemann BD, Lingvay I, Trivedi MH (2013) Brief report: depression and history of suicide attempts in adults with new-onset Type 2 Diabetes. Psychoneuroendocrinology 38(11):2810–2814
137. Madhu M, Abish A, Anu K, Jophin RI, Kiran AM, Vijayakumar K (2013) Predictors of depression among patients with diabetes mellitus in Southern India. Asian J Psychiatr 6(4):313–317
138. Kaur G, Tee GH, Ariaratnam S, Krishnapillai AS, China K (2013) Depression, anxiety and stress symptoms among diabetics in Malaysia: a cross sectional study in an urban primary care setting. BMC Fam Pract 14:69
139. Joseph N, Unnikrishnan B, Raghavendra Babu YP, Kotian MS, Nelliyanil M (2013) Proportion of depression and its determinants among type 2 diabetes mellitus patients in various tertiary care hospitals in Mangalore city of South India. Indian J Endocrinol Metab 17(4):681–688
140. Hawamdeh S, Almakhzoomy I, Hayajneh Y (2013) Screening and correlates of depression and HbA1 C in United Arab Emirates (UAE) women with diabetes. Perspect Psychiatr Care 49(4):262–268
141. Hajos TR, Pouwer F, Skovlund SE, Den Oudsten BL, Geelhoed-Duijvestijn PH, Tack CJ et al (2013) Psychometric and screening properties of the WHO-5 well-being index in adult outpatients with Type 1 or Type 2 diabetes mellitus. Diabetes Med 30(2):e63–e69
142. Furuya M, Hayashino Y, Tsujii S, Ishii H, Fukuhara S (2013) Comparative validity of the WHO-5 Well-Being Index and two-question instrument for screening depressive symptoms in patients with type 2 diabetes. Acta Diabetol 50(2):117–121
143. Frederick FT, Maharajh HD (2013) Prevalence of depression in type 2 diabetic patients in Trinidad and Tobago. West Indian Med J 62(7):628–631
144. Das R, Singh O, Thakurta RG, Khandakar MR, Ali SN, Mallick AK et al (2013) Prevalence of depression in patients with type II diabetes mellitus and its impact on quality of life. Indian J Psychol Med 35(3):284–289
145. Clyde M, Smith KJ, Gariepy G, Schmitz N (2013) The association between smoking and depression in a Canadian community-based sample with type 2 diabetes. Can J Diabetes 37(3):150–155
146. Chung JO, Cho DH, Chung DJ, Chung MY (2013) Assessment of factors associated with the quality of life in Korean type 2 diabetic patients. Intern Med 52(2):179–185
147. Choi SE, Reed PL (2013) Contributors to depressive symptoms among Korean immigrants with type 2 diabetes. Nurs Res 62(2):115–121
148. Baradaran HR, Mirghorbani SM, Javanbakht A, Yadollahi Z, Khamseh ME (2013) Diabetes distress and its association with depression in patients with type 2 diabetes in iran. Int J Prev Med 4(5):580–584
149. Tsujii S, Hayashino Y, Ishii H (2012) Diabetes distress, but not depressive symptoms, is associated with glycaemic control among Japanese patients with type 2 diabetes: Diabetes Distress and Care Registry at Tenri (DDCRT 1). Diabetes Med 29(11):1451–1455
150. Trento M, Raballo M, Trevisan M, Sicuro J, Passera P, Cirio L et al (2012) A cross-sectional survey of depression, anxiety, and cognitive function in patients with type 2 diabetes. Acta Diabetol 49(3):199–203
151. Tovilla-Zarate C, Juarez-Rojop I, Peralta Jimenez Y, Jimenez MA, Vazquez S, Bermudez-Ocana D et al (2012) Prevalence of anxiety and depression among outpatients with type 2 diabetes in the Mexican population. PloS One 7(5):e36887
152. Shah BM, Gupchup GV, Borrego ME, Raisch DW, Knapp KK (2012) Depressive symptoms in patients with type 2 diabetes mellitus: do stress and coping matter? Stress Health 28(2):111–122
153. Rahman M, Rahman MA, Flora MS, Karim R, Zaman MR (2012) Depression and its association with socio-demographic characteristics among type 2 diabetes mellitus patients of Bangladesh. Mymensingh Med J 21(3):490–496
154. Park H, Kim MT (2012) Impact of social role strain, depression, social support and age on diabetes self-efficacy in Korean women with type 2 diabetes. J Cardiovasc Nurs 27(1):76–83
155. Osme SF, Ferreira L, Jorge MT, de Souza Andreo J, Jorge M, de Melo Costa Pinto R et al (2012) Difference between the prevalence of symptoms of depression and anxiety in non-diabetic smokers and in patients with type 2 diabetes with and without nicotine dependence. Diabetol Metab Syndr 4(1):39
156. Osborn CY, Egede LE (2012) The relationship between depressive symptoms and medication nonadherence in type 2 diabetes: the role of social support. Gen Hosp Psychiatry 34(3):249–253
157. Mendenhall E, Jacobs EA (2012) Interpersonal abuse and depression among mexican immigrant women with type 2 diabetes. Cult Med Psychiatry 36(1):136–153
158. Maia AC, Braga Ade A, Brouwers A, Nardi AE, Oliveira e Silva AC (2012) Prevalence of psychiatric disorders in patients with diabetes types 1 and 2. Compr Psychiatry 53(8):1169–1173
159. Lynch CP, Hernandez-Tejada MA, Strom JL, Egede LE (2012) Association between spirituality and depression in adults with type 2 diabetes. Diabetes Educ 38(3):427–435
160. Lofman S, Hakko H, Mainio A, Timonen M, Rasanen P (2012) Characteristics of suicide among diabetes patients: a population based study of suicide victims in Northern Finland. J Psychosom Res 73(4):268–271
161. Labad J, Price JF, Strachan MW, Fowkes FG, Deary IJ, Seckl JR et al (2012) Leptin levels and depressive symptoms in people with type 2 diabetes: the edinburgh type 2 diabetes study. Psychosom Med 74(1):39–45
162. Katon W, Lyles CR, Parker MM, Karter AJ, Huang ES, Whitmer RA (2012) Association of depression with increased risk of dementia in patients with type 2 diabetes: the Diabetes and Aging Study. Arch Gen Psychiatry 69(4):410–417
163. Hosoya T, Matsushima M, Nukariya K, Utsunomiya K (2012) The relationship between the severity of depressive symptoms and diabetes-related emotional distress in patients with type 2 diabetes. Intern Med 51(3):263–269
164. Guruprasad KG, Niranjan MR, Ashwin S (2012) A study of association of depressive symptoms among the type 2 diabetic outpatients presenting to a tertiary care hospital. Indian J Psychol Med 34(1):30–33
165. Green AJ, Fox KM, Grandy S (2012) Self-reported hypoglycemia and impact on quality of life and depression among adults with type 2 diabetes mellitus. Diabetes Res Clin Pract 96(3):313–318
166. Feinkohl I, Sattar N, Welsh P, Reynolds RM, Deary IJ, Strachan MW et al (2012) Association of N-terminal pro-brain natriuretic peptide with cognitive function and depression in elderly people with type 2 diabetes. PloS One 7(9):e44569

167. Bassett J, Adelman A, Gabbay R, Anel-Tiangco RM (2012) Relationship between depression and treatment satisfaction among patients with type 2 diabetes. J Diabetes Metab 3(7):1–8
168. Wu SF, Huang YC, Liang SY, Wang TJ, Lee MC, Tung HH (2011) Relationships among depression, anxiety, self-care behaviour and diabetes education difficulties in patients with type-2 diabetes: a cross-sectional questionnaire survey. Int J Nurs Stud 48(11):1376–1383
169. van Steenbergen-Weijenburg KM, van Puffelen AL, Horn EK, Nuyen J, van Dam PS et al (2011) More co-morbid depression in patients with Type 2 diabetes with multiple complications. An observational study at a specialized outpatient clinic. Diabetes Med 28(1):86–89
170. Sorkin DH, Ngo-Metzger Q, Billimek J, August KJ, Greenfield S, Kaplan SH (2011) Underdiagnosed and undertreated depression among racially/ethnically diverse patients with type 2 diabetes. Diabetes Care 34(3):598–600
171. So ES, Chin YR, Lee IS (2011) Relationship between health-related behavioral and psychological factors and cardiovascular and cerebrovascular diseases comorbidity among korean adults with diabetes. Asian Nurs Res (Korean Soc Nurs Sci) 5(4):204–209
172. Rodriguez-Pascual C, Rodriguez-Justo S, Garcia-Villar E, Narro-Vidal M, Torrente-Carballido M, Paredes-Galan E (2011) Quality of life, characteristics and metabolic control in diabetic geriatric patients. Maturitas 69(4):343–347
173. Poongothai S, Anjana RM, Pradeepa R, Ganesan A, Unnikrishnan R, Rema M et al (2011) Association of depression with complications of type 2 diabetes—the Chennai Urban Rural Epidemiology Study (CURES-102). J Assoc Physicians India 59:644–648
174. Papelbaum M, Moreira RO, Coutinho W, Kupfer R, Zagury L, Freitas S et al (2011) Depression, glycemic control and type 2 diabetes. Diabetol Metab Syndr 3(1):26
175. Miller ST (2011) Diabetes and psychological profile of younger rural African American women with type 2 diabetes. J Health Care Poor Underserved 22(4):1239–1252
176. Mantyselka P, Korniloff K, Saaristo T, Koponen H, Eriksson J, Puolijoki H et al (2011) Association of depressive symptoms with impaired glucose regulation, screen-detected, and previously known type 2 diabetes: findings from the Finnish D2D Survey. Diabetes Care 34(1):71–76
177. Joshi A, Joshi A, Maseeh A, Jha PK, Bhatt M, Vyasa B (2011) A study of prevalence of depression in diabetes mellitus: analysis from urban India. Indian J Med Sci 65(11):497–501
178. Balhara YP, Sagar R (2011) Correlates of anxiety and depression among patients with type 2 diabetes mellitus. Indian J Endocrinol Metab 15(Suppl 1):S50–S54
179. Al-Amer RM, Sobeh MM, Zayed AA, Al-Domi HA (2011) Depression among adults with diabetes in Jordan: risk factors and relationship to blood sugar control. J Diabetes Compl 25(4):247–252
180. Yu R, L YH, Hong L (2010) Depression in newly diagnosed type 2 diabetes. Int J Diabetes Dev Ctries 30(2):102–104
181. Yekta Z, Pourali R, Yavarian R (2010) Behavioural and clinical factors associated with depression among individuals with diabetes. East Mediterr Health J 16(3):286–291
182. Tsirogianni E, Kouniakis F, Baltatzi M, Lavrentiadis G, Alevizos M (2010) [Biological factors associated with depression in patients with type IotaIota diabetes mellitus]. Psychiatriki 21(2):115–125
183. Sapozhnikova IE, Tarlovskaia EI, Sobolev AA, Rodygina EV (2010) [Frequency and specific features of depressive disorders in patients with type 2 diabetes mellitus]. Klin Med (Mosk) 88(3):43–46
184. Raval A, Dhanaraj E, Bhansali A, Grover S, Tiwari P (2010) Prevalence and determinants of depression in type 2 diabetes patients in a tertiary care centre. Indian J Med Res 132:195–200
185. Pouwer F, Geelhoed-Duijvestijn PH, Tack CJ, Bazelmans E, Beekman AJ, Heine RJ et al (2010) Prevalence of comorbid depression is high in out-patients with Type 1 or Type 2 diabetes mellitus. Results from three out-patient clinics in the Netherlands. Diabet Med 27(2):217–224
186. Poongothai S, Anjana RM, Pradeepa R, Ganesan A, Umapathy N, Mohan V (2010) Prevalence of depression in relation to glucose intolerance in urban south Indians—the Chennai Urban Rural Epidemiology Study (CURES-76). Diabetes Technol Ther 12(12):989–994
187. Khuwaja AK, Lalani S, Dhanani R, Azam IS, Rafique G, White F (2010) Anxiety and depression among outpatients with type 2 diabetes: a multi-centre study of prevalence and associated factors. Diabetol Metab Syndr 2:72
188. Cherrington A, Wallston KA, Rothman RL (2010) Exploring the relationship between diabetes self-efficacy, depressive symptoms, and glycemic control among men and women with type 2 diabetes. J Behav Med 33(1):81–89
189. Bair MJ, Brizendine EJ, Ackermann RT, Shen C, Kroenke K, Marrero DG (2010) Prevalence of pain and association with quality of life, depression and glycaemic control in patients with diabetes. Diabet Med 27(5):578–584
190. Yang J, Li S, Zheng Y (2009) Predictors of depression in Chinese community-dwelling people with type 2 diabetes. J Clin Nurs 18(9):1295–1304
191. Subramaniam M, Sum CF, Pek E, Stahl D, Verma S, Liow PH et al (2009) Comorbid depression and increased health care utilisation in individuals with diabetes. Gen Hosp Psychiatry 31(3):220–224
192. Lee HJ, Chapa D, Kao CW, Jones D, Kapustin J, Smith J et al (2009) Depression, quality of life, and glycemic control in individuals with type 2 diabetes. J Am Acad Nurse Pract 21(4):214–224
193. Kokoszka A, Pouwer F, Jodko A, Radzio R, Mucko P, Bienkowska J et al (2009) Serious diabetes-specific emotional problems in patients with type 2 diabetes who have different levels of comorbid depression: a Polish study from the European Depression in Diabetes (EDID) Research Consortium. Eur Psychiatry 24(7):425–430
194. Koopmans B, Pouwer F, de Bie RA, van Rooij ES, Leusink GL, Pop VJ (2009) Depressive symptoms are associated with physical inactivity in patients with type 2 diabetes. The DIAZOB Primary Care Diabetes study. Fam Pract 26(3):171–173
195. Graco M, Berlowitz DJ, Fourlanos S, Sundram S (2009) Depression is greater in non-English speaking hospital outpatients with type 2 diabetes. Diabetes Res Clin Pract 83(2):e51–e53
196. Aujla N, Abrams KR, Davies MJ, Taub N, Skinner TC, Khunti K (2009) The prevalence of depression in white-European and South-Asian people with impaired glucose regulation and screen-detected type 2 diabetes mellitus. PloS One 4(11):e7755
197. Collins-McNeil JC, Holston EC, Edwards CL, Benbow D, Ford Y (2009) Physical activity, depressive symptoms, and social support among African-American women with type 2 diabetes. Can J Nurs Res 41(3):24–43
198. Collins MM, Corcoran P, Perry IJ (2009) Anxiety and depression symptoms in patients with diabetes. Diabet Med 26(2):153–161
199. Ali S, Davies MJ, Taub NA, Stone MA, Khunti K (2009) Prevalence of diagnosed depression in South Asian and white European people with type 1 and type 2 diabetes mellitus in a UK secondary care population. Postgrad Med J 85(1003):238–243
200. Zhang CX, Chen YM, Chen WQ (2008) Association of psychosocial factors with anxiety and depressive symptoms in

Chinese patients with type 2 diabetes. Diabetes Res Clin Pract 79(3):523–530
201. Sotiropoulos A, Papazafiropoulou A, Apostolou O, Kokolaki A, Gikas A, Pappas S (2008) Prevalence of depressive symptoms among non insulin treated Greek type 2 diabetic subjects. BMC Res Notes 1:101
202. Rhee MK, Musselman D, Ziemer DC, Vaccarino V, Kolm P, Weintraub WS et al (2008) Unrecognized glucose intolerance is not associated with depression. Screening for Impaired Glucose Tolerance study 3 (SIGT 3). Diabet Med 25(11):1361–1365
203. Almawi W, Tamim H, Al-Sayed N, Arekat MR, Al-Khateeb GM, Baqer A et al (2008) Association of comorbid depression, anxiety, and stress disorders with Type 2 diabetes in Bahrain, a country with a very high prevalence of Type 2 diabetes. J Endocrinol Invest 31(11):1020–1024
204. Mier N, Bocanegra-Alonso A, Zhan D, Zuniga MA, Acosta RI (2008) Health-related quality of life in a binational population with diabetes at the Texas-Mexico border. Rev Panam Salud Publ 23(3):154–163
205. Mier N, Bocanegra-Alonso A, Zhan D, Wang S, Stoltz SM, Acosta-Gonzalez RI et al (2008) Clinical depressive symptoms and diabetes in a binational border population. J Am Board Fam Med 21(3):223–233
206. Adriaanse MC, Dekker JM, Heine RJ, Snoek FJ, Beekman AJ, Stehouwer CD et al (2008) Symptoms of depression in people with impaired glucose metabolism or Type 2 diabetes mellitus: the Hoorn Study. Diabetes Med 25(7):843–849
207. Wessels AM, Pouwer F, Geelhoed-Duijvestijn PH, Snel M, Kostense PJ, Scheltens P et al (2007) No evidence for increased self-reported cognitive failure in Type 1 and Type 2 diabetes: a cross-sectional study. Diabet Med 24(7):735–740
208. Sundaram M, Kavookjian J, Patrick JH, Miller LA, Madhavan SS, Scott VG (2007) Quality of life, health status and clinical outcomes in Type 2 diabetes patients. Qual Life Res 16(2):165–177
209. Sacco WP, Wells KJ, Friedman A, Matthew R, Perez S, Vaughan CA (2007) Adherence, body mass index, and depression in adults with type 2 diabetes: the mediational role of diabetes symptoms and self-efficacy. Health Psychol 26(6):693–700
210. Kogan SM, Brody GH, Crawley C, Logan P, Murry VM (2007) Correlates of elevated depressive symptoms among rural African American adults with type 2 diabetes. Ethn Dis 17(1):106–112
211. Knol MJ, Heerdink ER, Egberts AC, Geerlings MI, Gorter KJ, Numans ME et al (2007) Depressive symptoms in subjects with diagnosed and undiagnosed type 2 diabetes. Psychosom Med 69(4):300–305
212. Gonzalez JS, Safren SA, Cagliero E, Wexler DJ, Delahanty L, Wittenberg E et al (2007) Depression, self-care, and medication adherence in type 2 diabetes: relationships across the full range of symptom severity. Diabetes Care 30(9):2222–2227
213. Fisher L, Skaff MM, Mullan JT, Arean P, Mohr D, Masharani U et al (2007) Clinical depression versus distress among patients with type 2 diabetes: not just a question of semantics. Diabetes Care 30(3):542–548
214. Chazova TE, Voznesenskaia TG, Golitsyna T (2007) [Anxiety-depressive disorders in patients with type 2 diabetes mellitus complicated with acute coronary syndrome]. Kardiologiia 47(6):10–14
215. Arima H, Miwa M, Kawahara K (2007) The prevalence of comorbid depression among employees with type 2 diabetes in a Japanese corporation: a descriptive study using an integrated health database. J Med Dent Sci 54(1):39–48
216. Iwase M, Fujii H, Nakamura U, Ohkuma T, Ide H, Jodai-Kitamura T et al (2018) Incidence of diabetic foot ulcer in Japanese patients with type 2 diabetes mellitus: The Fukuoka diabetes registry. Diabetes Res Clin Pract 137:183–189
217. Chima CC, Salemi JL, Wang M, Mejia de Grubb MC, Gonzalez SJ, Zoorob RJ (2017) Multimorbidity is associated with increased rates of depression in patients hospitalized with diabetes mellitus in the United States. J Diabetes Compl 31(11):1571–1579
218. Zurita-Cruz JN, Manuel-Apolinar L, Arellano-Flores ML, Gutierrez-Gonzalez A, Najera-Ahumada AG, Cisneros-Gonzalez N (2018) Health and quality of life outcomes impairment of quality of life in type 2 diabetes mellitus: a cross-sectional study. Health Qual Life Outcomes 16(1):94
219. Wang D, Shi L, Li L, Guo X, Li Y, Xu Y et al (2018) Subthreshold depression among diabetes patients in Beijing: cross-sectional associations among sociodemographic, clinical, and behavior factors. J Affect Disord 237:80–86
220. Ronel J, Dinkel A, Wolf E, Marten-Mittag B, Mueck B, Mayr C et al (2018) Anxiety, depression, and health-related quality of life in aging people living with HIV compared to diabetes patients and patients with minor health conditions: a longitudinal study. Psychol Health Med 10:1–8
221. Rathmann W, Scheerer M, Rohwedder K, Busch S, Kostev K (2018) Changes in patient characteristics, glucose lowering treatment, glycemic control and complications in type 2 diabetes in general practices (Disease Analyzer, Germany: 2008–2016). Postgrad Med 130(2):244–250
222. Nanayakkara N, Pease A, Ranasinha S, Wischer N, Andrikopoulos S, Speight J et al (2018) Depression and diabetes distress in adults with type 2 diabetes: results from the Australian National Diabetes Audit (ANDA) 2016. Sci Rep 8(1):7846
223. Fung ACH, Tse G, Cheng HL, Lau ESH, Luk A, Ozaki R et al (2018) Depressive symptoms, co-morbidities, and glycemic control in Hong Kong Chinese Elderly Patients with type 2 diabetes mellitus. Front Endocrinol (Lausanne) 9:261
224. Tu HP, Hsieh HM, Liu TL, Jiang HJ, Wang PW, Huang CJ (2017) Prevalence of depressive disorder in persons with type 2 diabetes: a National Population-Based Cohort Study 2000–2010. Psychosomatics 58(2):151–163
225. Saetung S, Nimitphong H, Siwasaranond N, Manodpitipong A, Crowley SJ, Hood MM et al (2017) Eveningness is associated with greater depressive symptoms in type 2 diabetes patients: a study in two different ethnic cohorts. Behav Sleep Med 16:1–11
226. Smith KJ, Pedneault M, Schmitz N (2016) Investigation of anxiety and depression symptom co-morbidity in a community sample with type 2 diabetes: Associations with indicators of self-care. Can J Public Health 106(8):e496–e501
227. Rajput R, Gehlawat P, Gehlan D, Gupta R, Rajput M (2016) Prevalence and predictors of depression and anxiety in patients of diabetes mellitus in a tertiary care center. Indian J Endocrinol Metab 20(6):746–751
228. Nicolau J, Simo R, Sanchis P, Ayala L, Fortuny R, Rivera R et al (2016) Prevalence and clinical correlators of undiagnosed significant depressive symptoms among individuals with type 2 diabetes in a mediterranean population. Exp Clin Endocrinol Diabetes 124(10):630–636
229. Bruce DG, Davis WA, Dragovic M, Davis TM, Starkstein SE (2016) Comorbid anxiety and depression and their impact on cardiovascular disease in type 2 diabetes: the fremantle diabetes study phase II. Depress Anxiety 33(10):960–966
230. Barnacle M, Strand MA, Werremeyer A, Maack B, Petry N (2016) Depression screening in diabetes care to improve outcomes: are we meeting the challenge? Diabetes Educ 42(5):646–651
231. Park CY, Kim SY, Gil JW, Park MH, Park JH, Kim Y (2015) Depression among Korean adults with type 2 diabetes mellitus: ansan-community-based epidemiological study. Osong Public Health Res Perspect 6(4):224–232
232. Browne JL, Nefs G, Pouwer F, Speight J (2015) Depression, anxiety and self-care behaviours of young adults with Type 2

diabetes: results from the International Diabetes Management and Impact for Long-term Empowerment and Success (MILES) Study. Diabetes Med 32(1):133–140
233. Wami WM, Buntinx F, Bartholomeeusen S, Goderis G, Mathieu C, Aerts M (2013) Influence of chronic comorbidity and medication on the efficacy of treatment in patients with diabetes in general practice. Br J Gen Pract 63(609):e267–e273
234. Koekkoek PS, Rutten GE, Ruis C, Reijmer YD, van den Berg E, Gorter KJ et al (2013) Mild depressive symptoms do not influence cognitive functioning in patients with type 2 diabetes. Psychoneuroendocrinology 38(3):376–386
235. Lewko J, Zarzycki W, Krajewska-Kulak E (2012) Relationship between the occurrence of symptoms of anxiety and depression, quality of life, and level of acceptance of illness in patients with type 2 diabetes. Saudi Med J 33(8):887–894
236. Sieu N, Katon W, Lin EH, Russo J, Ludman E, Ciechanowski P (2011) Depression and incident diabetic retinopathy: a prospective cohort study. Gen Hosp Psychiatry 33(5):429–435
237. Heckbert SR, Rutter CM, Oliver M, Williams LH, Ciechanowski P, Lin EH et al (2010) Depression in relation to long-term control of glycemia, blood pressure, and lipids in patients with diabetes. J Gen Intern Med 25(6):524–529
238. Dirmaier J, Watzke B, Koch U, Schulz H, Lehnert H, Pieper L et al (2010) Diabetes in primary care: prospective associations between depression, nonadherence and glycemic control. Psychother Psychosom 79(3):172–178
239. Chiu CJ, Wray LA, Beverly EA, Dominic OG (2010) The role of health behaviors in mediating the relationship between depressive symptoms and glycemic control in type 2 diabetes: a structural equation modeling approach. Soc Psychiatry Psychiatr Epidemiol 45(1):67–76
240. Holt RI, Phillips DI, Jameson KA, Cooper C, Dennison EM, Peveler RC (2009) The relationship between depression and diabetes mellitus: findings from the Hertfordshire Cohort Study. Diabet Med 26(6):641–648
241. Icks A, Kruse J, Dragano N, Broecker-Preuss M, Slomiany U, Mann K et al (2008) Are symptoms of depression more common in diabetes? Results from the Heinz Nixdorf Recall study. Diabet Med 25(11):1330–1336
242. Pawaskar MD, Anderson RT, Balkrishnan R (2007) Self-reported predictors of depressive symptomatology in an elderly population with type 2 diabetes mellitus: a prospective cohort study. Health Qual Life Outcomes 5:50
243. Ismail K, Winkley K, Stahl D, Chalder T, Edmonds M (2007) A cohort study of people with diabetes and their first foot ulcer: the role of depression on mortality. Diabetes Care 30(6):1473–1479
244. Chowdhury SH, Karim MN, Selim S, Ahmed F, Azad AK, Maksud SA et al (2017) Risk of depression among Bangladeshi type 2 diabetic patients. Diabetes Metab Syndr 11(Suppl 2):S1009–S10s12
245. Samaan Z, Garasia S, Gerstein HC, Engert JC, Mohan V, Diaz R et al (2015) Lack of association between type 2 diabetes and major depression: epidemiologic and genetic evidence in a multiethnic population. Transl Psychiatry 5:e618
246. Islam SM, Ferrari U, Seissler J, Niessen L, Lechner A (2015) Association between depression and diabetes amongst adults in Bangladesh: a hospital based case-control study. J Glob Health 5(2):020406
247. Ferreira MC, Piaia C, Cadore AC, Antoniolli MA, Gamborgi GP, Oliveira PP (1992) Clinical variables associated with depression in patients with type 2 diabetes. Rev Assoc Med Bras 61(4):336–340 2015
248. Singh H, Raju MS, Dubey V, Kurrey R, Bansal S, Malik M (2014) A study of sociodemographic clinical and glycemic control factors associated with co-morbid depression in type 2 diabetes mellitus. Ind Psychiatry J 23(2):134–142
249. Siddiqui S, Jha S, Waghdhare S, Agarwal NB, Singh K (2014) Prevalence of depression in patients with type 2 diabetes attending an outpatient clinic in India. Postgrad Med J 90(1068):552–556
250. Kalantari S, Jafarinezhad A, Zohrevand B (2014) Association of depression with type 2 diabetes and relevant factors. Adv Biomed Res 3:244
251. Ali N, Jyotsna VP, Kumar N, Mani K (2013) Prevalence of depression among type 2 diabetes compared to healthy non diabetic controls. J Assoc Physicians India 61(9):619–621
252. Zahra S, Hossein S, Ali KV (2012) Relationship between opium abuse and severity of depression in type 2 diabetic patients. Diabetes Metab J 36(2):157–162
253. Ceretta LB, Reus GZ, Abelaira HM, Jornada LK, Schwalm MT, Hoepers NJ et al (2012) Increased prevalence of mood disorders and suicidal ideation in type 2 diabetic patients. Acta Diabetol 49(Suppl 1):S227–S234
254. Bener A, Ghuloum S, Al-Hamaq AO, Dafeeah EE (2012) Association between psychological distress and gastrointestinal symptoms in diabetes mellitus. World J Diabetes 3(6):123–129
255. Bajaj S, Agarwal SK, Varma A, Singh VK (2012) Association of depression and its relation with complications in newly diagnosed type 2 diabetes. Indian J Endocrinol Metab 16(5):759–763
256. Castro-Ake GA, Tovar-Espinosa JA, Mendoza-Cruz U (2009) [Association between depression and glycemic control disorder in patients with diabetes mellitus 2]. Rev Med Inst Mex Seguro Soc 47(4):377–382
257. Khamseh ME, Baradaran HR, Rajabali H (2007) Depression and diabetes in Iranian patients: a comparative study. Int J Psychiatry Med 37(1):81–86
258. Weikert B, Buttery AK, Heidemann C, Rieckmann N, Paprott R, Maske UE et al. Glycaemic status and depressive symptoms among adults in Germany: results from the German Health Interview and Examination Survey for Adults (DEGS1). Diabetes Med. 2018
259. Lopez-de-Andres A, Jimenez-Trujillo MI, Hernandez-Barrera V, de Miguel-Yanes JM, Mendez-Bailon M, Perez-Farinos N et al (2015) Trends in the prevalence of depression in hospitalized patients with type 2 diabetes in Spain: analysis of hospital discharge data from 2001 to 2011. PloS One 10(2):e0117346
260. Agbir TM, Audu MD, Adebowale TO, Goar SG (2010) Depression among medical outpatients with diabetes: a cross-sectional study at Jos University Teaching Hospital, Jos, Nigeria. Ann Afr Med 9(1):5–10
261. Kalsekar ID, Madhavan SS, Amonkar MM, Makela EH, Scott VG, Douglas SM et al (2006) Depression in patients with type 2 diabetes: impact on adherence to oral hypoglycemic agents. Ann Pharmacother 40(4):605–611
262. Hermanns N, Kulzer B, Krichbaum M, Kubiak T, Haak T (2006) How to screen for depression and emotional problems in patients with diabetes: comparison of screening characteristics of depression questionnaires, measurement of diabetes-specific emotional problems and standard clinical assessment. Diabetologia 49(3):469–477
263. Collins-McNeil J (2006) Psychosocial characteristics and cardiovascular risk in African Americans with diabetes. Arch Psychiatr Nurs 20(5):226–233
264. Chyun DA, Melkus GD, Katten DM, Price WJ, Davey JA, Grey N et al (2006) The association of psychological factors, physical activity, neuropathy, and quality of life in type 2 diabetes. Biol Res Nurs 7(4):279–288
265. Brown LC, Majumdar SR, Newman SC, Johnson JA (2006) Type 2 diabetes does not increase risk of depression. CMAJ 175(1):42–46
266. Pibernik-Okanovic M, Peros K, Szabo S, Begic D, Metelko Z (2005) Depression in Croatian Type 2 diabetic patients:

prevalence and risk factors. A Croatian survey from the European Depression in Diabetes (EDID) Research Consortium. Diabetic Med 22(7):942–945
267. Noh JH, Park JK, Lee HJ, Kwon SK, Lee SH, Park JH et al (2005) Depressive symptoms of type 2 diabetics treated with insulin compared to diabetics taking oral anti-diabetic drugs: a Korean study. Diabetes Res Clin Pract 69(3):243–248
268. Katon WJ, Rutter C, Simon G, Lin EH, Ludman E, Ciechanowski P et al (2005) The association of comorbid depression with mortality in patients with type 2 diabetes. Diabetes Care 28(11):2668–2672
269. Hill-Briggs F, Gary TL, Bone LR, Hill MN, Levine DM, Brancati FL (2005) Medication adherence and diabetes control in urban African Americans with type 2 diabetes. Health Psychol 24(4):349–357
270. Engum A, Mykletun A, Midthjell K, Holen A, Dahl AA (2005) Depression and diabetes: a large population-based study of sociodemographic, lifestyle, and clinical factors associated with depression in type 1 and type 2 diabetes. Diabetes Care 28(8):1904–1909
271. Bruce DG, Davis WA, Starkstein SE, Davis TM (2005) A prospective study of depression and mortality in patients with type 2 diabetes: the Fremantle Diabetes Study. Diabetologia 48(12):2532–2539
272. Ismail K, Winkley K, Rabe-Hesketh S (2004) Systematic review and meta-analysis of randomised controlled trials of psychological interventions to improve glycaemic control in patients with type 2 diabetes. Lancet 363(9421):1589–1597
273. Haghighatdoost F, Azadbakht L (2013) Dietary treatment options for depression among diabetic patient, focusing on macronutrients. J Diabetes Res 2013:421832
274. Alzoubi A, Abunaser R, Khassawneh A, Alfaqih M, Khasawneh A, Abdo N (2018) The bidirectional relationship between diabetes and depression: a literature review. Korean J Fam Med 39(3):137–146
275. Kan C, Silva N, Golden SH, Rajala U, Timonen M, Stahl D et al (2013) A systematic review and meta-analysis of the association between depression and insulin resistance. Diabetes Care 36(2):480–489
276. Azimova K, Rude J, Mallawaarachchi I, Dwivedi A, Sarosiek J, Mukherjee D (2015) Glucose levels and depression in Hispanic patients admitted to the cardiovascular intensive care unit: a cross-sectional study. Angiology 66(1):57–64
277. Sun JC, Xu M, Lu JL, Bi YF, Mu YM, Zhao JJ et al (2015) Associations of depression with impaired glucose regulation, newly diagnosed diabetes and previously diagnosed diabetes in Chinese adults. Diabet Med 32(7):935–943
278. Nouwen A, Nefs G, Caramlau I, Connock M, Winkley K, Lloyd CE et al (2011) Prevalence of depression in individuals with impaired glucose metabolism or undiagnosed diabetes: a systematic review and meta-analysis of the European Depression in Diabetes (EDID) Research Consortium. Diabetes Care 34(3):752–762
279. Chen S, Zhang Q, Dai G, Hu J, Zhu C, Su L et al (2016) Association of depression with pre-diabetes, undiagnosed diabetes, and previously diagnosed diabetes: a meta-analysis. Endocrine 53(1):35–46
280. Musselman DL, Betan E, Larsen H, Phillips LS (2003) Relationship of depression to diabetes types 1 and 2: epidemiology, biology, and treatment. Biol Psychiatry 54(3):317–329
281. Paile-Hyvarinen M, Raikkonen K, Forsen T, Kajantie E, Yliharsila H, Salonen MK et al (2007) Depression and its association with diabetes, cardiovascular disease, and birth weight. Ann Med 39(8):634–640
282. Collaboration C (2018) Cochrane handbook for systematic reviews of interventions: Cochrane Collaboration. Available from: https://training.cochrane.org/handbook. Accessed Feb 2019