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## Review

## The prevalence of depression and anxiety in Iranian patients with diabetes mellitus: A systematic review and meta-analysis

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## ABSTRACT

**Introduction:** This study aims to estimate the prevalence of depression and anxiety among Iranian patients with diabetes mellitus (DM) through meta-analysis.**Methods:** This is a systematic review article based on MOOSE and PRISMA guidelines. Review of the literature was done using databases including Magiran, Barakat Knowledge Network System, SID, RICST, IranDoc, PubMed/Medline, Science Direct, Embase, Scopus, Cochrane Library, Web of Science and the Google Scholar search engine without time limit until December, 2018. Heterogeneity between studies was assessed using Cochran's Q test and I<sup>2</sup> index. Data were analyzed using Comprehensive Meta-Analysis (CMA) software version 2 according to a random-effects model. P-values less than 0.05 were considered as the significance level.**Results:** The analysis consisted of 44 studies including 10,349 Iranian patients with DM. The prevalence of depression was estimated to be 61.8% (95% confidence interval [CI]: 56.6–66.7). The lowest and highest prevalence of depression based on regions was in the North (56.7% [95%CI: 44.9–67.8]) and the East (64.2% [95%CI: 30.7–87.9]), respectively. The depression prevalence in females and males was 63.9% (95%CI: 54.0–72.8) and 46.3% (95%CI: 36.4–56.4), respectively. The prevalence of mild, moderate, severe and highly severe depression was estimated to be 24.4% (95%CI: 21.0–28.2), 19.1% (95%CI: 15.2–23.9), 11.4% (95%CI: 8.6–14.9), and 4.6% (95%CI: 3.4–6.1), respectively. In eight studies, the prevalence of anxiety in Iranian patients with DM was estimated to be 64.5% (95%CI: 42.0–82.1).**Conclusions:** Depression and anxiety are more prevalent among Iranian patients with DM compared with developed countries. Therefore, regular psychiatric consultation is required for the early diagnosis and treatment of depression and anxiety in these patients.

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## 1. Introduction

Diabetes mellitus (DM) is a serious disease that is considered as the most common and important metabolic disease in humans [1]. DM types I and II are two forms of the disease and about 90–95% of patients have type II DM [2]. The prevalence of DM is increasing inconveniently in the world. The number of patients with DM was

171 million in 2000 and it is estimated to reach 366 million by 2030 [3]. The prevalence of DM has been reported to be about 7.7% in Iran [4].

In twenty-first century, we observe industrialization, globalization, increased longevity and changes in the lifestyle of people around the world. One result of these changes can be found in disease patterns and prevalence of chronic diseases such as DM [5]. The most common complications of DM include cardiovascular diseases, retinopathy, neuropathy, nephropathy, renal failure, infertility in men, infections and psychiatric disorders [6].

Depression is the most common psychiatric disorder in patients with DM [7–10] and its prevalence has been reported to be two

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times more than the general population [10,11]. Most psychiatric problems of patients are due to the problems imposed by DM such as invasive monitoring of blood sugar, daily insulin injection, physical complications, diets, low mobility and activity, and hospitalization [12,13]. In these patients, the occurrence of complications as well as the need for continuous care and fear of loneliness, suffering from emotional problems such as depression, fear, and anxiety cause a lot of complications [12].

Poor control of blood sugar is one of the effects of anxiety and stress on this disease. Studies have demonstrated that anxiety reduction decreases cortisol secretion and since cortisol increases blood sugar, it reduces anxiety and stress in patients with DM, which can help to adjust the level of blood sugar in these patients [11,13].

A simple review of the documents shows that the prevalence of depression and anxiety in Iranian patients with DM is reported to be highly diverse [14–50]. As a result, a systematic review of all documentations and their combinations can provide a more comprehensive picture of this problem in Iranian society and it also increases the chance of using the highest quality documentation [51,52].

This study aims to investigate the prevalence of depression and anxiety in patients with DM in Iran using systematic review and meta-analysis.

## 2. Methods

### 2.1. Study protocol

This is a systematic review and meta-analysis on the prevalence of depression and anxiety in Iranian patients with DM based on reviewing available papers. This study was designed according to Meta-analysis of Observational Studies in Epidemiology (MOOSE) protocol and results reported according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline [53]. To avoid bias, search strategy, study selection, quality evaluation and data extraction have been independently performed by two researchers and reaching an agreement on the results was archived with the help of a third reviewer.

### 2.2. Search strategy

The required data were collected from national databases, including Iranian Journal Database (Magiran) (<http://www.magiran.com/>), Barakat Knowledge Network System (<http://health.barakatkn.com>), Scientific Information Database (SID) (<http://www.sid.ir>), Iranian National Library (<http://www.nlai.ir/>), Regional Information Center for Science and Technology (RICST) (<http://en.ricest.ac.ir/>), Iranian Research Institute for Information Science and Technology (IranDoc) (<https://irandoc.ac.ir>), and international databases, including PubMed/Medline, Science Direct, Embase, Scopus, Cochrane Library, Web of Science as well as the Google Scholar search engine without time limit until December 2018. To maximize the comprehensiveness of the search, general Medical Subject Headings (MeSH) keywords such as “Epidemiology”, “Prevalence”, “Depression”, “Anxiety”, “Diabetes”, “Endocrine Disorders”, “Mental Disorders” and “Iran” were used. Reference lists of identified reports and previous review articles were also reviewed to identify other relevant studies. Combined search were conducted with “AND” & “OR” operations. As an example, PubMed search strategy is showed in appendix 1.

### 2.3. Inclusion and exclusion criteria

Inclusion criteria according to PICO (Population or Patient,

Intervention, Comparison and Outcome) [54] were: 1) **P**opulation: Iranian patients with DM; 2) **I**ntervention: questionnaires for confirmed depression and anxiety; 3) **C**omparison: variable aimed for prevalence of depression such as gender, province, year of study and etc; 4) **O**utcome: Estimating the overall prevalence of depression and anxiety in patients with DM.

The exclusion criteria were: 1. non-random samples; 2. non-Iranian patients; 3. irrelevance; and 4. review studies, case reports, letter to the editor without quantitative and comments. For papers that were not in full text, we asked the author for the full text article via e-mail.

### 2.4. Selection of studies

All papers with depression or DM related titles were screened independently by two researchers (M.A and Z.Kh) first and then a list of titles and abstracts was prepared. After hiding characteristics of articles including and the author(s) and the journal name, full text of articles was delivered to researchers. Multiple publications from a similar study were considered as a study. If an article was rejected, the reason was noted. A third researcher judged the article in case of disagreement. For papers that were incomplete information, we connected the corresponding author for provide information via e-mail.

### 2.5. Data extraction

All final articles included in the study process were ready to be extracted through a pre-prepared checklist. The checklist included the author's name, data publication, year of study, place of residence, study design, sample size, mean age and standard deviation (SD) of subjects, duration of DM, depression screening instrument, total prevalence of depression and anxiety, the prevalence based on gender, and the severity.

### 2.6. Quality assessment

In the next step, the selected articles were evaluated by researchers through the modified Newcastle Ottawa Scale (NOS) adapted for cross-sectional studies [55]. The checklist contains three different sections and evaluates the various aspects of methodology, including selection [maximum of 5 stars], comparability [maximum of 3 stars], and outcome [maximum of 2 stars]. The minimum obtained score for entering quantitative synthesis was 5 in this checklist.

### 2.7. Data analysis

The variance of the prevalence of depression and anxiety was estimated using binomial distribution. Odds ratio (OR) was used to assess the effect of gender (male to female ratio) on depression prevalence. Considering the Cochrane Handbook, the heterogeneity among studies was assessed using Cochran's Q test and  $I^2$  index. In this regard, there are three categories for the  $I^2$  index: (0–24% may not be important, 25–49% indicates moderate heterogeneity, 50–75% indicates substantial heterogeneity and over 75% indicates considerable heterogeneity) [56]. To combine data in low and high heterogeneity, we used fixed and random effects models, respectively [57]. Sensitivity analysis was performed by deleting a study at a time for the power of pooled estimate. To find the reason for the heterogeneity among studies, subgroup analysis was done based on region, province and questionnaire, while meta-regression between year of studies and prevalence of depression was used. Egger and Begg's tests were used to check publication bias. Data were analyzed using Comprehensive Meta-Analysis (CMA) Ver. 2. P-

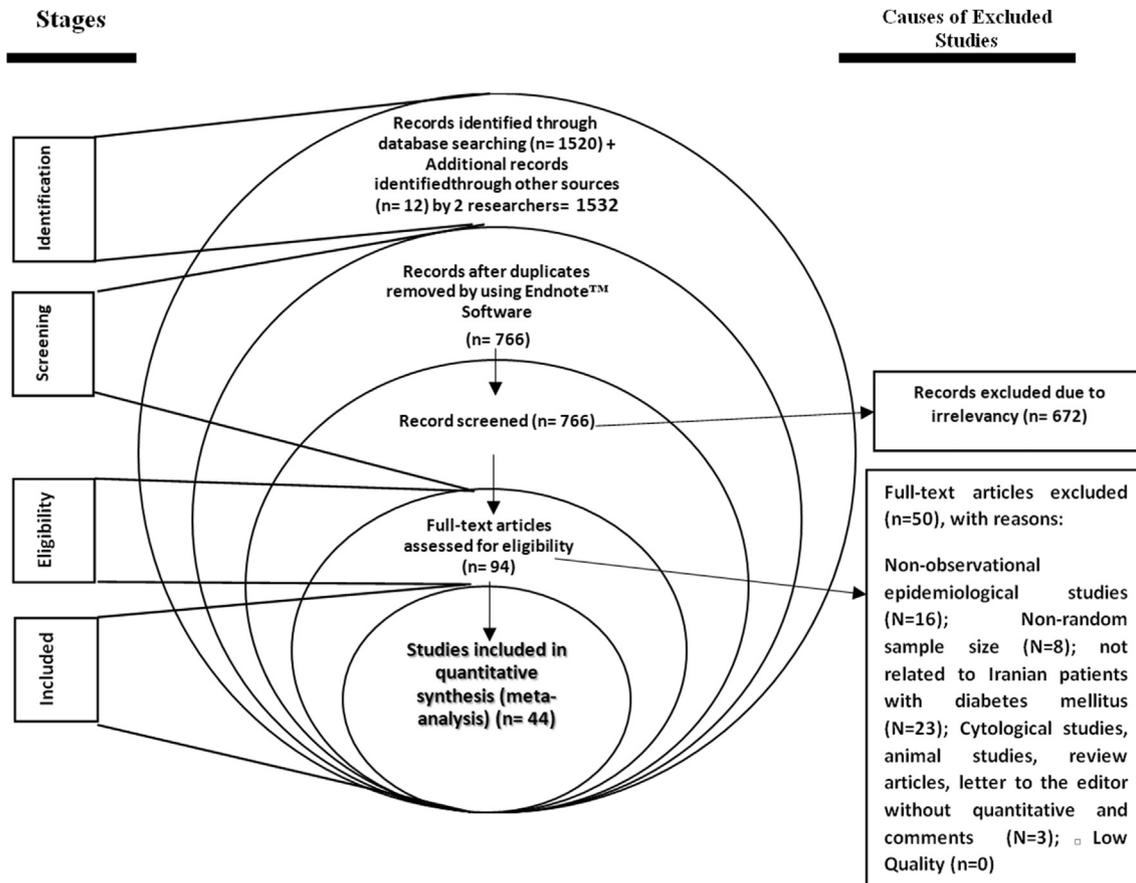


Fig. 1. The entrance steps of systematic review and Meta-analysis.

value lower than 0.05 were considered as the significance level.

### 3. Results

#### 3.1. Search results and characteristics

Overall, 1532 potential studies were found in systematic literature review. We excluded 1499 studies because of: duplicate studies (N = 766), irrelevant records (N = 672), not related to Iranian patients with DM (N = 23), non-observational epidemiological studies (N = 16), non-random sample size (N = 8); and cytological studies, animal studies, review articles, letter to the editor without quantitative and comments (N = 3); low quality (N = 1). Fig. 1 shows the PRISMA study selection flowchart. Finally, we included 44 papers (N = 10,349 patients) published from 1992 to 2016. The mean age and duration of disease (year) was estimated to be 49.7 (95% CI [Confidence Interval]: 46.0–53.3) and 8.0 (95% CI: 6.6–9.4), respectively. Also the result of the quality assessment was indicated most studies were in a moderate quality group (based on the NOS checklist). Table 1 shows the general specifications and data for each of the studies.

#### 3.2. Meta-analysis and sensitivity analysis of depression prevalence

The depression prevalence in Iranian patients with DM with a high heterogeneity rate ( $I^2 = 95.92\%$ ) was estimated to be 61.8% (95% CI: 56.6–66.7). The prevalence of depression was varied between 11.25% and 91.2% (Fig. 2). Major depressive disorder based on Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) criteria in four studies was estimated to be 42.3% (95% CI:

10.1–74.5). Sensitivity analysis showed that the pooled result was robust (Figure 1 in the supplementary file).

#### 3.3. Subgroup analysis of depression prevalence based on geographic regions and provinces

Meta-analysis results demonstrated that the lowest and highest prevalence of depression in Iranian patients with DM based on regions was in the North (56.7% [95% CI: 44.9–67.8]) and the East (64.2% [95% CI: 30.7–87.9]), respectively. According to subgroup analysis based on provinces, the lowest prevalence was in the Markazi province (11.2% [95% CI: 6.9–17.7]) and highest prevalence was in the Razavi Khorasan (82.7% [95% CI: 73.2–89.3]) (Table 2) (Figure 2 in the supplementary file).

#### 3.4. Subgroup analysis of depression prevalence based on questionnaires

The depression prevalence in Iranian patients with DM based on questionnaires of Beck, DASS-21,<sup>1</sup> GHQ-28,<sup>2</sup> SCL-90R,<sup>3</sup> WHOQOL-26,<sup>4</sup> HADS-D,<sup>5</sup> PHQ-9<sup>6</sup> and Hamilton was estimated to be 66.0% (95% CI: 60.7–70.9), 42.4% (95% CI: 37.9–47.1), 43.8% (95% CI: 33.3–54.7), 73.2% (95% CI: 53.1–86.8), 12.0% (95% CI: 4.3–29.1),

<sup>1</sup> Depression Anxiety Stress Scales.

<sup>2</sup> General Health Questionnaire-28.

<sup>3</sup> Symptom Checklist-90-R.

<sup>4</sup> World Health Organization Quality-of-Life Scale-26.

<sup>5</sup> Hospital Anxiety and Depression Scale.

<sup>6</sup> Patient Health Questionnaire-9.

**Table 1**  
Detailed characteristics of 37 articles included in the systematic review on the prevalence of depression and Anxiety among diabetic patients in Iran.

Ref	Author Name, published year	Place	Year of studies	Sample size	Age (Mean ± SD)	Duration of Diabetes (Mean ± SD)	Questionnaire for depression	Prevalence of depression (%)	Questionnaire for anxiety	Prevalence of anxiety (%)
[15]	Larijani B, 2004	Gorgan	2001	375	53.6 ± 13.6	10.1 ± 7.5	Beck	41.9		
[16]	Mahmudi A, 2008	Dehaghan	2006	227			Beck	77		
[17]	Sepehrmanesh Z, 2003	Kashan	2002	300			Beck	53		
[18]	Ranjbar K, 2007	Shiraz	2002	100	39.77 ± 13.48		Beck	71.4		
[19]	Noroozinejad Gh.H, 2006	Ahvaz	2003	309	44.4 ± 11.0		Beck	72.2		
[25]	Nikbakhat A, 2009	Bandar Abbas	2009	100			Beck	50	Beck	67
[26]	Tajfard M, 2014	Mashhad	2011	200			Beck	79	Beck	
[27]	Momeni S, 1997	Tehran	1996	94			Beck	50		
[28]	Vafadari Z, 2000	Yazd	2000	700			Beck	68		
[29]	Arefian N, 2003	Kerman	1996	300			Beck	57		
[30]	Yekta Z, 2010	Orumie	2006	295	55.6 ± 12.0	9.2 ± 6.8	Beck	43		
[31]	Paviz M, 2000	Kerman	2000	150			Beck	61		
[32]	Hamzehi M, 2000	Kashan	1998	80			Beck	91.2		
[33]	Payvandi B, 2000	Golestan	2007	150			Beck	82		
[35]	Salehi B, 2007	Arak	2006	134			Hamilton	11.2		
[36]	Norouzi Z, 2011	Ahvaz	2008	30			WHOQOL-26 <sup>a</sup>	12		
[37]	Rahimian-Boogar I, 2012	Tehran	2010	254	45.44 ± 6.02	6.59 ± 6.5	PHQ-9 <sup>b</sup>	25		
[38]	Taziki S.A, 2001	Gorgan	2000	150	47.2 ± 11.0	13.6 ± 4.5	Beck	40.6		
[39]	Sajadi A, 2012	Zahedan	2007	80	52.1 ± 11.9		GHQ-28 <sup>c</sup>	43.75	WHOQOL-26	
[41]	Behrouz B, 2014	Kermanshah	2012	210			SCL-90R <sup>d</sup>	56	SCL-90-R	59
[42]	Harooni J, 2013	Faridenvachadegan	2012	403	57.6 ± 11.7	5.3 ± 6.4	Beck	60		
[43]	Mazloomi S, 2008	Yazd	2008	100	55.8 ± 9.17		Beck	64		
[44]	Parham M, 2013	Ghom	2012	116	15.12 ± 11.0	3.5 ± 5.5	Beck	70.7		
[45]	Palizgir M, 2013	Tehran	2012	184			Beck	71	Beck	7
[46]	Behnam B, 2005	Semnan	2002	450			Beck	71.6		
[49]	Mousavi A, 2008	Shahrood	2006	100			Beck	78		
[50]	Abdollahiyan E, 2000	Mashhad	1998	100			SCL-90R	87	SCL-90-R	77
[7]	Baradaran HR, 2013	Tehran	2009	185	56.06 ± 9.5	9.7 ± 7.3	PHQ-9	47.6		
[11]	Shahrakivahed A, 2012	Zabol	2010	100			Beck	81		
[13]	Shamsaei F, 2006	Hamedan	2005	384			Beck	73.4		
[8]	Kalantari S, 2014	Rasht	2011	90	54.17 ± 10.57		Beck	37.8		
[22]	Taheri N, 2014	Abadan and Khorramshahr	2014	102	54.04 ± 14.37		Beck	85.3		
[20]	Kiani F, 2016	Zahedan	2015	350			Beck	18.8		
[40]	Derakhshanpour F, 2015	Gorgan	2012	330	50.6 ± 9.0	5.4 ± 4.5	Beck	58.2		
[48]	Khamseh ME, 2007	Tehran	2014	206			Beck	71.8		
[14]	Elyasi F, 2015	Sari	2012	150	42.0 ± 10.1	7.57 ± 5.5	HADS-D <sup>e</sup>	58.7	HADS-D	96.7
[9]	Norouzi Z, 2016	Khorramabad	2014	169			Beck	76.9		
[62]	Mirzaei M, 2015	Yazd	2014	439			DASS-21 <sup>f</sup>	42.4	DASS-21	48.7
[47]	KasiriDolatAbadi N, 2010	Isfahan	2007	383	54.95 ± 9.54	8.86 ± 6.7	Beck	72		
[10]	Zahiroddin A, 2003	Tehran	2002	100			Beck	78		
[21]	Nejati Safa A, 2007	Tehran	2005	100	52.0 ± 10.0	9.0 ± 6.0	HADS-D	66	HADS-D	
[23]	Atapour A, 2012	Isfahan	2011	250	59.93 ± 11.5		Beck	85		
[24]	Atadokht A, 2013	Ardebil	2011	120	53.86 ± 15.04	7.57 ± 6.37	SCL-90R	72.5	SCL-90-R	62
[34]	Shahnazaripoor M, 1992	Isfahan	1992	1200	53.6 ± 13.6		Beck	53.1		13.7

<sup>a</sup> World Health Organization Quality-of-Life Scale-26.

<sup>b</sup> Patient Health Questionnaire-9.

<sup>c</sup> General Health Questionnaire-28.

<sup>d</sup> Symptom Checklist-90-R.

<sup>e</sup> Hospital Anxiety and Depression Scale.

<sup>f</sup> Depression Anxiety Stress Scales.

61.8% (95% CI: 54.5–68.6), 35.5% (95% CI: 17.1–59.5), and 11.2% (95% CI: 6.9–17.7), respectively (Table 2).

### 3.5. Pooled prevalence of depression based on gender

The depression prevalence in females and males patients with DM was 63.9% (95% CI: 54.0–72.8) and 46.3% (95% CI: 36.4–56.4), respectively. The depression prevalence ratio in females to males was demonstrated that the higher prevalence of depression in females than males with OR was 1.37 (95% CI: 1.24–1.53,  $p < 0.001$ ) (Table 2).

### 3.6. Pooled prevalence of depression based on severity

The prevalence of mild, moderate, severe and highly severe depression was estimated to be 24.4% (95% CI: 21.0–28.2), 19.1%

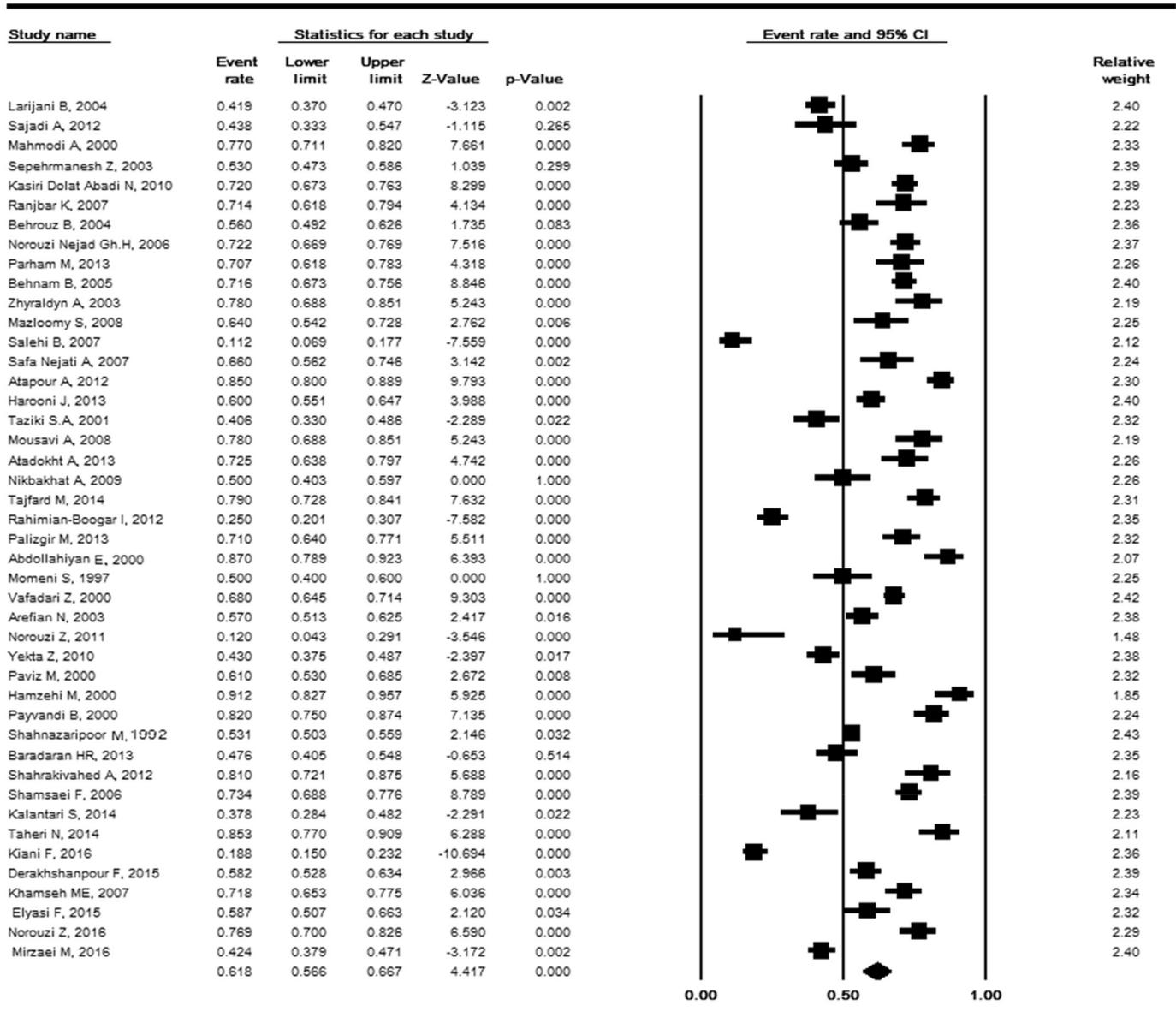
(95% CI: 15.2–23.9), 11.4% (95% CI: 8.6–14.9), and 4.4% (95% CI: 3.4–5.6), respectively (Table 2).

### 3.7. Prevalence of anxiety

In eight studies, the anxiety prevalence in patients with DM was estimated to be 64.5% (95% CI: 42.0–82.1) (Fig. 3). Pooled prevalence of anxiety based on severity is illustrated in Fig. 3.

### 3.8. Meta-regression of depression prevalence based on year of the studies

There was no significant relationship between the depression prevalence in patients with DM and the year of the studies ( $p = 0.81$ ) (Fig. 4-A).



## Meta Analysis

Fig. 2. Forest plots of the prevalence of depression in Iranian patients with DM. Random effects model in meta-analyses. DM: Diabetes Mellitus.

### 3.9. Publication bias

Publication bias for included studies in the meta-analysis was shown as asymmetry in funnel plot and p-value for Egger and Begg's tests was 0.19 and 0.24, respectively (Fig. 4-B).

### 3.10. Grading of evidence

According to GRADE summaries, we see the quality of evidence for all the results to be average. GRADE summaries are presented in Table 3.

## 4. Discussions

This study is the first systematic review on the prevalence of depression and anxiety in Iranian patients with DM. The total prevalence of depression in Iranian patients with DM was 61.8% and

the results of subgroup analysis of depression showed that the type of questionnaires and provinces may cause high levels of heterogeneity ( $I^2 = 95\%$ ). Overall, eight studies assessed the prevalence of anxiety and the prevalence was estimated to be 64.5% in these patients. We could not do further subgroup analysis on the prevalence of anxiety due to the low number of studies. The depression prevalence was reported to be 24–33% in several systematic reviews and meta-analyses conducted among patients with DM in developed countries [58–61]. The results show that depression prevalence in Iranian patients with DM is much more than other countries, which may be due to differences in the investigation and follow-up of these patients in Iran in comparison to developed countries or it may be due to the development of these countries in the field of health services and medical equipment compared to the developing countries.

The difference in the depression prevalence of Iranian patients ranges from 11.2% to 91.2%, most obviously due to different

**Table 2**  
Depression prevalence based on region, provinces, questionnaires and gender.

Variable		Studies (N <sup>a</sup> )	Sample (N)	Heterogeneity		95%CI <sup>b</sup>	Prevalence (%)
				I <sup>2</sup>	P-Value		
Regions	Center	21	6005	98.38	<0.001	56.0–69.4	63.0
	East	5	830	96.11	<0.001	30.7–87.9	64.2
	North	7	1365	94.00	<0.001	44.9–67.8	56.7
	South	7	1091	90.79	<0.001	50.3–71.8	61.6
	West	4	1058	96.33	<0.001	46.2–77.4	63.2
Test for subgroup differences: $Q = 0.90$ , $df(Q) = 4$ , $P = 0.92$							
Provinces	Khuzestan	3	441	94.40	<0.001	27.4–84.6	59.1
	Markazi	1	134	0	–	6.9–17.7	11.2
	Ardabil	1	120	0	–	63.8–79.7	72.5
	Hormozgan	1	100	0	–	40.3–59.7	50.0
	Qom	1	116	0	–	61.8–78.3	70.7
	Golestan	4	1005	95.91	<0.001	40.1–71.9	56.7
	Hamedan	1	384	0	–	68.8–77.6	73.4
	Isfahan	7	2843	96.19	<0.001	61.3–79.6	71.4
	Kerman	2	450	0	0.417	53.7–62.8	58.3
	Kermanshah	1	210	0	–	70.0–82.6	76.9
	Razavi Khorasan	2	300	64.27	0.094	73.2–89.3	82.7
	Orumieh	1	295	0	–	37.5–48.7	43.0
	Guilan	1	90	0	–	28.4–48.2	37.8
	Mazandaran	1	150	0	–	50.7–66.3	58.7
	Semnan	2	550	40.47	0.195	67.3–79.1	73.6
	Fars	1	100	0	–	61.8–79.4	71.4
	Tehran	7	1123	96.00	<0.001	42.9–73.1	58.9
	Yazd	3	1239	97.22	<0.001	39.3–75.1	58.3
	Sistan and Baluchestan	3	530	98.11	<0.001	14.6–82.7	47.5
	Lorestan	1	169	0	–	72.9–85.0	79.6
Test for subgroup differences: $Q = 241.70$ , $df(Q) = 19$ , $P < 0.001$							
Questionnaires	Beck	33	8547	95.62	<0.001	60.7–70.9	66.0
	DASS-21 <sup>c</sup>	1	439	0	–	37.9–47.1	42.4
	GHQ-28 <sup>d</sup>	1	80	0	–	33.3–54.7	43.8
	SCL-90R <sup>e</sup>	3	430	93.05	<0.001	53.1–86.8	73.2
	WHOQOL-26 <sup>f</sup>	1	30	0	–	4.3–29.1	12.0
	HADS-D <sup>g</sup>	2	250	25.83	0.246	54.5–68.6	61.8
	PHQ-9 <sup>h</sup>	2	439	95.75	<0.001	17.1–59.5	35.5
	Hamilton	1	134	0	–	6.9–17.7	11.2
	Test for subgroup differences: $Q = 129.99$ , $df(Q) = 7$ , $P < 0.001$						
Gender	Male	16	1169	89.48	<0.001	36.4–56.4	46.3
	Female	17	2263	93.49	<0.001	54.2–71.7	63.4
Female to male odds ratio: 1.37 (1.24–1.53, $P < 0.001$ )							
Severity	Mild	21	5017	88.08	<0.001	21.0–28.2	24.4
	Moderate	20	4917	93.05	<0.001	15.2–23.9	19.1
	Severe	19	4717	90.47	<0.001	8.6–14.9	11.4
	Highly severe	4	998	0	0.47	3.4–6.1	4.6

<sup>a</sup> Number.

<sup>b</sup> Confidence interval.

<sup>c</sup> Depression Anxiety Stress Scales.

<sup>d</sup> General Health Questionnaire-28.

<sup>e</sup> Symptom Checklist-90-R.

<sup>f</sup> World Health Organization Quality-of-Life Scale-26.

<sup>g</sup> Hospital Anxiety and Depression Scale.

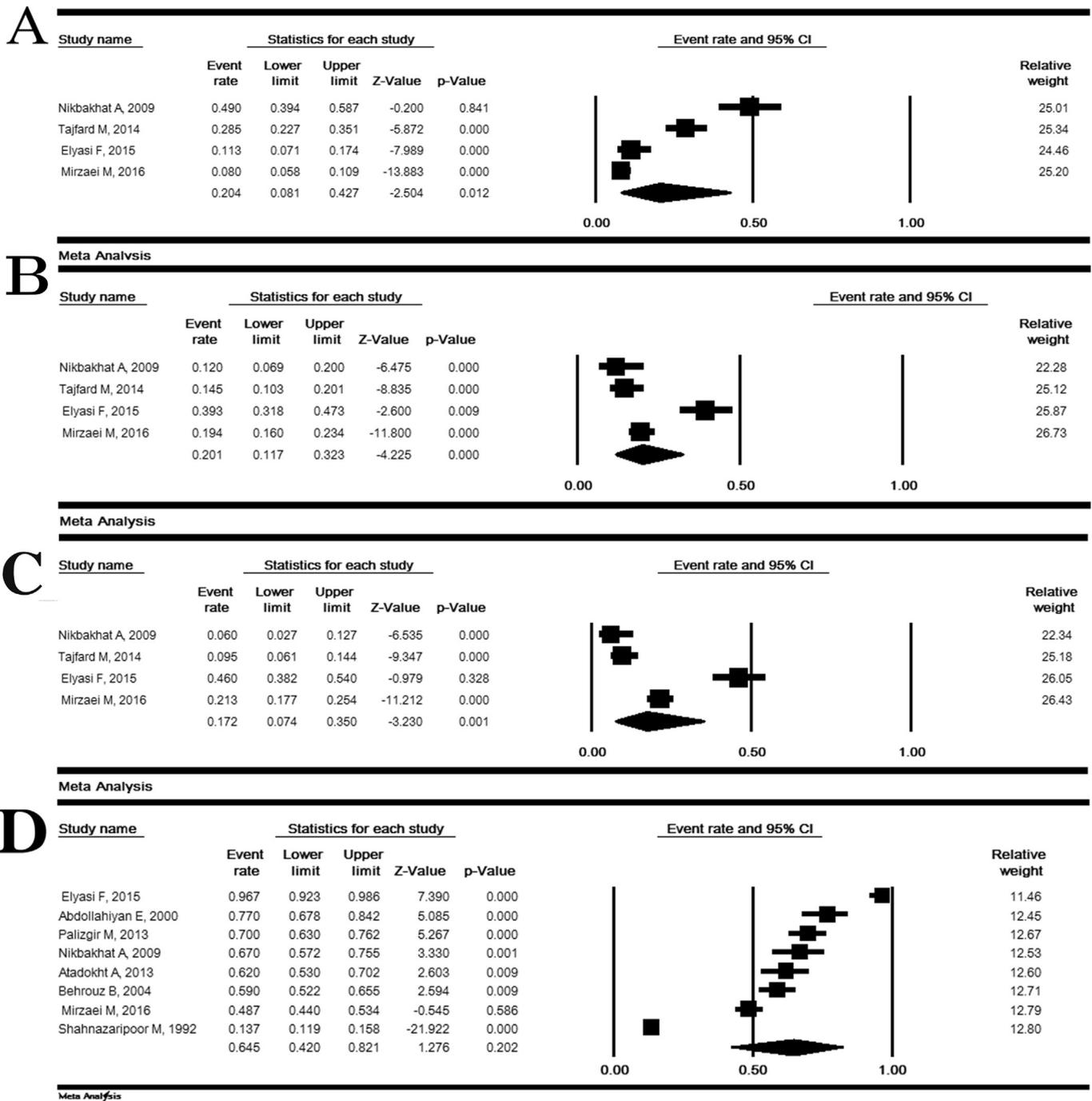
<sup>h</sup> Patient Health Questionnaire-9.

questionnaires in various studies. For example, Rahimian-Boogar [37] used PHQ-9 questionnaire for assessing depression and reported the depression prevalence of 25%, while NikibakhtF [25] used the Beck questionnaire and reported the depression prevalence of 50%. This is why subgroup analysis was performed in most studies (30 studies) that used the Beck questionnaire. Based on Beck questionnaire, the depression prevalence in patients with DM was estimated to be 66%, which is not significantly different in the general estimate. In the systematic review of dialysis patients, depression prevalence was reported to be 28–93%, while the total estimate of depression prevalence in this study was 61.8%. This study mentioned the variety of questionnaires as the cause of the large differences in the prevalence of depression in the studies [62].

The Beck Questionnaire is a 21-item self-report questionnaire that assesses depression severity [63]. Dabsonet al. [64] assessed the validity and reliability of this questionnaire regarding adult

patients with depression and concluded that items and components of this questionnaire can properly diagnose and assess the level and severity of depression. Thus, it is possible to diagnose depressive disorder by this questionnaire. Major depressive disorder based on DSM-IV criteria was reported in four articles. The meta-analysis estimates regarding the prevalence of depression based on DSM-IV criteria were 42.3%. On the other hand, the prevalence of depression (moderate and severe) based on studied questionnaires is 38%, which is close to estimates of the major depressive disorder. Therefore, one can say that the prevalence of the major depressive disorder in Iranian patients with DM is 38%.

In the present study, the depression prevalence was higher in female patients with DM (63.9%) than male patients with DM (46.3%) and similar to the results of other systematic reviews, we reported the depression prevalence of 28.2% for female patients and 18% for male patients [57,58]. Although the prevalence of



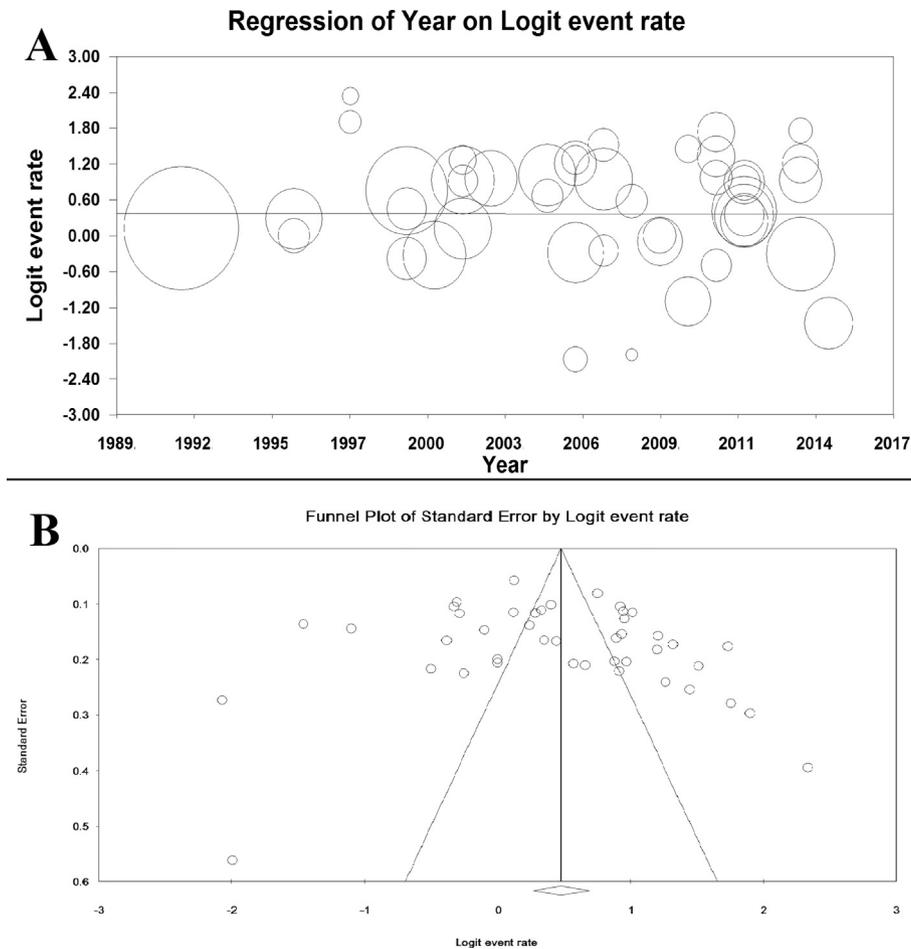
**Fig. 3.** Forest plots of mild (A), moderate (B), severe (C) and total(D) prevalence of anxiety in Iranian patients with DM. Random effects model in meta-analysis. DM: Diabetes Mellitus.

depression is high among both men and women, the rate of the disease among women is significantly higher than men and female gender can be considered as a risk factor for depression [65,66].

The meta-regression model was used to investigate the relationship between depression prevalence in patients with DM with the year of study and there was no statistically significant relationship and the prevalence of depression has been almost constant during 1992–2015. Constant prevalence of depression among Iranian patients with DM during the last 23 years and the high prevalence of depression (61.8%) in the patients shows less attention and follow-up of patients with DM by authorities regarding

their mental problems. Therefore, screening patients for early diagnosis of mental disorders, especially depression and anxiety, seems necessary.

Blood sugar control is more difficult in depressed patients than healthy individuals and preventive and maintenance treatment with antidepressants can prevent recurrence and be effective in preventing debilitating complications of DM [67,68]. In a systematic review on patients with DM, it was found that depression significantly increases the risk of death in these patients [69]. Due to the increase in DM and the importance of depression and anxiety in these patients, greater attention is required by authorities to solve



**Fig. 4.** Meta-regression plot of the prevalence of depression in Iranian patients with DM and year of the studies ( $P = 0.812$ ) (A) and funnel plot for checking publication bias for the prevalence of depression in Iranian patients with DM (B). DM: Diabetes Mellitus.

**Table 3**

GRADE assessment of confidence in estimates of effect.

Outcome	Risk of bias	Consistency	Directness	Precision	Publication bias	Quality
Depression	No serious limitations	Serious limitations <sup>a</sup>	No serious limitations	No serious limitations	No serious limitations	Moderate
Anxiety	No serious limitations	Serious limitations <sup>b</sup>	No serious limitations	No serious limitations	No serious limitations	Moderate

GRADE Grading of Recommendations Assessment, Development and Evaluation.

<sup>a</sup> High heterogeneity:  $I^2 = 95.92\%$ .

<sup>b</sup> May indicate moderate heterogeneity:  $I^2 = 96.60\%$ .

the psychological problems of these patients.

Anxiety may be secondary to hyperglycemia or other hormonal disorders or nervous transfers in patients with DM. It might also be due to the psychological stress of self-management and fear of hypoglycemia and medical complications [70–74]. Most anxiety cases were mild and moderate (55%), similar to depression. Early treatment of anxiety may prevent the development of anxiety and improve patients with DM condition. A systematic review [75] reported high prevalence of elevated anxiety symptoms in patients with DM (40%). However, the prevalence of this disorder is more among Iranian patients with DM who need screening for early diagnosis.

Given the high prevalence of DM in Iran and lack of studies on the prevalence of anxiety in patients, it is recommended that more epidemiological studies be conducted to determine the prevalence of anxiety in the wider population of Iranian patients with DM.

For future research studies, a study of the prevalence of depression and anxiety in Iranian patients with DM based on

diagnostic tools such as structured clinical interview is advised. For future review articles, it is suggested that: 1. The prevalence of depression and anxiety in Iranian type 1 and type 2 patients with DM be estimated separately 2. The outcome of treating depression and anxiety on controlling DM be assessed.

#### 4.1. Limitation

1. National databases did not have the possibility to search using combined keywords.
2. In many studies, the prevalence of depression was studied in both groups patients with DM (type I and II) and we could not investigate depression prevalence of type 2 DM patients exclusively. Therefore, statistics on the prevalence of depression and anxiety based on each DM type could not be provided.
3. Due to the low number of studies reporting the prevalence of anxiety in Iranian patients with DM, we could not provide data

on anxiety prevalence based on subtypes (gender, questionnaires, etc.).

- Due to the low number of studies reporting the prevalence of anxiety according to the place of patient recruitment, we could not perform subgroup analysis based on place of patient recruitment.

## 5. Conclusions

In general, considering that a high percentage of patients with DM are suffering from depression and anxiety. Prevention, recognition and treatment of depression, especially in the early years of disease onset, plays an important role in DM control. Depression not only directly affects blood sugar by influencing anti-insulin hormones, but also affects the treatment of DM and blood sugar condition by causing disturbance in eating habits, physical activity, and daily living activities. On the other hand, depression can increase self-destructive behaviors like overeating or drinking in patients with DM and in a vicious cycle, which intensifies DM as well as depression. Iran has a higher prevalence of depression and anxiety among patients with DM than developed countries; hence, regular psychiatric consultation for diagnosis and treatment of depression and anxiety is necessary for these patients. In addition, it is recommended that we implement a screening program for early diagnosis of depression and anxiety in this group of patients.

## Acknowledgement

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## Appendix. PubMed search strategy:

- exp Prevalence/
- exp Epidemiology/
- exp Diabetes/
- exp Endocrine Disorders/
- exp Mental Disorders/
- exp Depression/
- exp Anxiety/
- exp Iran
- 1 OR 2
- 3 OR 4
- 5 OR 6 OR 7
- 9 AND 10 AND 11 AND 8

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.dsx.2019.07.004>.

## Authors' contribution

Study designs: Milad Azami and Zahra Khalighi  
Data Collection; Milad Azami, Masoumeh Shohani, Gholamreza Badfar and Zahra Khalighi  
Biostatistics analysis: Milad Azami  
Quality evaluation: All authors  
Final revision and grammar editing: All authors

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## Conflicts of interest

The authors have no conflict.  
None.

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