**Name of Journal:** *World Journal of Meta-Analysis*

**Manuscript NO:** 55591

**Manuscript Type:** META-ANALYSIS

**Prevalence of anxiety among gestational diabetes mellitus patients: A systematic review and meta-analysis**

Lee KW *et al*. Anxiety among GDM

Kai Wei Lee, Hong Chuan Loh, Seng Choi Chong, Siew Mooi Ching, Navin Kumar Devaraj, Maiza Tusimin, Habibah Abdul Hamid, Fan Kee Hoo

**Kai Wei Lee, Siew Mooi Ching, Navin Kumar Devaraj,** Department of Family Medicine, Universiti Putra Malaysia, Serdang 43400, Malaysia

**Hong Chuan Loh,** Clinical Research Centre, Hospital Seberang Jaya, Perai 13700, Malaysia

**Seng Choi Chong,** Department of Psychiatry, Universiti Putra Malaysia, Serdang 43400, Selangor, Malaysia

**Maiza Tusimin, Habibah Abdul Hamid,** Department of Obstetrics and Gynaecology, Universiti Putra Malaysia, Serdang 43400, Malaysia

**Fan Kee Hoo,** Department of Medicine, Universiti Putra Malaysia, Serdang 43400, Malaysia

**Author contributions:** Lee KW and Loh HC conceived and designed the experiments; and performed the data extraction; Lee KW, Loh HC, Chong SC, Ching SM, Devaraj NK, Tusimin M, Abdul Hamid H, and Hoo FK analysed the data; Ching SM, Devaraj NK, Tusimin M, and Hoo FK contributed to the quality appraisal; Lee KW, Loh HC, Chong SC, Ching SM, Devaraj NK and Abdul Hamid H wrote the paper; all authors have read and approved the manuscript.

**Supported by** the Universiti Putra Malaysia under Putra Graduate Initiative, No UPM/700-2/1/GP-IPS/2018/9593800; and High Impact Grant, No. UPM/800-3/3/1/GPB/2018/9659600.

**Corresponding author: Siew Mooi Ching, MD, MHSc, Associate Professor,** Department of Family Medicine, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang 43400, Malaysia. sm\_ching@upm.edu.my

**Received:** April 23, 2020

**Revised:** May 4, 2020

**Accepted:** June 17, 2020

**Published online:** June 28, 2020

**Abstract**

BACKGROUND

A diagnosis of gestational diabetes mellitus (GDM) negatively influences maternal mental health. There is lack of systematic review and meta-analysis on prevalence of anxiety among GDM women.

AIM

To pool data from existing literature to determine the pool estimates for the prevalence of anxiety among women diagnosed with GDM.

METHODS

We searched multiple databases including MEDLINE, Cinahl, PubMed and Scopus to identify studies published up to 31 October 2019 with data on the prevalence of anxiety among women diagnosed with GDM. Data were extracted from published reports. Estimates were pooled using random-effects meta-analyses.

RESULTS

We reviewed 19 abstracts, retrieved 10 articles and included three studies incorporating 12744 GDM women from three countries. The pooled prevalence of anxiety was 29.5% (95%CI: 6.9, 52.0) among GDM women.

CONCLUSION

Prevalence of anxiety among GDM women was high. We suggest that epidemiological studies on anxiety should be conducted urgently as it merits clinical attention. In addition, it is important to identify factors associated with anxiety among women diagnosed with GDM.

**Key words:** Prevalence; Anxiety; Gestational diabetes; Psychiatry; Meta-analysis; Systematic review

**Citation:** Lee KW, Loh HC, Chong SC, Ching SM, Devaraj NK, Tusimin M, Abdul Hamid H, Hoo FK. Prevalence of anxiety among gestational diabetes mellitus patients: A systematic review and meta-analysis. *World J Meta-Anal* 2020; 8(3): 275-284

URL: <https://www.wjgnet.com/2308-3840/full/v8/i3/275.htm>

DOI: https://dx.doi.org/10.13105/wjma.v8.i3.275

**Core tip:** This is a systematic review and meta-analysis reporting the pooled prevalence of anxiety among gestational diabetes mellitus patients which stood at 29.5%.

**INTRODUCTION**

The prevalence of gestational diabetes mellitus (GDM) has been increasing over the past decades[1,2]. Globally, GDM has been reported as a leading cause of morbidity and mortality among both the infant and their mother[3,4]. Mothers with GDM are at increased risk of getting pregnancy complications such as preterm delivery, preeclampsia, abnormal birth weight and metabolic and electrolyte disorders[5]. Studies also indicated that GDM may persist after postpartum and subsequently develop into overt diabetes mellitus, and it was estimated that the risk for developing diabetes mellitus after GDM increased linearly with the duration of follow-up ranged from 19.72% at 10 years. The estimated risks for type-2 diabetes mellitus ranged from 19.7% at 10 year to 39.0% at 30 years[6]. Neonates born to GDM mothers are at higher risk of suffering from adverse neonatal outcomes such as abnormal birth weight, congenital anomalies, hypoglycaemia and longer duration in neonatal intensive care unit for further investigation[7-9].

Previous studies showed that the prevalence of depression among mothers with GDM have ranged from 25.9% to 56.7%[10,11] and the prevalence of anxiety was from a range of 4.8% to 57.7%[12,13]. Anxiety is a normal reaction to stress which involves both psychological and physical reactions. It becomes clinically significant when the anxiety grows out of proportion to the situation and causes functional impairment. Anxiety disorders are among the most common mental illness, and are characterized by feelings of tension, worried thoughts and physical changes such as increased blood pressure. People with anxiety disorders usually have recurring intrusive thoughts or concerns. They may avoid certain situations out of worry. They may also have physical symptoms such as sweating, trembling, dizziness or a rapid heartbeat[14]. With a remarkable increase in lifetime prevalence, anxiety has become a public health burden worldwide, causing increased use of mental health services and loss of productivity[15]. In particular, anxiety is a common psychiatric condition that affects up to one-fifth of pregnant mothers[16] and is significantly associated with postpartum depression (odds ratio = 2.6, 95%CI: 2.0, 3.5) and reduced odds of breastfeeding (odds ratio = 0.63, 95%CI: 0.5, 0.7)[17]. Thus, anxiety and related mental conditions could pose negative effects on child development[18]. A high state of anxiety is found in 15.8% of pregnant women, while 12.5% of women suffer high trait anxiety[19]. Similarly, pregnant mothers with GDM were more anxious than pregnant women with others medical problems and or healthy pregnant women[20].

There are multiple factors associated with anxiety during pregnancy, including current or past pregnancy complications, previous pregnant loss and personal history of mental illness[21]. Study have also shown that women with GDM experience significantly worse quality of life[22]. However, findings from previous studies lack of data on the epidemiology of antenatal anxiety among GDM patients. Therefore, we aimed to determine the pooled prevalence of anxiety among GDM patients by conducting a meta-analysis.

**MATERIALS AND METHODS**

This present study was registered in the Medical Research and Ethics Committee, Ministry of Health Malaysia (registration number: NMRR-20-117-52644) conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses[23]. As this work only involved secondary data retrieval and analysis, no ethical approval was sought.

***Literature search***

Two investigators (Lee KW and Loh HC) independently searched MEDLINE, Cinahl, PubMed and Scopus databases for potential studies published in journals from inception to 31 October 2019. We used following search terms: (Anxiety OR anxiety symptom OR anxiety disorder OR generalized anxiety disorder OR panic disorder OR panic attack OR agoraphobia OR phobia OR specific phobia OR specific phobic disorder OR medication-induced anxiety disorder OR medical condition induced anxiety disorder OR social anxiety disorder) AND (prevalence) AND (gestational diabetes OR GDM OR gestational diabetes mellitus OR diabetes in pregnancy). The search strategies with the Boolean or phrase operators were shown in the Supplementary material 1. Studies in English, available in full-text and conducted among humans were searched. Then, we removed duplications using Endnote, after that we screened the title and abstracts for its suitability. Finally, articles with their full text were assessed for eligibility to be recruited into the quantitative analysis.

***Inclusion criteria***

Any studies that reported the prevalence or percentage for anxiety symptoms or anxiety disorders among GDM patients and fulfilled the inclusion criteria were analysed. The inclusion criteria were as follows: (1) Diagnosing or screening of anxiety be made according to Diagnostic and Statistical Manual of Mental Disorders/International Classification of Diseases diagnostic criteria or by any screening tools; (2) Participants in the study were diagnosed with GDM; and (3) Studies were published in English peer-reviewed journal from inception to 31 October 2019. Other related studies were also included through careful review of the reference lists of related review articles and reverse-forward citation tracking. Studies were excluded if they included only pregnant mothers with pre-existing diabetes mellitus, case-control design or examined anxiety prior to the diagnosis of GDM.

***Study selection***

All relevant articles identified through the above databases were imported into Endnote programme X5 version. Initially, we performed de-duplication. Two investigators independently screened each title and abstract for suitability based on the search strategies mentioned above. Then, full-text articles were assessed based on the inclusion criteria mentioned above. Any disagreements between the investigators were resolved through discussions before the final consensus for quantitative analysis was reached.

***Data extraction***

The following data were extracted from every study: the last name of the first author, year of publication, country, sample size, study design, recruitment duration, timing of GDM diagnosis, GDM diagnosis guidelines, assessment of anxiety guidelines, and timing of anxiety assessment. The outcomes measures included the numbers of GDM patients with anxiety symptoms or disorders and total number of GDM patients. Two investigators (Lee KW and Loh HC) individually extracted the data and assessed the study quality, with differences resolved through discussion with the third and fourth investigators (Chong SM and Hoo FK).

***Quality assessment***

The quality of the individual studies was determined using the checklist of Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)[24]. The aim and use of STROBE is to assess the strengths and weaknesses of the studies reported in the medical literature, STROBE results also helps thought readers to know what was planned, done and found, as well as what is incomplete and inadequate in the reporting of articles. The tool consists of 22 items to help assess the important components found in observational studies. In certain instances where the information provided was insufficient in order to making judgement for a certain item, that item was graded with a ‘0’, rendering the item as having a high risk of bias. Each article’s quality was graded as ‘good’ if the STROBE score was ≥ 14; or graded as ‘poor’ if the STROBE score was < 14. Two investigators (Devaraj NK and Maiza T) individually assessed the study quality, with differences resolved by discussion with the third and fourth investigators (Chong SM and Hoo FK). Studies were included in analysis regardless of STROBE score and grade.

***Statistical analysis***

A random-effects (DerSimonian and Laird Method) meta-analysis method was employed to pool the prevalence estimated from these related studies and was reported with a 95%CI. *I*2 index was used to assess the studies heterogeneity (*i.e.* low is < 25%, moderate 25%–50%, and high > 50%), that indicated the total percent of discrepancy due to variation in the included studies[25]. For statistical analysis, Open Meta (Analyst) software was used, this software can be accessed and downloaded from http://www.cebm.brown.edu/openmeta/index.html[26]. Funnel plot was generated using The Jamovi project computer Software, this software can be retrieved from https://www.jamovi.org[27].

**RESULTS**

***Description of included studies***

Thirty manuscripts were identified in the initial screening as shown in Figure 1. After removal of duplicate articles (*n* = 11), a total of 19 studies were retrieved for further assessment. After screening for its suitability through title and abstract, 10 studies fulfilled both our inclusion and exclusion criteria. After careful evaluation of the 10 articles, only three studies were eligible for quantitative analysis in this study.

***Characteristics of included studies***

The main characteristics of the included studies are shown in Table 1. A total sample of 12744 women diagnosed with GDM was included in the analysis. The respondents were diagnosed using either American Diabetes Association or World Health Organization guidelines. These studies were conducted in Canada[13], Ireland[12] and Malaysia[28]. In terms of diagnosing or screening for anxiety, Beka *et al*[13] (2018) used the International Classification of Diseases- Ninth version (ICD-9) (prior to 2002) and the International Classification of Diseases- Tenth version (ICD-10) (2002 onward), diagnostic criteria; while Egan *et al*[12] (2017) and Lee *et al*[28] (2019) used 21-item Depression Anxiety Stress Scale (DASS-21). For quality assessment, we assigned each study with an overall rating based on the tool derived from STROBE checklist. The overall quality of included studies appeared to be good.

***Prevalence of anxiety***

The overall pooled prevalence of anxiety was 29.5% (95%CI: 6.9, 52.0) (Figure 2). The pooled prevalence of anxiety using DASS-21 was higher than prevalence of anxiety using ICD-9/10 (42.4% *vs* 4.8%). Sensitivity analysis reveals that Beka *et al*[13] had substantial influences on the overall prevalence which cause prevalence of anxiety increased from 29.5% (95%CI: 6.9, 52.0) to 42.4% (95%CI: 13.2, 71.5). On the other hand, removal of Egan *et al*[12], 2017 or Lee *et al*[28], 2019 did not cause statistically significant changes to the overall prevalence of anxiety (Supplementary material 2). Indeed, funnel plot (Supplementary material 3) suggested that there was publication bias. Nevertheless, we did not exclude any studies from the meta-analysis due to there was only three studies available.

***Quality assessment***

We assigned the studies with an overall rating based on STROBE checklist. All three studies received an overall “Good” quality with a score ≥ 14 over 22 (Supplementary materials 4-6). In summarizing the results, we concluded that all studies had methodological issues such as not describing any efforts to address potential sources of bias, how missing data were addressed, and lack of sensitivity analysis.

**DISCUSSION**

Our systematic review and meta-analysis offer preliminary evidence regarding the prevalence of anxiety among GDM patients. The results indicated that the pooled prevalence of anxiety among GDM patients was 29.5%.

Several reasons may have contributed to the high heterogeneity (*I*2 = 99.12%) in the pooled prevalence that was seen in our systematic review and meta-analysis. First, there are differences in terms of the methodological approach used in different studies for the detection of anxiety. The diagnostic method would identify specific anxiety disorders with more stringent criteria, while the screening method served as case identification. Diagnostic versus screening criteria used by different studies for the clinically significant anxiety symptoms were omitted. For instance, Beka *et al*[13] (2018) used ICD-9 and ICD-10 to diagnose anxiety disorder while Egan *et al*[12] (2017) and Lee *et al*[28] (2019) used DASS-21 for screening anxiety symptoms. Unlike ICD, DASS-21 is a screening tool with 21 items which consists of three domain assessing depression, anxiety and stress[29]. DASS-21 English version has been translated and validated into Malay version by Musa *et al*[30]. DASS-21 has distinctive cut-off value for severity rating scale; anxiety is detected if anxiety domain score is ≥ 8 (Mild and above)[29], however it should be noted that clinically significant anxiety symptoms should be moderate and above in severity scale is considered significant.

The vast disparity of anxiety prevalence between study population may be one of the reasons for the disparity. Beka *et al*[13] (2018) was a population-based study, while Egan *et al*[12] (2017) and Lee *et al*[28] (2019) were hospital-based study. Beka *et al*[13], 2018 was a population-based study without sample size calculation, and the patients’ medical information were obtained via health services databases. The weakness of health services databases is that it contains information about formal diagnosis and healthcare services provided for patients yet it didn’t provide result of mental health screening, therefore the prevalence of anxiety (4.8%) reported in Beka *et al*[13] (2018) may not reflect the prevalence of clinically significant anxiety faced by GDM patients. We noted that two studies which conducted in hospital (Egan *et al*[12], 2017 and Lee *et al*[28], 2019) had sample size calculation; these two studies achieved sufficient sample number. However, Egan *et al*[12] (2017) had a sample size of less than 100 for GDM patients. Hence, the prevalence of clinically significant anxiety symptoms in Egan *et al*[12] (2017) (57.7%) was higher compared to Lee *et al*[28] (2019) (27.9%). Sample size remains an important criteria when determining the prevalence of anxiety, as studies has shown the positive correlation between sample size and prevalence[31,32]. Hence, all these reasons might have contributed to the high heterogeneity in the prevalence of anxiety as noted in our study.

More than half of pregnant women showed moderate anxiety during their pregnancy[33,34]. Anxiety during pregnancy could be due to worries about health and well-being of the babies and the mothers themselves. The worries also extend to the concern of parenting and the transition to maternal role after birth[28]. A meta-analysis reported that antenatal anxiety could increase the risk for adverse birth outcomes such as preterm delivery (relative risk = 1.50, 95%CI: 1.33, 1.70) and low birth weight (relative risk = 1.76, 95%CI: 1.32, 2.33)[35].

Around 11.5% of pregnant women in Asia are affected by GDM[36]. Recent meta-analysis reported that hyperglycaemia in pregnancy increases the risk for adverse outcomes such as caesarean section (OR = 1.59, 95%CI: 1.49, 1.70), large for gestational age (OR = 2.11, 95%CI: 1.73, 2.58), macrosomia (OR = 2.06, 95%CI: 1.86, 2.28), neonatal hypoglycaemia (OR = 1.37, 95%CI: 1.20, 1.57), gestational hypertension (OR = 1.91, 95%CI: 1.49, 2.43) and pre-eclampsia (OR = 2.15, 95%CI: 1.45, 3.19)[5]. GDM patients are a higher risk for experiencing anxiety as compared to pregnant women without medical complications[20]. Similarly, the adverse birth outcomes could be exacerbated if women with GDM experiences anxiety during pregnancy.

Antenatal anxiety is an evolving field, and unlike depression, only a few studies have been conducted among GDM patients. However, studies have reported that antenatal anxiety is more prevalent than antenatal depression[28,34], and this study reports anxiety symptoms are prevalent in GDM patients. In order to promote the detection of antenatal anxiety, several screening tools have been recently recommended by National Institute for Health and Care Excellence, which include Generalized Anxiety Disorder scale, GAD-2)[37], GAD-2 can be used as an ultra-brief screening scale for antenatal anxiety. Even so, other screening scales are more commonly used in clinical setting as compared to GAD-2, such as DASS-21[29], Edinburgh Postnatal Depression Scale[38], Hospital Anxiety and Depression Scale – Anxiety subscale[39], State-Trait Anxiety Inventory[40], GAD-7[41], Brief Measure of Worry Severity[42], Cambridge Worry Scale[43] and Wijma Delivery Expectancy/Experience Questionnaire –Version A[44].

***Impacts of anxiety after delivery period***

Mental illness is a leading cause of maternal morbidity and even endangers maternal life especially in high income countries[45]. Indirectly it also impacts new-born babies, causing perinatal morbidity and mortality as well as the impact on the long-term child development[46,47]. He National Institute for Health and Clinical Excellence (NICE) has emphasised that perinatal mental illness is one of the most important issues in women’s health that need to be highlighted, especially in the postpartum period[48,49].

The prevalence of postpartum anxiety disorders varies. Reck *et al*[50] (2008) and Miller *et al*[51] (2006) found a comparable percentage of postpartum women as having anxiety disorder, at 11.1 % and 10 % respectively. Matthey *et al*[52] documented that 16.2% of mothers were diagnosed with a pure anxiety disorder while Wenzel *et al*[53] (2005) noted a prevalence rate of 8.2% for generalized anxiety disorder.

There were many reviews confined to maternal depression disorder in postpartum period but scarce data on anxiety disorder despite of the high health risks for both mother and child associated with postpartum disorders[50]. Maternal anxiety disorder is part of a broad spectrum comprising of mild to severe mental illness such as bipolar disorder and psychosis. It is commonly acknowledged that both anxiety and depression co-exist in postpartum women[51,54].

Socio-demographic factors and socioeconomically deprived status have important impacts on maternal mental illness. The most common risk factors include age of more than 35 year old, single parent, lower educational level and low income family[47,55]. Women with greater socioeconomic deprivation are more likely to have maternal mental illness than those with lesser degree of socioeconomic deprivation[56,57]. The early recognition of women at risk and effective intervention are essential as preventive measures to treat maternal mental illness accordingly, aiming to reduce the complications related to maternal mental illness.

***Strength and limitations***

To date, this is the first systematic and meta-analysis on anxiety among patient with GDM. This study clearly indicates that anxiety is prevalent among GDM patients. The finding of this review is consistent with the previous literature pertaining to anxiety among pregnant women experiencing medical complications. However, there are several limitations. Strict inclusion/exclusion criteria and a paucity of literature on the topic of interest have resulted in the inclusion of only three papers. However, according to Valentine *et al*[58], 2010, the minimum number of studies needed to conduct a meta-analysis is two. On top of that, we did sensitivity analysis and funnel plot to show the publication bias. Nevertheless, due care is necessary when interpreting the results as at least 5 studies or more are needed to reasonably and consistently achieve powers from the random-effects meta-analyses that are greater than the studies that contribute to them[59]. Second, the pooled sample size is not large enough to reflect the anxiety prevalence in clinical setting, therefore limiting the generalizability of our study findings.

In conclusion, our study provides an estimation of the prevalence of anxiety among patients with GDM. Our study showed that the pooled prevalence was high at 29.5%. We recommend that more epidemiological studies on anxiety during pregnancy be conducted in this particular population. In addition, it is important to identify factors associated with anxiety during pregnancy so that early detection and intervention can be implemented to improve various obstetric and mental health outcomes.

**ARTICLE HIGHLIGHTS**

***Research background***

There is lack of systematic review and meta-analysis on prevalence of anxiety among GDM women.

***Research motivation***

The systematic review and meta-analysis reporting the pooled prevalence of anxiety among GDM patients is high (29.5%).

***Research objectives***

Authors aimed to pool data from existing literature to determine the pool estimates for the prevalence of anxiety among women diagnosed with GDM.

***Research methods***

Multiple databases including MEDLINE, Cinahl, PubMed and Scopus were searched to identify studies published up to 31 October 2019 with data on the prevalence of anxiety among women diagnosed with GDM.

***Research results***

Total 19 abstracts, retrieved 10 articles and included three studies incorporating 12744 GDM women from three countries were reviewed. The pooled prevalence of anxiety was 29.5% among GDM women.

***Research conclusions***

The results suggest that epidemiological studies on anxiety should be conducted urgently as it merits clinical attention. In addition, it is important to identify factors associated with anxiety among women diagnosed with GDM.

**ACKNOWLEDGEMENTS**

We would like to thank the Director General of Health Malaysia for his permission to publish this article.

**REFERENCES**

1 **Bellamy L**, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. *Lancet* 2009; **373**: 1773-1779 [PMID: 19465232 DOI: 10.1016/S0140-6736(09)60731-5]

2 **Rayanagoudar G**, Hashi AA, Zamora J, Khan KS, Hitman GA, Thangaratinam S. Quantification of the type 2 diabetes risk in women with gestational diabetes: a systematic review and meta-analysis of 95,750 women. *Diabetologia* 2016; **59**: 1403-1411 [PMID: 27073002 DOI: 10.1007/s00125-016-3927-2]

3 **Bener A**, Saleh NM, Al-Hamaq A. Prevalence of gestational diabetes and associated maternal and neonatal complications in a fast-developing community: global comparisons. *Int J Womens Health* 2011; **3**: 367-373 [PMID: 22140323 DOI: 10.2147/IJWH.S26094]

4 **Veeraswamy S**, Vijayam B, Gupta VK, Kapur A. Gestational diabetes: the public health relevance and approach. *Diabetes Res Clin Pract* 2012; **97**: 350-358 [PMID: 22726771 DOI: 10.1016/j.diabres.2012.04.024]

5 **Farrar D**, Simmonds M, Bryant M, Sheldon TA, Tuffnell D, Golder S, Dunne F, Lawlor DA. Hyperglycaemia and risk of adverse perinatal outcomes: systematic review and meta-analysis. *BMJ* 2016; **354**: i4694 [PMID: 27624087 DOI: 10.1136/bmj.i4694]

6 **Li Z**, Cheng Y, Wang D, Chen H, Chen H, Ming WK, Wang Z. Incidence Rate of Type 2 Diabetes Mellitus after Gestational Diabetes Mellitus: A Systematic Review and Meta-Analysis of 170,139 Women. *J Diabetes Res* 2020; **2020**: 3076463 [PMID: 32405502 DOI: 10.1155/2020/3076463]

7 **Mak JKL**, Lee AH, Pham NM, Pan XF, Tang L, Binns CW, Sun X. Gestational diabetes incidence and delivery outcomes in Western China: A prospective cohort study. *Birth* 2019; **46**: 166-172 [PMID: 30216525 DOI: 10.1111/birt.12397]

8 **Thevarajah A**, Simmons D. Risk factors and outcomes for neonatal hypoglycaemia and neonatal hyperbilirubinaemia in pregnancies complicated by gestational diabetes mellitus: a single centre retrospective 3-year review. *Diabet Med* 2019; **36**: 1109-1117 [PMID: 30972790 DOI: 10.1111/dme.13962]

9 **Somohano-Mendiola N**, Champion JD, Vatcheva K. Assessment of Gestational Diabetes Mellitus Outcomes for Hispanic Women Living in the Rio Grande Valley. *Hisp Health Care Int* 2019; **17**: 111-117 [PMID: 30922188 DOI: 10.1177/1540415319833996]

10 **Chazotte C,** Freda MC, Elovitz M, Youchah J. Maternal depressive symptoms and maternal-fetal attachment in gestational diabetes. *J Womens Health* 1995; **4**: 375-380 [DOI: 10.1089/jwh.1995.4.375]

11 **Natasha K**, Hussain A, Khan AK. Prevalence of depression among subjects with and without gestational diabetes mellitus in Bangladesh: a hospital based study. *J Diabetes Metab Disord* 2015; **14**: 64 [PMID: 26221580 DOI: 10.1186/s40200-015-0189-3]

12 **Egan AM**, Dunne FP, Lydon K, Conneely S, Sarma K, McGuire BE. Diabetes in pregnancy: worse medical outcomes in type 1 diabetes but worse psychological outcomes in gestational diabetes. *QJM* 2017; **110**: 721-727 [PMID: 29024981 DOI: 10.1093/qjmed/hcx106]

13 **Beka Q**, Bowker S, Savu A, Kingston D, Johnson JA, Kaul P. Development of Perinatal Mental Illness in Women With Gestational Diabetes Mellitus: A Population-Based Cohort Study. *Can J Diabetes* 2018; **42**: 350-355.e1 [PMID: 28943221 DOI: 10.1016/j.jcjd.2017.08.005]

14 **Major B,** Cozzarelli C, Horowitz MJ. Encyclopedia of psychology: 8 Volume set. New York and Washington: Oxford University Press and the American Psychological Association, 2000

15 **Sowers KM,** Dulmus CN, Linn BK. Mental Illness: Worldwide. In: Encyclopedia of Social Work. National Association of Social Workers Press and Oxford University Press, 2019 [DOI: 10.1093/acrefore/9780199975839.013.1154]

16 **Soto-Balbuena C**, Rodríguez MF, Escudero Gomis AI, Ferrer Barriendos FJ, Le HN, Pmb-Huca G. Incidence, prevalence and risk factors related to anxiety symptoms during pregnancy. *Psicothema* 2018; **30**: 257-263 [PMID: 30009746 DOI: 10.7334/psicothema2017.379]

17 **Grigoriadis S**, Graves L, Peer M, Mamisashvili L, Tomlinson G, Vigod SN, Dennis CL, Steiner M, Brown C, Cheung A, Dawson H, Rector NA, Guenette M, Richter M. A systematic review and meta-analysis of the effects of antenatal anxiety on postpartum outcomes. *Arch Womens Ment Health* 2019; **22**: 543-556 [PMID: 30523416 DOI: 10.1007/s00737-018-0930-2]

18 **Netsi E**, Pearson RM, Murray L, Cooper P, Craske MG, Stein A. Association of Persistent and Severe Postnatal Depression With Child Outcomes. *JAMA Psychiatry* 2018; **75**: 247-253 [PMID: 29387878 DOI: 10.1001/jamapsychiatry.2017.4363]

19 **Podvornik N**, Globevnik Velikonja V, Praper P. Depression and Anxiety in Women During Pregnancy in Slovenia. *Zdr Varst* 2015; **54**: 45-50 [PMID: 27646621 DOI: 10.1515/sjph-2015-0006]

20 **Abrar A**, Fairbrother N, Smith AP, Skoll A, Albert AYK. Anxiety among women experiencing medically complicated pregnancy: A systematic review and meta-analysis. *Birth* 2020; **47**: 13-20 [PMID: 31222840 DOI: 10.1111/birt.12443]

21 **Biaggi A**, Conroy S, Pawlby S, Pariante CM. Identifying the women at risk of antenatal anxiety and depression: A systematic review. *J Affect Disord* 2016; **191**: 62-77 [PMID: 26650969 DOI: 10.1016/j.jad.2015.11.014]

22 **Marchetti D**, Carrozzino D, Fraticelli F, Fulcheri M, Vitacolonna E. Quality of Life in Women with Gestational Diabetes Mellitus: A Systematic Review. *J Diabetes Res* 2017; **2017**: 7058082 [PMID: 28326332 DOI: 10.1155/2017/7058082]

23 **Moher D**, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA; PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015; **4**: 1 [PMID: 25554246 DOI: 10.1186/2046-4053-4-1]

24 **Vandenbroucke JP**, von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, Poole C, Schlesselman JJ, Egger M; STROBE Initiative. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. *Epidemiology* 2007; **18**: 805-835 [PMID: 18049195 DOI: 10.1097/EDE.0b013e3181577511]

25 **Higgins JP**, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Stat Med* 2002; **21**: 1539-1558 [PMID: 12111919 DOI: 10.1002/sim.1186]

26 **Wallace BC,** Dahabreh IJ, Trikalinos TA, Lau J, Trow P, Schmid CH. Closing the gap between methodologists and end-users: R as a computational back-end. *J Stat Softw* 2012; **49**: 1-15 [DOI: 10.18637/jss.v049.i05]

27 **Jamovi.** The jamovi project (2020). jamovi (Version 1.2). Available from: https://www.jamovi.org

28 **Lee KW**, Ching SM, Hoo FK, Ramachandran V, Chong SC, Tusimin M, Mohd Nordin N. Prevalence and factors associated with depressive, anxiety and stress symptoms among women with gestational diabetes mellitus in tertiary care centres in Malaysia: a cross-sectional study. *BMC Pregnancy Childbirth* 2019; **19**: 367 [PMID: 31638930 DOI: 10.1186/s12884-019-2519-9]

29 **Lovibond PF**, Lovibond SH. The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav Res Ther* 1995; **33**: 335-343 [PMID: 7726811 DOI: 10.1016/0005-7967(94)00075-U]

30 **Musa R,** Fadzil MA, Zain Z. Translation, validation and psychometric properties of Bahasa Malaysia version of the Depression Anxiety and Stress Scales (DASS). *ASEAN J Psychiatr* 2007; **8**: 82-89

31 **Guo X**, Zheng L, Zhang X, Zou L, Li J, Sun Z, Hu J, Sun Y. The prevalence and heterogeneity of prehypertension: a meta-analysis and meta-regression of published literature worldwide. *Cardiovasc J Afr* 2012; **23**: 44-50 [PMID: 22331252 DOI: 10.5830/CVJA-2011-058]

32 **Arya R**, Antonisamy B, Kumar S. Sample size estimation in prevalence studies. *Indian J Pediatr* 2012; **79**: 1482-1488 [PMID: 22562262 DOI: 10.1007/s12098-012-0763-3]

33 **Faisal-Cury A**, Rossi Menezes P. Prevalence of anxiety and depression during pregnancy in a private setting sample. *Arch Womens Ment Health* 2007; **10**: 25-32 [PMID: 17187166 DOI: 10.1007/s00737-006-0164-6]

34 **Lee AM**, Lam SK, Sze Mun Lau SM, Chong CS, Chui HW, Fong DY. Prevalence, course, and risk factors for antenatal anxiety and depression. *Obstet Gynecol* 2007; **110**: 1102-1112 [PMID: 17978126 DOI: 10.1097/01.AOG.0000287065.59491.70]

35 **Ding XX**, Wu YL, Xu SJ, Zhu RP, Jia XM, Zhang SF, Huang K, Zhu P, Hao JH, Tao FB. Maternal anxiety during pregnancy and adverse birth outcomes: a systematic review and meta-analysis of prospective cohort studies. *J Affect Disord* 2014; **159**: 103-110 [PMID: 24679397 DOI: 10.1016/j.jad.2014.02.027]

36 **Lee KW**, Ching SM, Ramachandran V, Yee A, Hoo FK, Chia YC, Wan Sulaiman WA, Suppiah S, Mohamed MH, Veettil SK. Prevalence and risk factors of gestational diabetes mellitus in Asia: a systematic review and meta-analysis. *BMC Pregnancy Childbirth* 2018; **18**: 494 [PMID: 30547769 DOI: 10.1186/s12884-018-2131-4]

37 **Antenatal N.** Postnatal mental health: Clinical management and service guidance (CG192). London: National Institute for Health and Care Excellence, 2014

38 **Cox JL**, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry* 1987; **150**: 782-786 [PMID: 3651732 DOI: 10.1192/bjp.150.6.782]

39 **Zigmond AS**, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand* 1983; **67**: 361-370 [PMID: 6880820 DOI: 10.1111/j.1600-0447.1983.tb09716.x]

40 **Spielberger CD,** Gorsuch RL, Lushene RE. State-Trait Anxiety Inventory (STAI). Test Manual for Form X: Consulting Psychologists Press, 1968

41 **Spitzer RL**, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med* 2006; **166**: 1092-1097 [PMID: 16717171 DOI: 10.1001/archinte.166.10.1092]

42 **Gladstone GL**, Parker GB, Mitchell PB, Malhi GS, Wilhelm KA, Austin MP. A Brief Measure of Worry Severity (BMWS): personality and clinical correlates of severe worriers. *J Anxiety Disord* 2005; **19**: 877-892 [PMID: 16243636 DOI: 10.1016/j.janxdis.2004.11.003]

43 **Green JM**, Kafetsios K, Statham HE, Snowdon CM. Factor structure, validity and reliability of the Cambridge Worry Scale in a pregnant population. *J Health Psychol* 2003; **8**: 753-764 [PMID: 14670208 DOI: 10.1177/13591053030086008]

44 **Wijma K**, Wijma B, Zar M. Psychometric aspects of the W-DEQ; a new questionnaire for the measurement of fear of childbirth. *J Psychosom Obstet Gynaecol* 1998; **19**: 84-97 [PMID: 9638601 DOI: 10.3109/01674829809048501]

45 **Oates M**. Perinatal psychiatric disorders: a leading cause of maternal morbidity and mortality. *Br Med Bull* 2003; **67**: 219-229 [PMID: 14711766 DOI: 10.1093/bmb/ldg011]

46 **Jablensky AV**, Morgan V, Zubrick SR, Bower C, Yellachich LA. Pregnancy, delivery, and neonatal complications in a population cohort of women with schizophrenia and major affective disorders. *Am J Psychiatry* 2005; **162**: 79-91 [PMID: 15625205 DOI: 10.1176/appi.ajp.162.1.79]

47 **Ban L**, Gibson JE, West J, Fiaschi L, Oates MR, Tata LJ. Impact of socioeconomic deprivation on maternal perinatal mental illnesses presenting to UK general practice. *Br J Gen Pract* 2012; **62**: e671-e678 [PMID: 23265226 DOI: 10.3399/bjgp12X656801]

48 **The National Institute for Health and Care Excellence.** Antenatal and postnatal mental health: the NICE guideline on clinical management and service guidance. British Psychological Society, 2007

49 **Feldman R**, Granat A, Pariente C, Kanety H, Kuint J, Gilboa-Schechtman E. Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation, and stress reactivity. *J Am Acad Child Adolesc Psychiatry* 2009; **48**: 919-927 [PMID: 19625979 DOI: 10.1097/CHI.0b013e3181b21651]

50 **Reck C**, Struben K, Backenstrass M, Stefenelli U, Reinig K, Fuchs T, Sohn C, Mundt C. Prevalence, onset and comorbidity of postpartum anxiety and depressive disorders. *Acta Psychiatr Scand* 2008; **118**: 459-468 [PMID: 18840256 DOI: 10.1111/j.1600-0447.2008.01264.x]

51 **Miller RL**, Pallant JF, Negri LM. Anxiety and stress in the postpartum: is there more to postnatal distress than depression? *BMC Psychiatry* 2006; **6**: 12 [PMID: 16563155 DOI: 10.1186/1471-244X-6-12]

52 **Matthey S**, Barnett B, Howie P, Kavanagh DJ. Diagnosing postpartum depression in mothers and fathers: whatever happened to anxiety? *J Affect Disord* 2003; **74**: 139-147 [PMID: 12706515 DOI: 10.1016/s0165-0327(02)00012-5]

53 **Wenzel A**, Haugen EN, Jackson LC, Brendle JR. Anxiety symptoms and disorders at eight weeks postpartum. *J Anxiety Disord* 2005; **19**: 295-311 [PMID: 15686858 DOI: 10.1016/j.janxdis.2004.04.001]

54 **Ross LE**, McLean LM. Anxiety disorders during pregnancy and the postpartum period: A systematic review. *J Clin Psychiatry* 2006; **67**: 1285-1298 [PMID: 16965210 DOI: 10.4088/jcp.v67n0818]

55 **Nager A**, Johansson LM, Sundquist K. Are sociodemographic factors and year of delivery associated with hospital admission for postpartum psychosis? A study of 500,000 first-time mothers. *Acta Psychiatr Scand* 2005; **112**: 47-53 [PMID: 15952945 DOI: 10.1111/j.1600-0447.2005.00525.x]

56 **Rich-Edwards JW**, Kleinman K, Abrams A, Harlow BL, McLaughlin TJ, Joffe H, Gillman MW. Sociodemographic predictors of antenatal and postpartum depressive symptoms among women in a medical group practice. *J Epidemiol Community Health* 2006; **60**: 221-227 [PMID: 16476752 DOI: 10.1136/jech.2005.039370]

57 **Wall-Wieler E**, Carmichael SL, Urquia ML, Liu C, Hjern A. Severe maternal morbidity and postpartum mental health-related outcomes in Sweden: a population-based matched-cohort study. *Arch Womens Ment Health* 2019; **22**: 519-526 [PMID: 30334101 DOI: 10.1007/s00737-018-0917-z]

58 **Valentine JC,** Pigott TD, Rothstein HR. How many studies do you need? A primer on statistical power for meta-analysis. *J Educ Behav Stat* 2010; **35**: 215-247 [DOI: 10.3102/1076998609346961]

59 **Jackson D**, Turner R. Power analysis for random-effects meta-analysis. *Res Synth Methods* 2017; **8**: 290-302 [PMID: 28378395 DOI: 10.1002/jrsm.1240]

**Footnotes**

**Conflict-of-interest statement:** The authors declare that they have no competing interests.

**PRISMA 2009 Checklist statement:** This study was written according to the PRISMA 2009 Checklist.

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/

**Manuscript source:** Unsolicited manuscript

**Peer-review started:** April 23, 2020

**First decision:** April 30, 2020

**Article in press:** June 17, 2020

**Specialty type:** Medicine, research and experimental

**Country/Territory of origin:** Malaysia

**Peer-review report’s scientific quality classification**

Grade A (Excellent): 0

Grade B (Very good): B

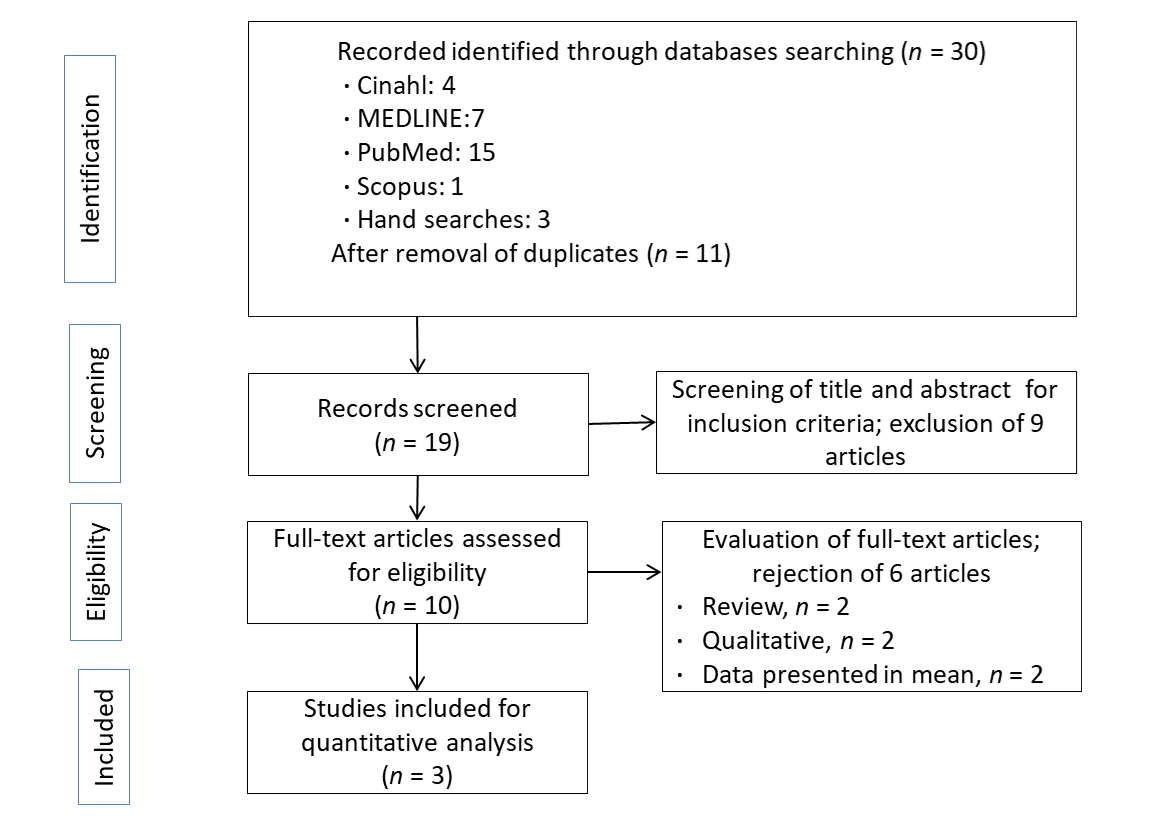
Grade C (Good): 0

Grade D (Fair): 0

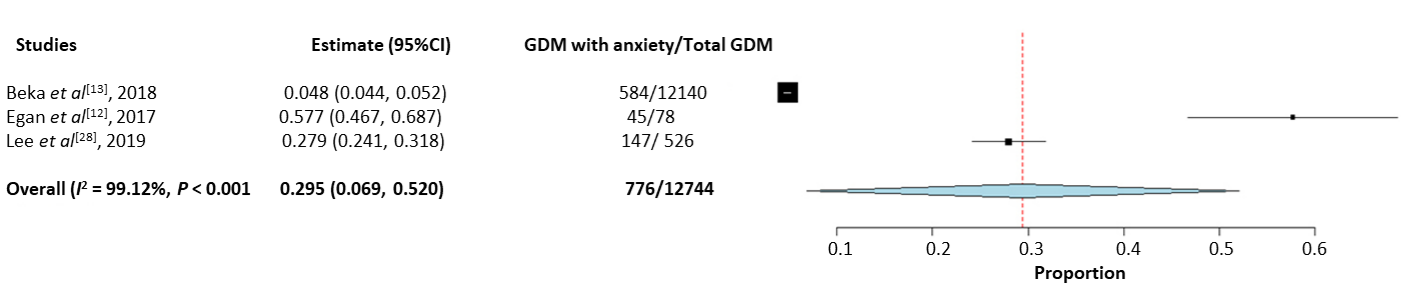
Grade E (Poor): 0

**P-Reviewer:** Byeon H **S-Editor:** Wang JL **L-Editor:** A **E-Editor:** Li X

**Figure Legends**



**Figure 1 Preferred reporting items for systematic review and meta-analysis protocols flow diagram of the literature screening process.**



**Figure 2 The forest plot of the pooled prevalence of anxiety among gestational diabetes mellitus patients.** GDM: Gestational diabetes mellitus.

**Table 1 Characteristics of the included studies**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Ref.** | **Year** | **Country** | **Study setting** | **Diagnostic guidelines for GDM** | **Diagnostic or screening methods for anxiety** | **Mean age of GDM patients** | **Ethnicity among GDM** | **Number of GDM patients with anxiety** | **Total number of GDM patients** | **Prevalence of anxiety** | **Quality (Score)** |
| Beka *et al*[13] | 2018 | Canada | Population | ADA | ICD-9 (Prior to 2002) and ICD-10 (2002 onward) | 32.1 ± 5.3 | Aboriginal (6.9%); Caucasian (70.8%), Chinese (6.9%), South Asian (15.5%) | 584 | 12140 | 4.8 | Good (18) |
| Egan *et al*[12] | 2017 | Ireland | Hospital | N/A | 21-item Depression Anxiety Stress Scale | 33.6 ± 4.8 | Caucasian (89.7); Non-Caucasian (9%) | 45 | 78 | 57.7 | Good (14) |
| Lee *et al*[28] | 2019 | Malaysia | Hospital | WHO | 21-item Depression Anxiety Stress Scale | 32.3 ± 4.9 | Malay (82.3%); Non-Malay (17.7%) | 147 | 526 | 27.9 | Good (15) |

Clinically significant anxiety symptoms/disorders in 2nd trimester. ADA: American Diabetes Association; WHO: World Health Organization; GDM: Gestational diabetes mellitus; ICD: International Classification of Diseases.