YOGA'S THERAPEUTIC EFFECT ON PERINATAL DEPRESSION: A SYSTEMATIC REVIEW AND META-ANALYSIS

Guanyu Wang[1], Ce Liang[2] & Guiju Sun[1]

[1]*Key Laboratory of Environmental Medical Engineering of Ministry of Education, Department of Nutrition and Food Hygiene, School of Public Health, Southeast University, Nanjing, Jiangsu, China*
[2]*Department of Mechanical Engineering, University College London, London, UK*

SUMMARY

Introduction: In recent years, the incidence of perinatal depression in female population is very high. Perinatal depression has adverse effects on the physical and mental health of mothers and children. However, according to current researches, Yoga has been considered as an effective exercise that can help pregnant women to regulate their emotions. Thus, this review reports the effectiveness of yoga on perinatal depression.

Methods: We reviewed all of the relevant RCT (Randomized Control Trial, RCT) studies published until June 2021 from the major open-access databases.

Results: 12 RCTs were selected and included in this study, and the total number of people included in the analysis in the combined study was 594. The level of depression and anxiety of participants was evaluated using detailed and recognized scale. Compared with the control group, the yoga intervention group indicates a statistically significant decrease in depression levels (SMD (Standardised Mean Difference, SMD), -2.31; 95% CI, -3.67 to -0.96; P=0.139) and anxiety (SMD, -4.75; 95% CI, -8.3 to -1.19; P=0.002). In addition, we also conducted a subgroup analysis according to the type of population. The subgroup analysis successfully reduced the level of heterogeneity and the results indicated that the difference in population types in the combined analysis leads to the higher heterogeneity. The SMD value for healthy women is -2.3 (95% CI, -4.83 to 0.23) and for depressed women is -9.02 (95% CI, -11.42 to -6.62). Finally, the meta-analysis results of the self-control group prove that yoga can reduce the depression scores (SMD, 5.23; 95% CI, 1.90 to 8.56; P=0.049) compared with baseline.

Conclusions: Yoga can effectively relieve symptoms of depression and anxiety in the perinatal period, which can be used as an auxiliary treatment option clinically.

Key words: *perinatal depression - yoga - systematic review - meta-analysis*

* * * * *

INTRODUCTION

Perinatal depression is defined as depression that occurs from the beginning of pregnancy to the first four weeks after delivery. Perinatal depression can significantly lower the quality of life of patients which has been classified as a type of major depressive disorder by the American Psychiatric Association (APA) (American Psychiatric Association 2013). In the United States, the average incidence of perinatal depression is 11.5%, and according to the statistics, more than 500,000 women suffer from depression each year (Ko & Rockhill 2017).

Perinatal depression is mainly manifested in the decline of short-term memory, attention and thinking of patients. Some patients will become irritable and have serious sleep disorders, and in the most severe cases, hallucinations and suicidal tendencies (Pio de Almeida et al. 2012). Meanwhile, it may also lead to an increase in the incidence of other obstetric diseases, such as gestational diabetes, gestational hypertension, etc. (Hinkle et al. 2016). In addition, when suffering from this severe mental stress, patients have high possibility to harm themselves or their babies. As reported, 19.3% of mothers with Edinburgh Postnatal Depression Scale (EPDS) scores over 10 have these negative thoughts (Wisner et al. 2013). Many suicide cases show that they had self-harm in the early stage, and suicide is now the second leading cause of death in postpartum women (Orsolini et al. 2016).

Besides, a number of large cohort studies have shown that maternal perinatal depression has negative effects on children's emotional and behavioral development (Judith et al. 2015, Woolhouse et al. 2015). Depressive symptoms adversely affect the development of a fetus (O'Connor et al. 2014), and maternal depression in infancy also can hinder psychosocial development in the first year of life (Kingston et al. 2012). Clinical evidence suggests that this may be associated with decreased cerebral cortex thickness and mean dispersion in children (Lebel et al. 2016). The cause of perinatal depression is limited, but it is affected by a combination of physiological, psychological and social factors (Lim 2021). Antidepressants are the main clinical treatment, but in recent years, more and more researchers have investigated the effect of exercise as an auxiliary treatment method (Davenport et al. 2018).

Yoga is an ancient sport which originated in India and adopts easy-to-master techniques to regulate people's physical and mental states. Compared with running, swimming and other traditional aerobic exercise, yoga has less burden on the human body and puts particular emphasis on the psychological adjustment during

practice (Field 2016). Therefore, yoga is more suitable for the treatment of physical and mental diseases than other sports, especially for depression, anxiety, pressure, etc. According to reported data, about 15 million adults in the United States practice yoga, believing it helps them prevent disease and keep themselves healthy (Saper et al. 2004).

Yoga-related researches has been conducted by obstetricians. However, randomized controlled trials on the therapeutic effect of yoga on perinatal depression seem to be difficult to obtain a unified result. Some previous studies by Field et al. (2013a,b, 2012) have suggested that yoga can significantly reduce depression and anxiety levels in pregnant women. But in the latest study, Yuvarani et al. (2020) reported that there was no significant difference between yoga and general aerobic exercise in reducing depression scores. The purpose of this study is to use meta-analysis to review evidences that links yoga with improvements in symptoms of perinatal depression or anxiety.

METHODS

Search strategy

We searched and sorted out all relevant studies available in Embase, Pubmed and Web of science database websites. Most studies use depression and anxiety to assess psychological status of patients because of their strong correlation. This review therefore retrieved symptoms of depression and anxiety. The search terms are based on available text terms or Medical Subject Heading (MeSH) or Emtree terms including yoga, yoga therapy, yoga exercise, yoga activity, yoga intervention, postpartum depression, antenatal anxiety, postpartum anxiety, perinatal stress. The accessed date was from June 5 to 10, 2021, the search scope was limited to 2012 to 2021, and the prediction was limited to English language. We searched the bibliography of eligible studies and reviews to find other trials, and contacted the authors when needed to obtain more information about ongoing trials. Two researchers independently reviewed the title, abstract, and full text article.

Inclusion and exclusion

Most of the studies included in this review are randomized controlled trials. In order to distinguish them from the meta-analyses that have been done before, as well as to explore the feasibility of yoga intervention as a treatment for perinatal depression in a more comprehensive way, we discussed 3 extra self-controlled clinical trials in our analysis. Participants can either be healthy pregnant women or pregnant women who have been diagnosed with depression. The intervention group received the detailed Yoga trainings under the supervision of professional instructors. It required group member to attend at least eight courses and each course lasted no less than 20 minutes. Meanwhile, the control group chose other methods except yoga, including

standard prenatal care, social support, and other sports exercises. There are many types of yoga practice at present, and our research did not make specific limitations on the types of yoga adopted in the intervention group, for example, comprehensive yoga such as pranayama, meditation or body scanning are also included. The observation index is a depression or anxiety evaluation scale generally applied for pregnant women. Exclusion criteria include non-random or non-controlled trials, articles that are still unavailable or incomplete after contacting the author, and the evaluation method does not use a recognized scale.

Data extraction

Regarding the various types of data used in analyses, such as publication year, number of participants, patient characteristics (age, gender, diagnosis), method (random, blinding), intervention (type, duration, frequency of yoga), control intervention (type, Frequency, duration), outcome indicators (such as depression or anxiety to measure), etc., are collected by two reviewers using standard extraction tables. If there is a dispute, an arbitration mechanism was activated and a third reviewer was required to participate in the discussion to reach a consensus.

Quality assessment

Bias risk assessment based on RCTs were independently assessed by two reviewers according to the Cochrane System Reviewer's Manual Version 5.1 Bias Risk Assessment Standard, including random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcomes assessment, data completeness, publication Bias, and other biases. Considering the characteristics of yoga practice, it is difficult for researchers to blind participants, and the restrictions on participant blinding was relaxed in the assessment process. The quality of each study was assessed as "Low risk", "High risk", or "Unclear risk". The more standards a study meets, the higher its quality. If the results of the two evaluators are inconsistent, the third evaluator will step in and reach an agreement through discussion.

Data synthesis

Stata 15.1 was used for meta-analysis. First, evaluated the heterogeneity among similar studies where the test level is $P=0.1$. If $P \geq 0.1$ and $I^2 \leq 50\%$, it means that the heterogeneity among studies is not significant; Whereas, if $P<0.1$, $I^2>50\%$, it indicates the significant heterogeneity exists and the source of the heterogeneity needs to be analyzed. We performed subgroup analysis according to possible heterogeneity factors. If necessary, used sensitivity analysis to analyze the stability of the test results. If the heterogeneity exceeds the limit which means the source cannot be judged, then we adopted descriptive analysis to replace Meta-analysis. Conti-

nuous data were analyzed by weighted mean difference (MD) when the measurement tools were same. Otherwise, the standardized mean difference (SMD) is used for analysis where the confidence interval is 95%. A related study can contain many types of depression evaluation scales and the most important scale results were selected and summarized in our analyses. The publication bias of the included studies was represented by Begg and Egger test criteria and funnel plots.

RESULT

Trail flow

A total of 2612 potentially relevant documents were identified through the open-access database. After narrowing the search range, only 84 articles met the content including "yoga training" and "perinatal depression" at the same time. Then, articles not in RCT types were excluded (n=49). Twelve articles were finally selected. Criteria for exclusion included repeated studies, studies that did not meet the theme, studies where participants did not meet the requirements, studies that did not meet the requirements of yoga intervention, and studies with incomplete results. The flow chart of trail screening is shown in Figure 1.

Study characteristics

The 12 articles included in the meta-analysis all have been peer reviewed and received as journal articles. Eight of the trials were conducted in the United States (Battle et al. 2015, Buttner et al. 2015, Davis et al. 2015, Field et al. 2013a,b, 2012, Miklowitz et al. 2015,
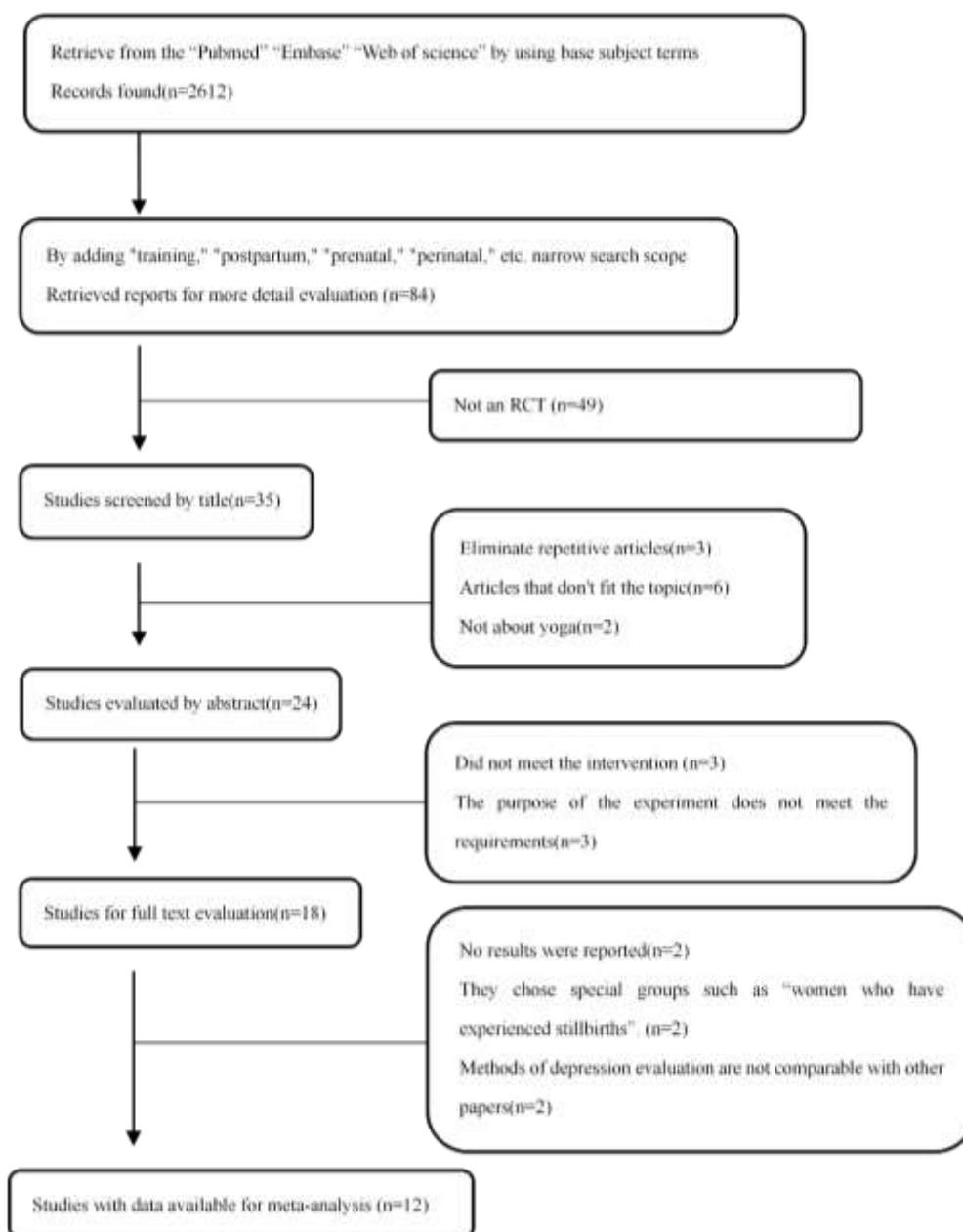

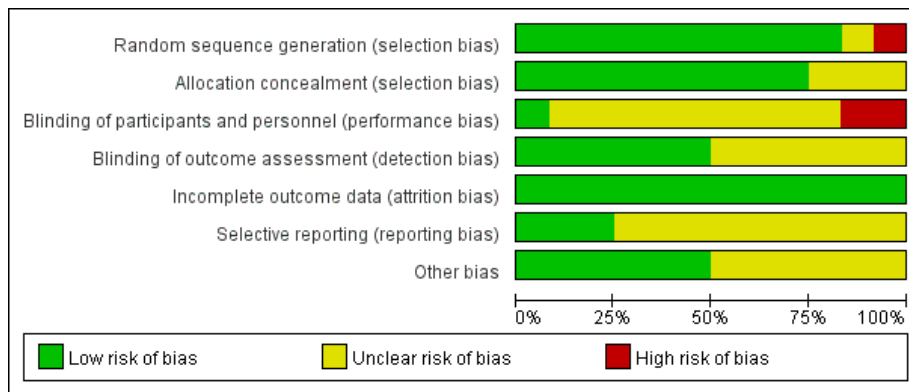**Figure 1.** Flow chart of study selection in meta-analysis

Figure 2a. The risk of bias graph by Revman

Figure 2b. The risk of bias summary by Revman

Uebelacker et al. 2016), two in India (Satyapriya et al. 2013, Yuvarani et al. 2020), one in the United Kingdom (Newham et al. 2014), and one in Taiwan (Ko et al. 2013), China. The total number of pregnant women included in the analysis in the combined study was 594. Participants in eight studies were depressed women, two studies required participants Quick Inventory of Depressive

Symptomatology (QIDS) score >7 and <20 (Battle et al. 2015, Uebelacker et al. 2016); one study required EPDS >9 or State-Trait Anxiety Inventory (STAI) >25 (Davis et al. 2015); one study required Hamilton Depression Rating Scale (HDRS) score >12 (Buttner et al. 2015); the remaining four studies require meeting diagnostic criteria for depression on the Structured Clinical Interview for Depression (SCID) (Field et al. 2013a,b, 2012, Miklowitz et al. 2015). Participants in the other four studies were healthy women with no symptoms of depression or anxiety (Ko et al. 2013, Newham et al. 2014, Satyapriya et al. 2013, Yuvarani et al. 2020). All studies reported the baseline depression (or anxiety) score and the depression (or anxiety) score after the intervention. The control group in the nine RCT studies received routine obstetric care in local hospitals. These cares include appropriate exercise, psychological counseling, and social support measures except yoga. The yoga intervention group all joined yoga courses on the basis of routine care. Detailed characteristics are shown in Table 1.

Risk of bias assessment

Revman 5.3 was adopted to assess the risk of bias in the included studies (Figure 2a, 2b). Most of the research met the requirements of random sequence generation and only Ko et al. (2013) reported high risk in this project. Due to the particularity of yoga intervention, most of the study did not report the status of "blinding of participants and personnel" except Newham et al. (2014). In terms of data integrity, all studies can confirm that the data is complete and reliable.
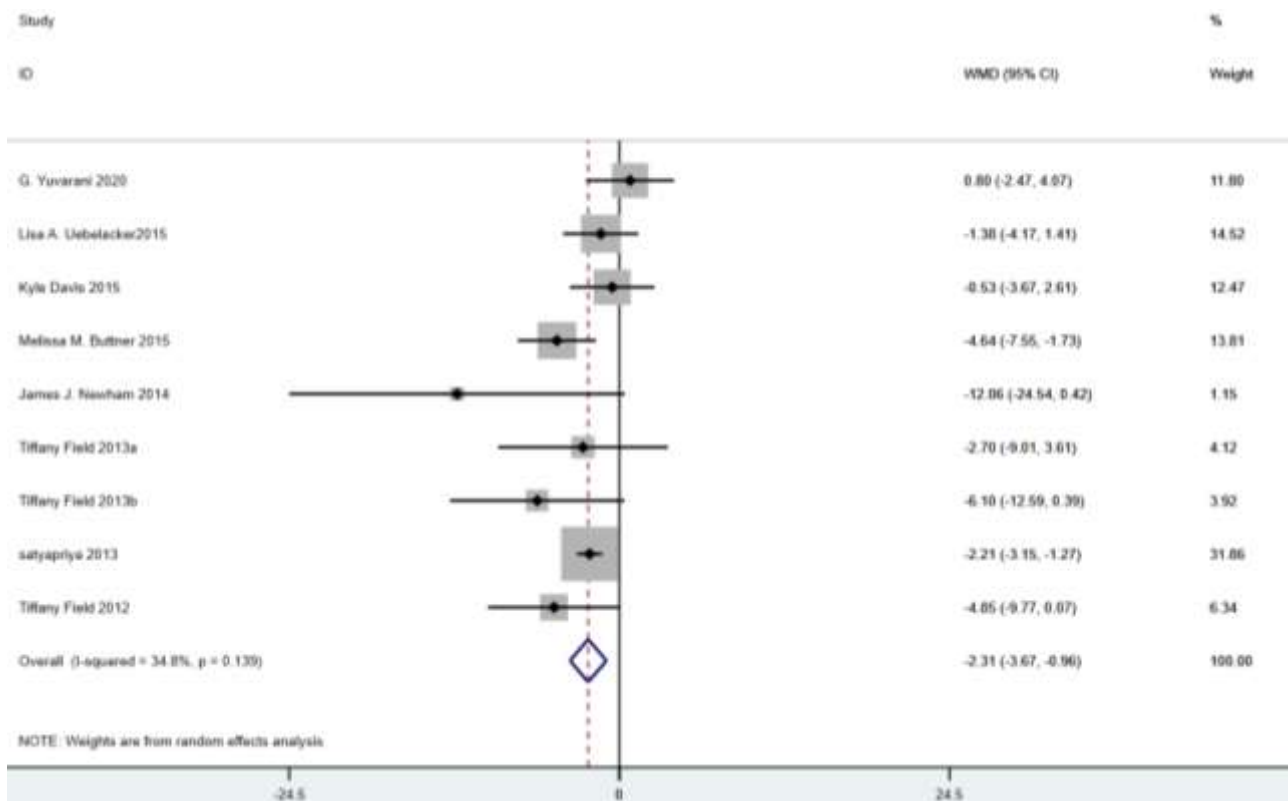
Meta-analysis
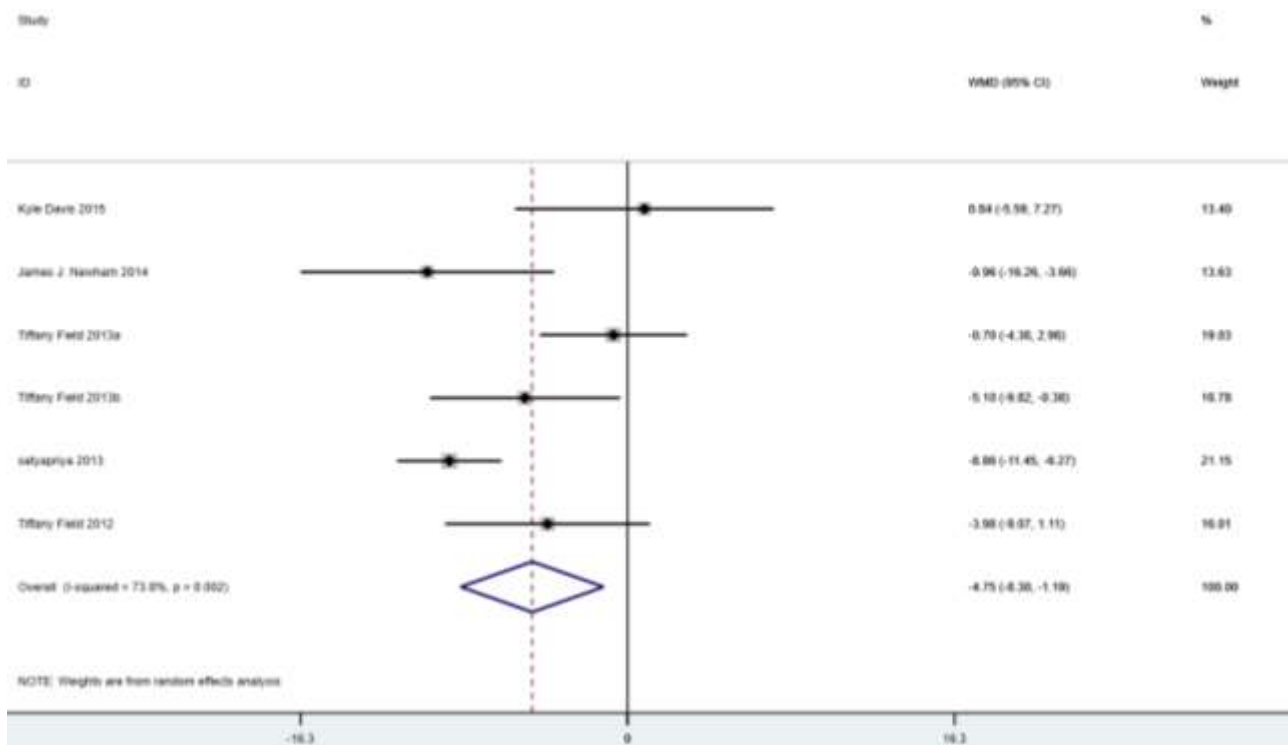
The total effect of yoga on depression scores

The Cochrane System Review Manual stipulates that if $I^2<50\%$, a fixed-effect model can be used. Here we choose the random-effect model in order to make meta-analysis results more stable. Meta-analysis of nine RCTs showed no significant heterogeneity in the combined results ($I^2=34.8\%$, $P=0.139$). The depression scores of the participants from intervention group are lower than that from control group. The random effects model shows that the standardized weight mean difference (SMD) was -2.31 (95% CI, -3.67 to -0.96) (Figure 3).

Table 1. Characteristics of included studies

Study	Population	N	Intervention	Comparator	Outcomes	Result
G. Yuvarani (2020, India)	Healthy primiparous women	30	20-minute of yoga training, 12 weeks	Aerobic exercise	CES-D 12 weeks	No significant difference in CES-D between groups.
Lisa A. Uebelacker (2015, United States)	Depressed women	20	75-minute yoga course training, 9 weeks	Usual perinatal treatment	QIDS 3 weeks, 6 weeks, 9 weeks	No significant difference in QIDS between groups.
Kyle Davis (2015, United States)	Depressed women	46	75-minute yoga course training, 8 weeks	Usual perinatal treatment	EPDS, STAI 4 weeks, 8 weeks	No significant difference in EPDS or STAI between groups.
Melissa M. Buttner (2015, United States)	Depressed women	57	One-hour yoga classes twice a week and practice at home, 8 weeks	Usual perinatal treatment	HDRS 2 weeks, 4 weeks, 6 weeks, 8 weeks	Significant difference decrease in HDRS in yoga intervention compared with comparator
David J. Miklowitz (2015, United States)	Women with major depressive disorder or bipolar spectrum disorder	39	Two-hour Meditation, body scanning and mindfulness yoga, 8 weeks	Self before and after comparison	BDI-II 8 weeks	The depression score of the major depression disorder group decreased significantly before and after intervention
Cynthia L. Battle (2015, United States)	Depressed women	22	Yoga classes twice a week, 10 weeks	Self before and after comparison	EPDS 10 weeks	The depression score decreased significantly before and after intervention
James J. Newham (2014, United Kingdom)	Healthy primiparous women	51	Yoga classes, 8 weeks	Usual perinatal treatment	WDEQ, STAI 8 weeks	Significant difference decrease in WDEQ and STAI in yoga intervention compared with comparator
Tiffany Field (2013a, United States)	Depressed women	79	20-minute of yoga training, 12 weeks	Social support	POMS, STAI 12 weeks	Significant difference decrease in POMS (but not in STAI) in yoga intervention compared with comparator
Tiffany Field (2013b, United States)	Depressed women	75	20-minute of yoga/tai chi training, 12 weeks	The same training classes unless yoga/tai chi	CES-D, STAI 12 weeks	Significant difference decrease in CES-D and STAI in yoga intervention compared with comparator
Satyapriya (2013, India)	Healthy women	96	Yoga classes, 16 weeks	Usual perinatal treatment	HADS, STAI 16 weeks	Significant difference decrease in HADS and STAI in yoga intervention compared with comparator
Tiffany Field (2012, United States)	Depressed women	56	Yoga sessions, 12 weeks	Usual perinatal treatment	CES-D, STAI 12 weeks	Significant difference decrease in CES-D and STAI in yoga intervention compared with comparator
Yi-Li Ko (2012, Taiwan, China)	Healthy women	23	Yoga sessions were every Saturday, 12 weeks	Self before and after comparison	CES-D, 12 weeks	The depression score decreased significantly before and after intervention

Figure 3. Forest plots of effects of yoga on perinatal depression scores

Figure 4. Forest plots of effects of yoga on perinatal anxiety scores

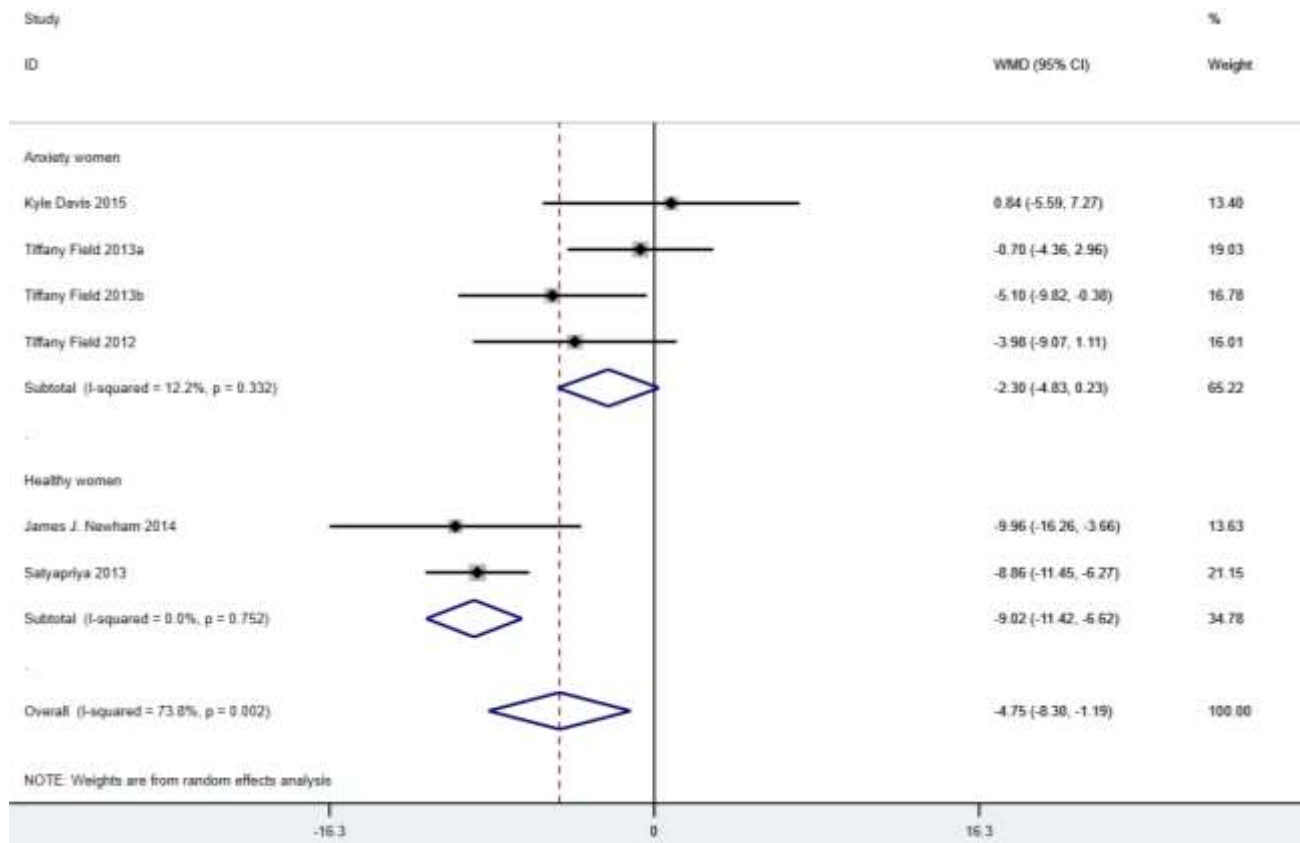### *The total effect of yoga on anxiety scores*

Meta-analysis was performed on six RCTs. Yoga reduced anxiety scores of women compared with control group that did not receive the yoga intervention. Random effect model showed that the SMD was - 4.75 (95% CI, - 8.3 to -1.19) (Figure 4). There was significant heteroge-

neity in the combined results (I^2=73.8%, *P*=0.002). Each study was removed one by one to conduct a sensitivity analysis and the results show that Satyapriya (2013) was the main source of heterogeneity. The original conclusion remained true when the study was removed, which proves that the combined results were stable.

Subgroup of analysis

Subgroups were created based on the different mental health status of participants. In the analysis of anxiety scores, participants in two RCTs were healthy women who were not diagnosed with depression, while the participants in the other four RCTs had perinatal depressed. The SMD for healthy women was -2.3 (95% CI, -4.83 to 0.23) and for depressed women was -9.02 (95% CI, -11.42 to -6.62). The results of Healthy population subgroup (I^2=0%, P=0.752) and the subgroup of depressed people (I^2=12.2%, P=0.332) did not show any significant heterogeneity. There is no significant difference in depression scores between the yoga intervention group and the control group in the depressed population, as shown in Figure 5.

Figure 5. Forest plots of subgroup of analysis on perinatal anxiety scores
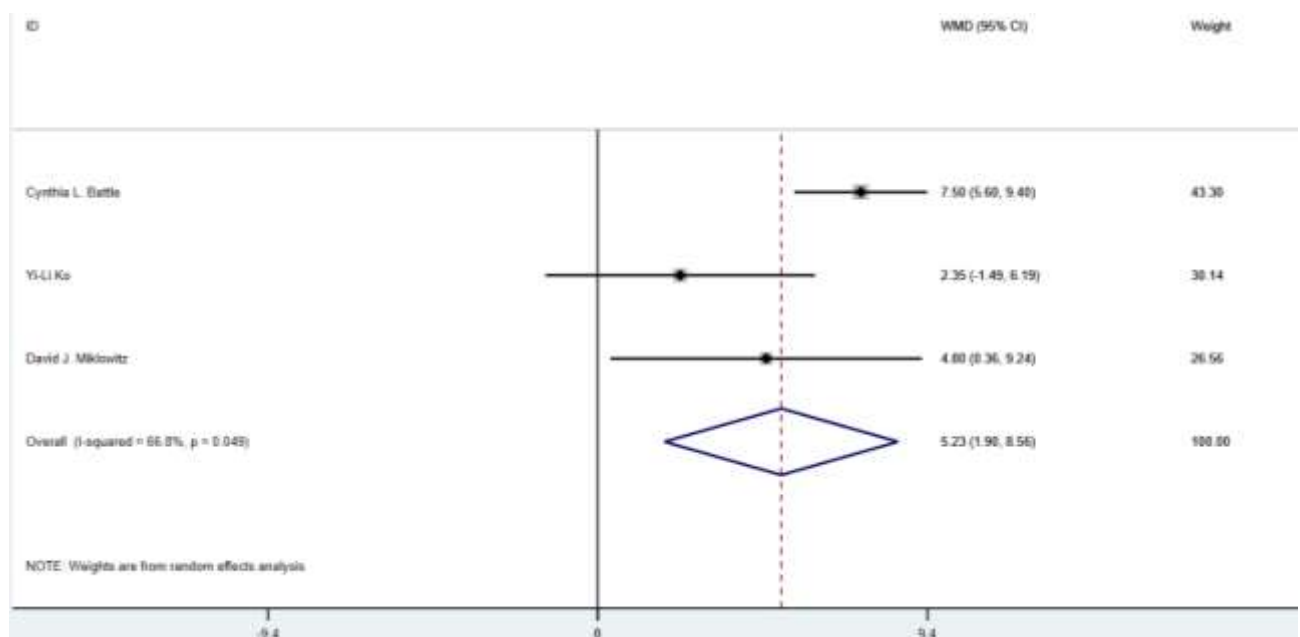
Figure 6. Forest plots of self-control group

(a)   **(b)**
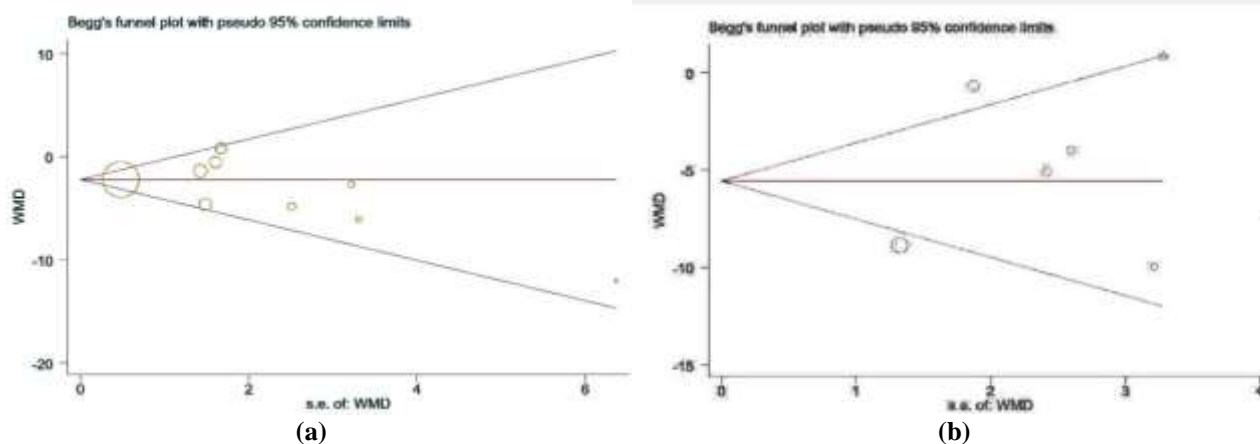
Figure 7. Funnel chart of depression score (a) and anxiety score (b)

The effect of yoga on self-control group

A meta-analysis was performed on three self-controlled articles. Comparing the baseline values before the yoga intervention with the retest results after the intervention, yoga intervention reduced the depression scores of women. Figure 6 shows the difference in scores before and after the yoga intervention. The random effects model showed that the SMD was 5.23 (95% CI, 1.90 to 8.56). The combined result has significant heterogeneity (I^2=66.8%, P=0.049).

Publication bias

We used Stata 15.1 to draw a funnel chart and the Begg and Egger's method to test the funnel chart. Visual inspection of the funnel chart was symmetrical, suggesting that there is less possibility of publication bias. The Begg and Egger's method was used to quantitatively analyze the publication bias of the clinical total effective rate. Figure 7 showed no publication bias which was indicated by the depression score of P=0.41 and anxiety score of P=0.395.

DISCUSSION

The results of the meta-analysis prove the therapeutic effect of yoga as an auxiliary treatment option on perinatal depression and anxiety. The heterogeneity of depression scores in depression group is low, indicating that the combined results are stable and reliable. Considering the actual application scenarios, we have also combined data on our self-control research. The quantitative results showed that the depression symptoms of perinatal women were relieved after yoga training.

Perinatal anxiety and depression usually occur at the same time and anxiety was normally considered as a necessary condition for depression (Matthey et al. 2003, van Bussel et al. 2006). Current clinical evidence suggests that perinatal anxiety can also adversely affect mothers and children (Alder et al. 2007). Six of the nine RCT articles we included have STAI test results. Meta analysis results show that yoga has a good therapeutic effect on perinatal anxiety. Comparing the forest plots of depression and anxiety, it is obvious that the depression

score and anxiety score changes in one study have a high consistency, which also illustrates the high correlation between depression and anxiety. The anxiety level of the population can be used as an auxiliary judgment of the depression level. The results of the combined anxiety scores are highly heterogeneous, so we conducted subgroup analysis according to the type of population. The results suggested that the difference in population types in the combined analysis is the reason for the higher heterogeneity. Healthy people and people diagnosed with depression showed different improvement in anxiety after yoga intervention. The forest plot results show that the improvement of anxiety status in healthy people was better than that in depressed people.

The preventive (Galper et al. 2006) and therapeutic (Chu et al. 2009) effects of physical exercise on depression have been widely recognized. Yoga exercises, which promotes the movement within muscles and other surrounding soft tissues to relax the whole body, emphasize breathing with the adjustment of body posture, are more suitable for perinatal women than other types of exercise. The physiological function of yoga in regulating emotions may be similar to that of exercise, such as promoting the release of endorphins. Endorphins are mainly secreted by the hypothalamic pituitary gland, and their main function is to help the body endure stress and pain, making them feel refreshed and in a better mood. Some studies have proven that the level of endorphin in plasma increases after exercise (Moreira Antunes et al. 2016). In addition to endorphins, other physiological processes that can regulate emotions may include improvement of mitochondrial function (Broskey et al. 2014), activation of the mTOR (Mammalian Target of Rapamycin, mTOR) signaling pathway (Bolster et al. 2003), and increased brain serotonin levels (Wipfli et al. 2011).

Although not all studies have elaborated on the specific steps of yoga intervention, we still found that perinatal women get better improvement in depression in the study (Buttner et al. 2015, Newham et al. 2014, Satyapriya et al. 2013) of a complete comprehensive yoga (including exercise, breathing, and meditation). We reviewed the article (Yuvarani et al. 2020) which had the least significant improvement in depression scores, and found

that the intervention measures taken by the control group of the study were more intense and comprehensive aerobic exercise. The study showed that although the depression score was significantly improved before and after yoga intervention, but there was no significant difference from other professional aerobic exercise treatments.

Limitations

First of all, most of the analyzed studies are from the United States, and only four are from other countries (UK, India, Taiwan), which may lead to a certain degree of selection bias. Second, the scales used in these studies are not consistent, increase the difficulty of our comparative analysis. Although we have taken standardized measures, it may still affect the results of the analysis. In fact, the most suitable of these scales is EPDS, because EPDS is a depression evaluation scale designed specifically for the postpartum population. The options of EPDS will take into account some special physical and psychological states of perinatal women (such as fatigue), EPDS will correctly explain these symptoms caused by pregnancy.

Implication

In this meta-analysis, we have reviewed the main evidence that yoga improves perinatal depression and raise the possibility of yoga as an adjunctive therapy. But at the same time, we should also realize that the therapeutic effect of yoga is derived from its psychological adjustment function (Field 2016), so the psychosocial support of perinatal women is also very important. Regular telephone follow-up and online mental health education are also complementary therapies for perinatal depression (Field et al. 2013b, Lebel et al. 2020), at this point, there are a lot of new technology can produce help such as OPV (Online Photovoice, OPV) (Tanhan et al. 2021, Tanhan & Strack 2020). We hope that more non-pharmacological approaches will be used to treat perinatal depression.

CONCLUSION

This review demonstrates the ability of yoga to improve depression and anxiety symptoms in perinatal women. The anxiety improvement that healthy people get from yoga may be greater. Adding yoga training to the existing perinatal care can help maintain women's mental health.

References

1. Alder J, Fink N, Bitzer J, Hosli I & Holzgreve W: Depression and anxiety during pregnancy: a risk factor for obstetric, fetal and neonatal outcome? A critical review of the literature. J. Matern Fetal Neonatal Med 2007; 20:189-209. doi:10.1080/14767050701209560

2. American Psychiatric Association: D.-T.F. Diagnostic and statistical manual of mental disorders: DSM-5™ (5th ed.), 2013

3. Battle CL, Uebelacker LA, Magee SR, Sutton KA & Miller IW: Potential for prenatal yoga to serve as an intervention to treat depression during pregnancy. Womens Health Issues 2015; 25:134-141. doi:10.1016/j.whi.2014.12.003

4. Bolster DR, Kubica N, Crozier SJ, Williamson DL, Farrell PA, Kimball SR et al.: Immediate response of mammalian target of rapamycin (mTOR)-mediated signalling following acute resistance exercise in rat skeletal muscle (see Perspectives). J Physiol 2003; 553:213-220. doi:10.1113/jphysiol.2003.047019

5. Broskey NT, Greggio C, Boss A, Boutant M, Dwyer A, Schlueter L et al.: Skeletal muscle mitochondria in the elderly: effects of physical fitness and exercise training. J Clin Endocrinol Metab 2014; 99:1852-1861. doi:10.1210/jc.2013-3983

6. Buttner MM, Brock RL, O'Hara MW & Stuart S: Efficacy of yoga for depressed postpartum women: A randomized controlled trial. Complement Ther Clin Pract 2015; 21:94-100. doi:10.1016/j.ctcp.2015.03.003

7. Chu IH, Buckworth J, Kirby TE, Emery CFJMH & Activity P: Effect of exercise intensity on depressive symptoms in women. Mental Health and Physical Activity 2009; 2:37-43. doi:10.1016/j.mhpa.2009.01.001

8. Davenport MH, McCurdy AP, Mottola MF, Skow RJ, Meah VL, Poitras VJ et al.: Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: a systematic review and meta-analysis. Br J Sports Med 2018; 52:1376-1385. doi:10.1136/bjsports-2018-099697

9. Davis K, Goodman SH, Leiferman J, Taylor M & Dimidjian S: A randomized controlled trial of yoga for pregnant women with symptoms of depression and anxiety. Complement. Ther Clin Pract 2015; 21:166-172. doi:10.1016/j.ctcp.2015.06.005

10. Field T: Yoga research review. Complement Ther Clin Pract 2016; 24:145-161. doi:10.1016/j.ctcp.2016.06.005

11. Field T, Diego M, Delgado J & Medina L: Tai chi/yoga reduces prenatal depression, anxiety and sleep disturbances. Complement Ther Clin Pract 2013a; 19:6-10. doi:10.1016/j.ctcp.2012.10.001

12. Field T, Diego M, Delgado J & Medina L: Yoga and social support reduce prenatal depression, anxiety and cortisol. J Bodyw Mov Ther 2013b; 17:397-403. doi:10.1016/j.jbmt.2013.03.010

13. Field T, Diego M, Hernandez-Reif M Medina L, Delgado, J & Hernandez A: Yoga and massage therapy reduce prenatal depression and prematurity. J Bodyw Mov Ther 2012; 16:204-209. doi:10.1016/j.jbmt.2011.08.002

14. Galper DI, Trivedi MH, Barlow CE, Dunn AL & Kampert JB: Inverse association between physical inactivity and mental health in men and women. Med Sci Sports Exerc 2006; 38:173-178. doi:10.1249/01.mss.0000180883.32116.28

15. Hinkle SN, Buck Louis GM, Rawal S, Zhu Y, Albert PS & Zhang C: A longitudinal study of depression and gestational

diabetes in pregnancy and the postpartum period. Diabetologia 2016; 59:2594-2602. doi:10.1007/s00125-016-4086-1

16. *Judith V, Galéra C, Larroque B, Saurel-Cubizolles MJ, Sutter-Dallay AL & Melchior MJJoP: Maternal Depression Trajectories and Children's Behavior at Age 5 Years. J Pediatr 2015; 166:1440-1448.e1441. doi:10.1016/j.jpeds.2015.03.002*

17. *Kingston D, Tough S & Whitfield H: Prenatal and Postpartum Maternal Psychological Distress and Infant Development: A Systematic Review. Child Psychiatry Hum Dev 2012; 43:683-714. doi:10.1007/s10578-012-0291-4*

18. *Ko JY & Rockhill KM: Trends in Postpartum Depressive Symptoms - 27 States, 2004, 2008, and 2012. Mmwr-Morbidity and Mortality Weekly Report 2017; 66:153-158. doi:10.15585/mmwr.mm6606a1*

19. *Ko YL, Yang CL, Fang CL, Lee MY & Lin PC: Community-based postpartum exercise program. J Clin Nurs 2013; 22:2122-2131. doi:10.1111/jocn.12117*

20. *Lebel C, MacKinnon A, Bagshawe M, Tomfohr-Madsen L & Giesbrecht G: Elevated depression and anxiety symptoms among pregnant individuals during the COVID-19 pandemic. J Affect Disord 2020; 277:5-13. doi:10.1016/j.jad.2020.07.126*

21. *Lebel C, Walton M, Letourneau N, Giesbrecht GF, Kaplan BJ & Dewey D: Prepartum and Postpartum Maternal Depressive Symptoms Are Related to Children's Brain Structure in Preschool. Biol Psychiatry 2016; 80:859-868. doi:10.1016/j.biopsych.2015.12.004*

22. *Lim G: Perinatal depression. Curr Opin Anaesthesiol 2021; 34:233-237. doi:10.1097/ACO.0000000000000998*

23. *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. doi:10.1016/s0165-0327(02)00012-5*

24. *Miklowitz DJ, Semple RJ, Hauser M, Elkun D, Weintraub, MJ & Dimidjian S: Mindfulness-Based Cognitive Therapy for Perinatal Women with Depression or Bipolar Spectrum Disorder. Cognit Ther Res 2015; 39:590-600. doi:10.1007/s10608-015-9681-9*

25. *Moreira Antunes HK, Fogaca Leite GS, Lee KS, Barreto AT, Thomatieli dos Santos RV, Souza HdS et al.: Exercise deprivation increases negative mood in exercise-addicted subjects and modifies their biochemical markers. Physiol Behav 2016; 156:182-190. doi:10.1016/j.physbeh.2016.01.028*

26. *Newham JJ, Wittkowski A, Hurley J, Aplin JD & Westwood M: Effects of antenatal yoga on maternal anxiety and depression: a randomized controlled trial. Depress Anxiety 2014; 31:631-640. doi:10.1002/da.22268*

27. *O'Connor TG, Monk C & Fitelson EM: Practitioner Review: Maternal mood in pregnancy and child development - implications for child psychology and psychiatry. Journal of Child Psychology and Psychiatry 2014; 55:99-111. doi:10.1111/jcpp.12153*

28. *Orsolini L, Valchera A, Vecchiotti R, Tomasetti C, Iasevoli F, Fornaro M et al.: Suicide during Perinatal Period: Epi demiology, Risk Factors, and Clinical Correlates. Frontiers in Psychiatry 2016; 7:138-138. doi:10.3389/fpsyt.2016.00138*

29. *Pio de Almeida LS, Jansen K, Koehler CA, Pinheiro RT, da Silva RA & Bonini JS: Working and short-term memories are impaired in postpartum depression. J Affect Disord 2012; 136:1238-1242. doi:10.1016/j.jad.2011.09.031*

30. *Saper RB, Eisenberg DM, Davis RB, Culpepper L, Phillip RSJATiH & Medicine: Prevalence and patterns of adult yoga use in the United States: results of a national survey. Altern Ther Health Med 2004; 10:123506-123506-123503*

31. *Satyapriya M, Nagarathna R, Padmalatha V & Nagendra HR: Effect of integrated yoga on anxiety, depression & well being in normal pregnancy. Complement Ther Clin Pract 2013; 19:230-236. doi:10.1016/j.ctcp.2013.06.003*

32. *Tanhan A, Arslan G, Yavuz KF, Young JS, Çiçek İ, Akkurt MN et al.: A Constructive Understanding of Mental Health Facilitators and Barriers through Online Photovoice (OPV) during COVID-19. ESAM Ekonomik ve Sosyal Araştırmalar Dergisi 2021; 2:214-249*

33. *Tanhan A & Strack RW: Online photovoice to explore and advocate for Muslim biopsychosocial spiritual wellbeing and issues: Ecological systems theory and ally development. Current Psychology 2020; 39:2010-2025. doi:10.1007/s12144-020-00692-6*

34. *Uebelacker LA, Battle CL, Sutton KA, Magee SR & Miller IW: A pilot randomized controlled trial comparing prenatal yoga to perinatal health education for antenatal depression. Arch Womens Ment Health 2016; 19:543-547. doi:10.1007/s00737-015-0571-7*

35. *van Bussel JCH, Spitz B & Demyttenaere K: Women's mental health before, during, and after pregnancy: a population-based controlled cohort study. Birth-Issues in Perinatal Care 2006; 33:297-302. doi:10.1111/j.1523-536X.2006.00122.x*

36. *Wipfli B, Landers D, Nagoshi C & Ringenbach S: An examination of serotonin and psychological variables in the relationship between exercise and mental health. Scand J Med Sci Sports 2011; 21:474-481. doi:10.1111/j.1600-0838.2009.01049.x*

37. *Wisner KL, Sit DKY, McShea MC, Rizzo DM, Zoretich RA, Hughes CL et al.: Onset Timing, Thoughts of Self-harm, and Diagnoses in Postpartum Women With Screen-Positive Depression Findings. Jama Psychiatry 2013; 70:490-498. doi:10.1001/jamapsychiatry.2013.87*

38. *Woolhouse H, Gartland D, Mensah F, Giallo R & Brown SJAoWsMH: Maternal depression from pregnancy to 4years postpartum and emotional/behavioural difficulties in children: results from a prospective pregnancy cohort study. Archives of Women's Mental Health 2015; 19:141-151. doi:10.1007/s00737-015-0562-8. Epub 2015 Aug 14*

39. *Yuvarani G, Manoranjitham R, Tharani G, Kamatchi K & Vaishnavi GJB: A study to compare the effects of aerobic exercises and yoga on depression and maternal anxiety orienting among primiparous women. Biomedicine 2020; 40:395-398. doi:10.51248/.v40i3.38*

Correspondence:

Guiju Sun, MD
Key Laboratory of Environmental Medical Engineering of Ministry of Education
Department of Nutrition and Food Hygiene, School of Public Health, Southeast University
Nanjing, 210009, Jiangsu, China
E-mail: gjsun@seu.edu.cn