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Postpartum depression risk factors: A narrative review

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Abstract:

Postpartum depression is a debilitating mental disorder with a high prevalence. The aim of this study was review of the related studies. In this narrative review, we report studies that investigated risk factors of postpartum depression by searching the database, Scopus, PubMed, ScienceDirect, Uptodate, Proquest in the period 2000-2015 published articles about the factors associated with postpartum depression were assessed in Farsi and English. The search strategy included a combination of keywords include postpartum depression and risk factors or obstetrical history, social factors, or biological factors. Literature review showed that risk factors for postpartum depression in the area of economic and social factors, obstetrical history, and biological factors, lifestyle and history of mental illness detected. Data from this study can use for designing a screening tools for high-risk pregnant women and for designing a prevention programs.

Keywords:

Narrative review, postpartum depression, risk factors

Introduction

Postpartum depression is a debilitating mental disorder with a prevalence between 5% and 60.8% worldwide.^[1] The intensity of feeling inability in suffering mothers is so high that some mothers with postpartum depression comment life as the death swamp^[2] while nondepressed mothers see their baby's birth as the happiest stage of their life.^[3] The disease manifests as sleep disorders, mood swings, changes in appetite, fear of injury, serious concerns about the baby, much sadness and crying, sense of doubt, difficulty in concentrating, lack of interest in daily activities, thoughts of death and suicide.^[4,5] Feelings of hopelessness in severe cases of illness can threaten life and lead to suicide;^[6] it is a factor that causes 20% of maternal deaths in the course after giving birth.^[7] In addition, issues such as fear of harming the baby (36%), weak attachment to the baby (34%) and even, in extreme cases, child suicide attempts

have been reported.^[8,9] These symptoms have serious effects on family health.^[10] Therefore, susceptible people need to be identified before delivery to receive proper care measures. However, the development of screening programs as well as designing evidence-based prevention programs requires principled collection of scientific documentations. However, systematic reviews were seen in the review of some available studies that have assessed the resources in explaining the therapeutic effects of selective serotonin reuptake inhibitors on postpartum depression^[11] and cognitive behavioral therapies.^[12] Review studies seem to be inadequate, which evaluate the social factors besides addressing biological and psychological factors, while for achieving sufficient knowledge to design screening and preventing programs, all the factors associated with postpartum depression need be evaluated together. Thus, this study aimed to evaluate risk factors for postpartum depression during pregnancy and afterward.

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Materials and Methods

This was a review (narrative) study, in which literature in English and Farsi was evaluated using electronic search in databases of Scopus, PubMed, ScienceDirect, UpToDate, and Proquest in the time range returns between 2000 and 2015. Searching in the databases was made using key words of “postpartum depression” and “risk factors” or “predisposing factors” or “predictive factors” and “biological agents” or “social factors” or “pathophysiology” or “hormonal factors” or “lifestyle” and “pregnancy.” In assessing in the PubMed database, the keywords were selected in accordance with the MeSH system. Those articles were included in the study that had done research on risk factors and predisposing factors of postpartum depression, which were of cross-sectional, cohort, case-control, interventional, and review article types. In addition, the illness diagnosis basis in these articles was the diagnosis of depression within 4 weeks after giving birth to 1 year after delivery. The articles improper regarding the adequacy of sample size, research design, and statistical methods were excluded from the study.

In the initial evaluation of the articles titles, 200 paper abstracts were extracted and evaluated by two members of the research team in terms of inclusion criteria after removal the authors’ names. In case of nonagreement on the presence if inclusion criteria between the two evaluators, the articles abstract was given to the third evaluator whose opinion was determinant to include the article in the review. According to the articles arbitration, 74 papers were detected appropriate. Then, the full-texts of available articles were prepared. In case of articles with unavailable full text, correspondence was done with the authors to request them for sending the article’s full text after explaining the purpose of the survey.

The articles were evaluated by three team members of the research in terms of inclusion criteria. In case of meeting the inclusion criteria, the article was reviewed and contents related to the subject were extracted. Thus, the main results of each study with the article’s specifications under the relevant title were noted. After collecting, the material and content were categorized based on scientific content in their respective area subsets.

Results and Discussion

Articles’ assessment showed that the factors associated with postpartum depression can be classified in five domains of risk factors for psychiatric, obstetric risk factors, biological and hormonal risk factors, social risk factors, and lifestyle risk factors.

Psychological factors

Previous history of depression and anxiety is among the factors that are associated with a higher risk of postpartum depression. The relationship between postpartum depression and prior onset of depression has been reported in many studies,^[13,14] which has been referred to as powerful factors in postpartum depression.^[15,16] The occurrence of mental health disorders such as depression during pregnancy is a powerful factor in predicting postpartum depression.^[17]

There is evidence in explaining these relationships suggesting that women with a positive history of depression are more susceptible to hormonal changes.^[18] In support of this finding, it has reported that a history of moderate to severe premenstrual syndrome (PMS) is a factors affecting the onset of postpartum depression.^[19] In women with severe PMS, the serotonin transport system will change while the serotonin transporter polymorphism area is associated with major depression.^[20] High serotonin polymorphism may lead to tryptophan depletion and induction of postpartum major depression.^[21]

In addition to previous depression history, negative attitude toward the recent pregnancy, number of life events,^[18] and a history of sexual abuse in the past^[22] were as predisposing risk factors of postpartum depression. Furthermore, the reluctance of the baby gender^[13] and having low self-esteem with the impact on parenting stress^[22] are factors that contribute in the development of postpartum depression.

Obstetric risk factors

Assessment the relationship between the number of delivery and postpartum depression has been associated with conflicting results. Mayberry *et al.* have reported postpartum depression is more prevalent in multiparous women than in nulliparous women^[23] while the results of another study indicate a higher prevalence of the disease in nulliparous women.^[16] Furthermore, in a study conducted by Matsin in 2013, on 86 participants within 6 weeks after delivery, it was found that having two or more children due to higher psychological burden is more likely to be associated with the occurrence of depression.^[10] The discrepancies between the results of these studies suggest that the number of childbirth alone is not an independent factor for developing postpartum depression and the development of pathological conditions for the occurrence of the illness is caused by psychosocial conditions that the multiplicity of delivery creates for the women.

Risky pregnancy is also associated with an increased risk of postpartum depression. These risks include conditions that lead to performing emergency cesarean

section or hospitalization during pregnancy. Postpartum complications^[22,24] are also effective on the incidence of postpartum depression as much as during labor complications such as meconium passage, umbilical cord prolapse, and obstetric hemorrhages.^[10] Mothers with the birth of an infant with a weight <1500 g are 4–18 times at risk for postpartum depression^[25] more than others.

A mismatch between the expectations of mother and pregnancy events is as factors that affect the occurrence of depression. It has been reported that women with strong desire to have natural childbirth during the perinatal period whose delivery are done by caesarean section are more prone to risk for postpartum depression than others.^[26] Spending the course of pregnancy in a natural state away from the excitements due to complications during pregnancy and preparedness for the delivery seem to be as conditions effective in the prevention of postpartum depression. Since it has been reported that the use of epidural anesthesia during childbirth, attending in childbirth preparation classes during pregnancy, and continued breastfeeding after childbirth were associated with a reduced risk of postpartum depression.^[27] However, insomnia during pregnancy can lead to the risk of recurrent postpartum depression in women with a previous history of the disease.^[28]

The inverse association between breastfeeding and postpartum depression shows that breastfeeding is associated with a reduction in the rate of postpartum depression. It has been reported that women exclusively breastfeed their infants in the first 3 months after childbirth show lower values of Edinburgh Postnatal Depression Scale.^[29] In a study conducted by Hamdan and Tamim, it was found that breastfeeding during the first 4 months after delivery reduces the risk of postpartum depression.^[30] Although no causal relationship has been established for the relationship between breastfeeding and postpartum depression, breastfeeding increases the interaction between mother and baby^[31,32] and thereby may affect the health of the mother.

A relationship has been observed between low hemoglobin concentration at day 7 after delivery (<120 g/L) and postpartum depressive symptoms at day 28 after childbirth.^[3] Furthermore, an effective correlation has been seen between homocysteinemia in the 1st week and 6 weeks after delivery and depression. However, there is not enough evidence in this regard that postpartum anemia can cause postpartum depression or complications of pregnancy period associated with the postpartum anemia may lead to increased risk of the disease.

Biological factors

Young age during pregnancy increases the risk of depression. The highest level of depression has been

reported in mothers aged 13–19 years^[33] while the lowest rate has been seen in women with the age range of 31–35-year-old.^[34] In a study conducted by Abdollahi *et al.* on 1950 women at 2–12 weeks after giving birth, it was found that increasing maternal age and maternal self-efficacy are associated with a reduced risk of postpartum depression.^[35]

Studies show that glucose metabolism disorders during pregnancy are also as predisposing factors for postpartum depression so that it has been observed that women with higher blood glucose levels (mean of 120 vs. 114 mg/dl) after an hour after performing the glucose challenge test with 50 g of glucose were more at risk of postpartum depression than others.^[36]

Serotonin and tryptophan levels in the blood are also known factors effective on depression. A study has shown a relationship between different serotonin transporter gene alleles and serotonin receptors with mood disorders and depression.^[37] Serotonin is a monoamine neurotransmitter that is synthesized during an enzymatic route from amino acid tryptophan.^[38] The amount of serotonin directly depends on the individual diet. The consumption of foods rich in protein reduces the amounts of tryptophan and serotonin in the brain while a carbohydrate snack has reverse effects.^[38] In nutritional deficiencies, reduced brain tryptophan (a precursor of serotonin) up to 15% leads to increased depression scale rate of postpartum depression.^[21]

Oxytocin also plays a key role in regulating emotions, social interactions, and emotional responses.^[39] Higher levels of oxytocin in midpregnancy have been predictors of postpartum depression within less than the first 2 weeks after delivery.^[40] Recent evidence suggests that oxytocin induces the activity of serotonin receptors^[41] and reduces the response to stress. The intranasal oxytocin spraying has increased the duration of positive behaviors such as eye contact and possibility of emotions and feelings both in women and men.^[42]

The role of estrogen has been also evaluated in the incidence of postpartum depression. Studies on animal models have shown that steroid and estrogen hormones are modulators of transcription from nervous neurotransmitters^[43] and adjust the function of serotonin receptors.^[44] This hormone causes the renewal of the generation of damaged neurons in brain and leads to the production of brain neurotransmitters.^[45] In hypothalamus, estrogen also affects the neurotransmitters and regulates sleep and temperature. It has been observed that the fluctuations in this hormone or its absence is associated with depression.^[45]

The role of corticotropin-releasing hormone in the regulation of steroid hormones and depression has

been studied as well. In addition to hypothalamus, this hormone is also produced during pregnancy in placenta, uterus, and ovaries and regulates the pituitary-hypothalamus-adrenal axis for production of steroid hormones.^[46] After delivery and expulsion of the placenta, dramatic drop of this hormone leads to reduced production of steroid hormones such as estrogen and leads to increased susceptibility to depression in the first 12 weeks after childbirth.^[47] In addition to steroid hormones, some evidence has been reported suggesting the inverse association of free thyroxine levels and total serum thyroxine concentrations with symptoms of postpartum depression.^[48]

Although the relationship between thyroid dysfunction and postpartum depression has not been certainly established, the disorder may cause postpartum depression in a subgroup of women.^[18] According to a report, a positive thyroid peroxidase antibody test at 32 weeks of pregnancy will increase the risk of postpartum depression as 2–3 times.^[49]

In addition to the association of some endogenous hormones with postpartum depression, cytokine network and inflammatory responses have been observed to be involved in the pathophysiology of depression as well.^[50] Administration of cytokines such as interferon alpha and cytokine inducers such as lipopolysaccharides and typhoid vaccines have caused behavioral changes such as mood disorders, anorexia, fatigue, sleep disorders, and other temperamental mood swings, which overlap with depression symptoms.^[51] Depressed women may develop postpartum psychoneuroimmunological disorder, which is caused by inflammatory response turmoil in the normal course of labor and delivery.^[52] Some evidence of changes in the regulators of T-cells has also been observed in depressed women before delivery.^[53] The mechanism of explaining the changes in T-cells in depression is unknown. However, it is observed that the T-cells develop apoptosis in depressed patients. One of the possible mechanisms of explaining T-cells apoptosis in depression is the increased activity of the immune system, especially depletion of their tryptophan. Tryptophan is an essential component for the proliferation of T-cells, and in an environment free of tryptophan, the T-cells undergo apoptosis process.^[51]

In depressed patients, increased apoptosis in the T-cells along with decreased response to glucocorticoids will lead to decreased available T-cells and reduced the capacity of the brain in response to immunological stimuli.^[51]

Social factors

Social support refers to emotional support, financial support, intelligence support, and empathy relations.^[54] The

role of social support in reducing postpartum depression has been demonstrated.^[55] Reducing social support is the most important environmental factor in the onset of depression and anxiety disorders.^[56] At the International Conference on Population and Development of the year, decision-making power at home and increased support of the partner have been considered as the most important solution to promote women's reproductive health.^[57] The spouse sexual violence and other forms of domestic violence during pregnancy are seen as factors contributing to the incidence of postpartum depression.^[58]

In addition to the women's relationship with family members and community, behaviors such as smoking during prenatal period, is of social factors associated with increased incidence of postpartum depression as 1.7 times.^[59]

The simultaneous relationship between smoking and socioeconomic level and the relationship between socioeconomic level with depression complicate the association between smoking and postpartum depression. However, the physiological changes of pregnancy may seem as a stressful event for some mothers and lead to the onset of depression symptoms and start of smoking.^[60]

Another social factor is employment status, especially professional careers, which have been associated with a reduced risk of postpartum depression.^[61] However, education and low income are associated with the risk of postpartum depression.^[36,62]

Lifestyle

Among the factors related to lifestyle, factors of food intake patterns, sleep status, exercise, and physical activities may affect postpartum depression. It was observed that sufficient consumption of vegetables, fruits, legumes, seafood, milk and dairy products, olive oil, and a variety of nutritious may reduce postpartum depression as 50%.^[63]

Vitamin B6 is effective in the production of serotonin from tryptophan as a cofactor. Therefore, the reduction of this vitamin may be involved in the process of postpartum depression.^[64] In a study, the positive relation between the level of vitamin B2 absorption at week 21 of pregnancy and postpartum depression has been reported.^[37] The results of an ecological study from 23 countries found that increased seafood consumption is associated with reduced risk of postpartum depression.

The results of an ecological study on 23 countries indicated that high docosahexaenoic acid levels and increased seafood consumption have been associated

with reduced risk of postpartum depression.^[65,66] This compound is found in fish oil.

Among the micronutrients, reduced intake of zinc and selenium is linked with the incidence of postpartum depression.^[67] It was reported in a study that zinc applies its antidepressant by influencing the serotonin reuptake.^[68] Selenium deficiency is likely to affect the postpartum depression by developing thyroid dysfunction.^[69] Zinc is specifically found in red meat, grains, meat, and fish.

In addition to nutritional status, sleep status is among the factors influencing the risk of depression. Evidence shows that there is a relationship between less sleep and postpartum depression.^[20,70] Furthermore, an effective relationship has been observed between the rate of fatigue and depression levels in days after delivery. Periods of severe sleep deprivation have been reported in depressed women after delivery.^[20] Chronic sleep deprivation affects glucose metabolism, inflammatory processes, social communications, mental health, and the quality of life.^[71] In addition, acute episodes of sleep deprivation affect the immune system and increase inflammatory markers such as interleukin-6 and tumor necrosis factor while these inflammatory factors have been seen more in women with postpartum depression.

There is also some evidence to suggest that exercise and physical activity have significant benefits in reducing depression symptoms, which are comparable with medicinal benefits.^[72] Moderate physical activity in the third trimester of pregnancy has lowered the postpartum depression scale at 6 weeks after the delivery.^[73]

A possible mechanism is the effect of exercise on mental conditions of women by increasing the endogenous opioids and endorphins, which improve the mental health. Exercise also increases self-confidence and will eliminate negative self-assessments caused by depression. In addition, exercise will help women focusing on the environment around and solving their problems.^[74]

Conclusion

Biological factors and social factors create intertwined rings that each makes women prone to postpartum depression by affecting each other. According to the findings of this study, many biological and environmental factors, such as lifestyle-related factors, are involved in the incidence or prevention of postpartum depression through direct and indirect impact on the level of serotonin in the brain and its function. Furthermore, many environmental factors such as socioeconomic factors cause crisis conditions and postpartum depression

through influencing the mental health during pregnancy. Therefore, postpartum depression prevention programs need to focus on individuals interpersonal relationships to reduce domestic violence and increase social protection in addition to modify the women's lifestyle and increase their ability to cope with the crisis conditions. Moreover, based on the results of this research, the postpartum depression predictor tools should focus on social factors and lifestyle in addition to physical health conditions of individuals.

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Conflicts of interest

There are no conflicts of interest.

References

1. Klainin P, Arthur DG. Postpartum depression in Asian cultures: A literature review. *Int J Nurs Stud* 2009;46:1355-73.
2. Beck CT, Records K, Rice M. Further development of the Postpartum Depression Predictors Inventory-Revised. *J Obstet Gynecol Neonatal Nurs* 2006;35:735-45.
3. Corwin EJ, Murray-Kolb LE, Beard JL. Low hemoglobin level is a risk factor for postpartum depression. *J Nutr* 2003;133:4139-42.
4. Aswathi A, Rajendiren S, Nimesh A, Philip RR, Kattimani S, Jayalakshmi D, *et al.* High serum testosterone levels during postpartum period are associated with postpartum depression. *Asian J Psychiatr* 2015;17:85-8.
5. Norhayati MN, Hazlina NH, Asrenee AR, Emilin WM. Magnitude and risk factors for postpartum symptoms: A literature review. *J Affect Disord* 2015;175:34-52.
6. Youn JH, Jeong IS. Predictive validity of the postpartum depression predictors inventory-revised. *Asian Nurs Res (Korean Soc Nurs Sci)* 2011;5:210-5.
7. Chaudron LH. Postpartum depression: What pediatricians need to know. *Pediatr Rev* 2003;24:154-61.
8. Thorsteinsson EB, Loi NM, Moulynox AL. Mental health literacy of depression and postnatal depression: A community sample. *Open J Depress* 2014;2014:101-11.
9. Spinelli MG. Maternal infanticide associated with mental illness: Prevention and the promise of saved lives. *Am J Psychiatry* 2004;161:1548-57.
10. Mathisen SE, Glavin K, Lien L, Lagerløv P. Prevalence and risk factors for postpartum depressive symptoms in Argentina: A cross-sectional study. *Int J Womens Health* 2013;5:787-93.
11. De Crescenzo F, Perelli F, Armando M, Vicari S. Selective serotonin reuptake inhibitors (SSRIs) for post-partum depression (PPD): A systematic review of randomized clinical trials. *J Affect Disord* 2014;152:39-44.
12. Nardi B, Laurenzi S, Di Nicolò M, Bellantuono C. Is the cognitive-behavioural therapy an effective strategy also in the prevention of post partum depression? a critical review. *Riv Psychiatr* 2012;47:205-13.

13. Lee DT, Yip AS, Leung TY, Chung TK. Identifying women at risk of postnatal depression: Prospective longitudinal study. *Hong Kong Med J* 2000;6:349-54.
14. Davey HL, Tough SC, Adair CE, Benzie KM. Risk factors for sub-clinical and major postpartum depression among a community cohort of Canadian women. *Matern Child Health J* 2011;15:866-75.
15. McCoy SJ, Beal JM, Shipman SB, Payton ME, Watson GH. Risk factors for postpartum depression: A retrospective investigation at 4-weeks postnatal and a review of the literature. *J Am Osteopath Assoc* 2006;106:193-8.
16. Kheirabadi GR, Maracy MR, Barekatin M, Salehi M, Sadri GH, Kelishadi M, *et al.* Risk factors of postpartum depression in rural areas of Isfahan Province, Iran. *Arch Iran Med* 2009;12:461-7.
17. Lancaster CA, Gold KJ, Flynn HA, Yoo H, Marcus SM, Davis MM. Risk factors for depressive symptoms during pregnancy: A systematic review. *Am J Obstet Gynecol* 2010;202:5-14.
18. Bloch M, Daly RC, Rubinow DR. Endocrine factors in the etiology of postpartum depression. *Compr Psychiatry* 2003;44:234-46.
19. Buttner MM, Mott SL, Pearlstein T, Stuart S, Zlotnick C, O'Hara MW. Examination of premenstrual symptoms as a risk factor for depression in postpartum women. *Arch Womens Ment Health* 2013;16:219-25.
20. Zinga D, Phillips SD, Born L. Postpartum depression: We know the risks, can it be prevented? *Rev Bras Psiquiatr* 2005;27 Suppl 2:S56-64.
21. Sanjuan J, Martin-Santos R, Garcia-Esteve L, Carot JM, Guillamat R, Gutierrez-Zotes A, *et al.* Mood changes after delivery: Role of the serotonin transporter gene. *Br J Psychiatry* 2008;193:383-8.
22. Leigh B, Milgrom J. Risk factors for antenatal depression, postnatal depression and parenting stress. *BMC Psychiatry* 2008;8:24.
23. Mayberry LJ, Horowitz JA, Declercq E. Depression symptom prevalence and demographic risk factors among U.S. women during the first 2 years postpartum. *J Obstet Gynecol Neonatal Nurs* 2007;36:542-9.
24. Gaillard A, Le Strat Y, Mandelbrot L, Keita H, Dubertret C. Predictors of postpartum depression: Prospective study of 264 women followed during pregnancy and postpartum. *Psychiatry Res* 2014;215:341-6.
25. Helle N, Barkmann C, Bartz-Seel J, Diehl T, Ehrhardt S, Hendel A, *et al.* Very low birth-weight as a risk factor for postpartum depression four to six weeks postbirth in mothers and fathers: Cross-sectional results from a controlled multicentre cohort study. *J Affect Disord* 2015;180:154-61.
26. Houston KA, Kaimal AJ, Nakagawa S, Gregorich SE, Yee LM, Kuppermann M. Mode of delivery and postpartum depression: The role of patient preferences. *Am J Obstet Gynecol* 2015;212:229.e1-7.
27. Ding T, Wang DX, Qu Y, Chen Q, Zhu SN. Epidural labor analgesia is associated with a decreased risk of postpartum depression: A prospective cohort study. *Anesth Analg* 2014;119:383-92.
28. Dørheim SK, Bjorvatn B, Eberhard-Gran M. Can insomnia in pregnancy predict postpartum depression? A longitudinal, population-based study. *PLoS One* 2014;9:e94674.
29. Figueiredo B, Canário C, Field T. Breastfeeding is negatively affected by prenatal depression and reduces postpartum depression. *Psychol Med* 2014;44:927-36.
30. Hamdan A, Tamim H. Psychosocial risk and protective factors for postpartum depression in the United Arab Emirates. *Arch Womens Ment Health* 2011;14:125-33.
31. Kiernan K, Pickett KE. Marital status disparities in maternal smoking during pregnancy, breastfeeding and maternal depression. *Soc Sci Med* 2006;63:335-46.
32. Field T, Hernandez-Reif M, Feijo L. Breastfeeding in depressed mother-infant dyads. *Early Child Dev Care* 2002;172:539-45.
33. Silva R, Jansen K, Souza L, Quevedo L, Barbosa L, Moraes I, *et al.* Sociodemographic risk factors of perinatal depression: A cohort study in the public health care system. *Rev Bras Psiquiatr* 2012;34:143-8.
34. Milgrom J, Gemmill AW, Bilszta JL, Hayes B, Barnett B, Brooks J, *et al.* Antenatal risk factors for postnatal depression: A large prospective study. *J Affect Disord* 2008;108:147-57.
35. Abdollahi F, Sazlina SG, Zain AM, Zarghami M, Asghari Jafarabadi M, Lye MS. Postpartum depression and psycho-socio-demographic predictors. *Asia Pac Psychiatry* 2014;6:425-34.
36. Huang T, Rifas-Shiman SL, Ertel KA, Rich-Edwards J, Kleinman K, Gillman MW, *et al.* Pregnancy hyperglycaemia and risk of prenatal and postpartum depressive symptoms. *Paediatr Perinat Epidemiol* 2015;29:281-9.
37. Aishwarya S, Rajendiren S, Kattimani S, Dhiman P, Haritha S, Ananthanarayanan PH. Homocysteine and serotonin: Association with postpartum depression. *Asian J Psychiatr* 2013;6:473-7.
38. Sholehvar F, Takhshid MA, Rafiei M. Review of metabolism, transport and role of serotonin in the body and the relation between serotonin and diseases. *J Fasa Univ Med Sci* 2013;3:9-17.
39. Neumann ID, Landgraf R. Balance of brain oxytocin and vasopressin: Implications for anxiety, depression, and social behaviors. *Trends Neurosci* 2012;35:649-59.
40. Skrudz M, Bolten M, Nast I, Hellhammer DH, Meinlschmidt G. Plasma oxytocin concentration during pregnancy is associated with development of postpartum depression. *Neuropsychopharmacology* 2011;36:1886-93.
41. Yoshida M, Takayanagi Y, Inoue K, Kimura T, Young LJ, Onaka T, *et al.* Evidence that oxytocin exerts anxiolytic effects via oxytocin receptor expressed in serotonergic neurons in mice. *J Neurosci* 2009;29:2259-71.
42. Slattery DA, Neumann ID. Oxytocin and major depressive disorder: Experimental and clinical evidence for links to aetiology and possible treatment. *Pharmaceuticals (Basel)* 2010;3:702-24.
43. Shapiro GD, Fraser WD, Séguin JR. Emerging risk factors for postpartum depression: Serotonin transporter genotype and omega-3 fatty acid status. *Can J Psychiatry* 2012;57:704-12.
44. Osterlund MK, Witt MR, Gustafsson JA. Estrogen action in mood and neurodegenerative disorders: Estrogenic compounds with selective properties-the next generation of therapeutics. *Endocrine* 2005;28:235-42.
45. Douma SL, Husband C, O'Donnell ME, Barwin BN, Woodend AK. Estrogen-related mood disorders: Reproductive life cycle factors. *ANS Adv Nurs Sci* 2005;28:364-75.
46. Tsigos C, Chrousos GP. Hypothalamic-pituitary-adrenal axis, neuroendocrine factors and stress. *J Psychosom Res* 2002;53:865-71.
47. Kammerer M, Taylor A, Glover V. The HPA axis and perinatal depression: A hypothesis. *Arch Womens Ment Health* 2006;9:187-96.
48. Pedersen CA, Johnson JL, Silva S, Bunevicius R, Meltzer-Brody S, Hamer RM, *et al.* Antenatal thyroid correlates of postpartum depression. *Psychoneuroendocrinology* 2007;32:235-45.
49. Kuijpers JL, Vader HL, Drexhage HA, Wiersinga WM, van Son MJ, Pop VJ. Thyroid peroxidase antibodies during gestation are a marker for subsequent depression postpartum. *Eur J Endocrinol* 2001;145:579-84.
50. Qu M, Tang Q, Li X, Zhao R, Li J, Xu H, *et al.* Shen-Qi-Jie-Yu-Fang has antidepressant effects in a rodent model of postpartum depression by regulating the immune organs and subsets of T lymphocytes. *Neuropsychiatr Dis Treat* 2015;11:1523-40.
51. Miller AH. Depression and immunity: A role for T cells? *Brain Behav Immun* 2010;24:1-8.
52. Kendall-Tackett K. A new paradigm for depression in new mothers: The central role of inflammation and how breastfeeding and anti-inflammatory treatments protect maternal mental health. *Int Breastfeed J* 2007;2:6.
53. Krause D, Jobst A, Kirchberg F, Kieper S, Härtl K, Kästner R,

- et al.* Prenatal immunologic predictors of postpartum depressive symptoms: A prospective study for potential diagnostic markers. *Eur Arch Psychiatry Clin Neurosci* 2014;264:615-24.
54. Feng Z, Jones K, Wang WW. An exploratory discrete-time multilevel analysis of the effect of social support on the survival of elderly people in China. *Soc Sci Med* 2015;130:181-9.
 55. Escribà-Agüir V, Artazcoz L. Gender differences in postpartum depression: A longitudinal cohort study. *J Epidemiol Community Health* 2011;65:320-6.
 56. Landman-Peeters KM, Hartman CA, van der Pompe G, den Boer JA, Minderaa RB, Ormel J. Gender differences in the relation between social support, problems in parent-offspring communication, and depression and anxiety. *Soc Sci Med* 2005;60:2549-59.
 57. Galvão J. Brazil and access to HIV/AIDS drugs: A question of human rights and public health. *Am J Public Health* 2005;95:1110-6.
 58. Ludermir AB, Lewis G, Valongueiro SA, de Araújo TV, Araya R. Violence against women by their intimate partner during pregnancy and postnatal depression: A prospective cohort study. *Lancet* 2010;376:903-10.
 59. Jansen K, Curra AR, Souza LD, Pinheiro RT, Moraes IG, Cunha MS, *et al.* Tobacco smoking and depression during pregnancy. *Rev Psiquiatr Rio Gd Sul* 2010;32:44-7.
 60. Gurber S, Baumeler L, Grob A, Surbek D, Stadlmayr W. Antenatal depressive symptoms and subjective birth experience in association with postpartum depressive symptoms and acute stress reaction in mothers and fathers: A longitudinal path analysis. *Eur J Obstet Gynecol Reprod Biol.* 2017; 215:68-74.
 61. Miyake Y, Tanaka K, Sasaki S, Hirota Y. Employment, income, and education and risk of postpartum depression: The Osaka Maternal and Child Health Study. *J Affect Disord* 2011;130:133-7.
 62. Chien LY, Tai CJ, Yeh MC. Domestic decision-making power, social support, and postpartum depression symptoms among immigrant and native women in Taiwan. *Nurs Res* 2012;61:103-10.
 63. Chatzi L, Melaki V, Sarri K, Apostolaki I, Roumeliotaki T, Georgiou V, *et al.* Dietary patterns during pregnancy and the risk of postpartum depression: The mother-child 'Rhea' cohort in Crete, Greece. *Public Health Nutr* 2011;14:1663-70.
 64. Hvas AM, Juul S, Bech P, Nexø E. Vitamin B6 level is associated with symptoms of depression. *Psychother Psychosom* 2004;73:340-3.
 65. Hibbeln JR. Seafood consumption, the DHA content of mothers' milk and prevalence rates of postpartum depression: A cross-national, ecological analysis. *J Affect Disord* 2002;69:15-29.
 66. Gur EB, Gokduman A, Turan GA, Tatar S, Hepyilmaz I, Zengin EB, *et al.* Mid-pregnancy Vitamin D levels and postpartum depression. *Eur J Obstet Gynecol Reprod Biol* 2014;179:110-6.
 67. Ellsworth-Bowers ER, Corwin EJ. Nutrition and the psychoneuroimmunology of postpartum depression. *Nutr Res Rev* 2012;25:180-92.
 68. Levenson CW. Zinc: The new antidepressant? *Nutr Rev* 2006;64:39-42.
 69. Sher L. Role of thyroid hormones in the effects of selenium on mood, behavior, and cognitive function. *Med Hypotheses* 2001;57:480-3.
 70. Ross LE, Murray BJ, Steiner M. Sleep and perinatal mood disorders: A critical review. *J Psychiatry Neurosci* 2005;30:247-56.
 71. Chang JJ, Pien GW, Duntley SP, Macones GA. Sleep deprivation during pregnancy and maternal and fetal outcomes: Is there a relationship? *Sleep Med Rev* 2010;14:107-14.
 72. Dinas PC, Koutedakis Y, Flouris AD. Effects of exercise and physical activity on depression. *Ir J Med Sci* 2011;180:319-25.
 73. Nordhagen IH, Sundgot-Borgen J. Physical activity among pregnant women in relation to pregnancy-related complaints and symptoms of depression. *Tidsskr Nor Laegeforen* 2002;122:470-4.
 74. Daley AJ, Macarthur C, Winter H. The role of exercise in treating postpartum depression: A review of the literature. *J Midwifery Womens Health* 2007;52:56-62.