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Epidemiology of maternal depression, risk factors, and child outcomes in low-income and middle-income countries

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Abstract

Maternal depression, a non-psychotic depressive episode of mild to major severity, is one of the major contributors of pregnancy-related morbidity and mortality. Maternal depression (antepartum or post partum) has been linked to negative health-related behaviours and adverse outcomes, including psychological and developmental disturbances in infants, children, and adolescents. Despite its enormous burden, maternal depression in low-income and middle-income countries remains under-recognised and undertreated. In this Series paper, we systematically review studies that focus on the epidemiology of perinatal depression (ie, during antepartum and post-partum periods) among women residing in low-income and middle-income countries. We also summarise evidence for the association of perinatal depression with infant and childhood outcomes. This review is intended to summarise fi ndings from the existing literature, identify important knowledge gaps, and set the research agenda for creating new generalisable knowledge pertinent to increasing our understanding of the prevalence, determinants, and infant and childhood health outcomes associated with perinatal depression. This review is also intended to set the stage for subsequent work aimed at reinforcing and accelerating investments toward providing services to manage maternal depression in low-income and middle-income countries.

Keywords

antepartum depression; postpartum depression; LAMICS; maternal depression

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Authors' contribution

BG and MAW developed the outline of this review. BG performed the literature search and data analysis. All authors contributed to the writing and editing of the manuscript. All authors have read and approved the final manuscript.

Conflict of interest

The authors have no competing interests to declare.

Ethical committee approval

Not applicable.

Introduction

Perinatal depression is typically defined as a nonpsychotic depressive episode of mild to major severity that occurs during pregnancy or postnatally.[1-3] Historically much greater emphasis has been placed on perinatal depression during the postpartum period, and relatively less attention has been paid to depression in the antepartum period.[45] Pregnancy is a major life event that is inevitably accompanied by social, psychological and hormonal changes.[6] These changes can trigger depressive episodes with serious implications for both maternal and infant outcomes.[7-9] The prevalence of antepartum depression ranges from 7 to 15% in high-income countries[2,10] and 19 to 25% in low-and middle-income countries (LAMICs).[11] Notably, the prevalence of postpartum depression among women residing in high income countries is reported to be approximately 10%[12] and 20% for women in LAMICs.[3] The high prevalence of perinatal depression is influenced by a number of risk factors including increased somatic symptoms, [13] exposure to intimate partner violence, [14] lack of social support,[15] unintended pregnancy[16] and high rates of relapse of depression during the perinatal period.[17] Antepartum depression has been linked to negative health-related behaviors and adverse outcomes, including poor nutrition, increased substance use, inadequate prenatal care, preeclampsia, low birth weight, preterm delivery, postpartum depression, and suicide.[18-23] Women who experience antepartum depression often continue to experience depressive symptoms into the postpartum period, with more than 54% of those with postpartum depression reporting depressive episodes before or during pregnancy.[5,24] Despite its enormous burden, antepartum depression in LAMICs remains under-recognized and under-treated,[25] in part, because greater priority has been assigned to preventing deaths related to obstetric complications.[3] Untreated antepartum depression is of concern because of its association with postpartum depression, and poor infant physical and neurocognitive developmental outcomes.[4,26-30] A prior *Lancet* series on maternal mental health primarily focused on the effects of mood and anxiety disorders during the perinatal period, as well as other psychiatric disorders including bipolar disorder, psychoses, personality disorders, and eating disorders.[31] With the exception of one study, all other studies included in the series focused on women residing in high-income countries. Therefore, the primary purpose of this report is to systematically review studies that focused on (1) the prevalence and risk factors of perinatal depression; and (2) the association of perinatal depression with infant and childhood outcomes among women residing in LAMICs. This review is intended to identify important knowledge gaps and to set the research agenda for creating new generalizable knowledge pertinent to increasing our understanding of the prevalence, determinants and infant health outcomes associated with perinatal depression.

Materials and methods

Meta-analysis

Published research papers were retrieved and included in this meta-analysis according to guidelines for Meta-Analysis of Observational Studies in Epidemiology (MOOSE).[32] Given that the studies included in this review differed with regard to population samples and depression assessment tools, pooled estimates were calculated using the random effects model to take into account between study heterogeneity.[33] We refer to the random effects

estimate as the pooled prevalence estimate representing the weighted average of the prevalence estimates within the meta-analysis. The pooled prevalence estimate was consistent when the analysis was repeated using a fixed-effects model. A sensitivity analysis that allowed for omitting one study at a time and recalculating the pooled prevalence for the remainder of those studies in the meta-analysis showed that none of the studies substantially influenced the pooled estimates. Data analysis was performed using the metan procedure in STATA (version 14, STATA Corporation, College Station, TX, USA).

Results

Literature search for meta-analysis

Figure 1 shows the study selection process and results from the literature search for the meta-analyses. The systematic search yielded 581 total articles. We excluded reviews, duplicates, studies conducted in high income countries and studies that did not report prevalence of antepartum or postpartum depression. We included a total of 51 full-length English language papers that reported on the prevalence of antepartum depression and 53 studies on the prevalence of postpartum depression.

Literature search for perinatal depression with infant and childhood outcomes

Figure 2 shows the study selection process and results from the literature search for articles examining the association of perinatal depression with infant and childhood outcomes. An initial search returned a total of 1,838 titles. We excluded reviews, duplicates, studies conducted in high income countries and studies that did not examine the relationship of perinatal depression with infant and childhood outcomes. We included a total 25 studies that reported on association of perinatal depression (antepartum or postpartum) and childhood outcomes (five assessing antepartum and 20 assessing postpartum depression).

Prevalence of antepartum depression—A total of 51 studies were included in the meta-analysis which represented research conducted in 20 LAMICs with a total of 48,904 participants. Characteristics of populations considered in the selected studies are presented in Table 1. Of the 51 studies, 15 studies were from Brazil, six from Turkey, four from South Africa, three from China, three from Pakistan, and the rest (one or two studies) from other LAMICs (i.e., Bangladesh, Cote d'Ivoire, Ethiopia, Ghana, Jamaica, Jordan, Malawi, Malaysia, Mexico, Nepal, Papa New Guinea, Peru, Tanzania, Thailand, and Vietnam). Included studies were published between 1998 and 2015, with sample sizes that ranged from 29 in Brazil[34] to 20,920 participants in Ghana.[35] Antepartum depression was determined using Structured Clinical Interview for DSM-IV (SCID) in four studies, Edinburgh Postnatal Depression Scale (EPDS) in 22 studies, Patient Health Questionnaire-9 (PHQ-9) in four studies, Mini International Neuropsychiatric Interview (MINI) in four studies, Hamilton Depression Scale in four studies, Beck Depression Inventory (BDI) in three studies and other screening and diagnostic scales including Aga Khan University Anxiety and Depression Scale, Composite International Diagnostic Interview, Johns Hopkins Symptom Checklist, Primary Care Evaluation of Mental Disorders, Self-Rating Depression Scale, and Self-Reporting Questionnaire in other studies. As shown in Table 1, the pooled prevalence estimate of antepartum depression was 25.3% (95% CI 21.4-29.6%) across 51 studies.

Significant heterogeneity was observed between studies (P-value <0.001). Visual inspection of the funnel plot showed some evidence of the presence of significant publication bias, and this was confirmed by the Egger's test for publication bias (H_0: intercept = 5.89; P-value = 0.0092). A sensitivity analysis was completed after excluding the study with the largest sample size[35] from the summary analysis. In this sensitivity analysis, the pooled antepartum depression prevalence for the remaining studies was 25.8% (95% CI 22.8-29.0%).

Prevalence of postpartum depression—A total of 53 studies were included in the meta-analysis which represented research conducted in 23 LAMICs representing 38,142 participants. The characteristics of study populations are presented in Table 2. Of the 53 studies, seven studies were from Brazil, six from Turkey, four from India, four from Thailand, four from China, three from Mexico, three from Nigeria, three from Iran and the rest (one or two studies) from other LAMICs (Armenia, Ghana, Jordan, Lebanon, Malaysia, Mongolia, Morocco, Nepal, Pakistan, Peru, South Africa, Tunisia, Uganda, Vietnam and Zimbabwe). Included studies were published between 1998 and 2015, with sample sizes that ranged from 41 in Thailand[36] to 13,360 participants in Ghana.[37] Among the studies, postpartum depression was predominantly determined using the EPDS. The EPDS was used in 38 studies, PHQ-9 in three studies, MINI in two studies, BDI in two studies and other screening and diagnostic scales in other studies including Aga Khan University Anxiety and Depression Scale, Center for Epidemiological Studies Depression Scale, Clinical Interview Schedule, Health Related Self Report Scale, Maternity Blues Scale, Self-Reporting Questionnaire, and Structured Clinical Interview for DSM-IV Diagnoses. As shown in Table 2, the pooled prevalence estimate of postpartum depression was 19.0% (15.5-23.0%) across 53 studies. Significant heterogeneity was observed between studies (P-value <0.001). Visual inspection of the funnel plot showed no evidence of a significant publication bias, confirmed by the Egger's test for publication bias (H_0: intercept =1.09; P-value = 0.656). A sensitivity analysis was performed after excluding the study with the largest sample size[35] from the summary analysis. In this sensitivity analysis, the pooled postpartum depression prevalence for the remaining studies was 19.6% (16.8-22.6%). Furthermore, the prevalence of postpartum depression was re-calculated after removing a study conducted in teenage mothers.[38] In this analysis postpartum depression prevalence for the remaining studies was 19.7% (16.9-22.8%).

This meta-analysis underscores the high prevalence of antepartum and postpartum depression among women residing in LAMICs; namely about one in four women were identified as having antepartum depression and one in five women having postpartum depression. Several risk factors, including financial and socio-environmental distress, increase susceptibility to perinatal depression.[39] Some investigators have speculated that pregnancy related hormonal changes might increase vulnerability for the onset or return of depression.[40,41] For example, blunted memory and diminished anxiety during pregnancy have been associated with progesterone and glucocorticoids.[42,43] Taken together, these seminal observations combined with reviews by others[3,15] and the results of our current meta-analysis indicate that antepartum and postpartum depression are common morbidities among women residing in LAMICs.

Risk factors for maternal antepartum and postpartum depression—In this section, we provide a brief summary of studies that have assessed risk factors of perinatal depression in LAMICs.

Early life abuse

Child maltreatment, a severe early life stressor, includes all forms of physical, sexual and psychological maltreatment that pose harm to a child's health, development or dignity.[44] Child abuse tends to co-occur with one or more types of childhood maltreatment such as child neglect, and emotional abuse.[45,46] One of the most widely studied types of child maltreatment is childhood sexual abuse. To this end, during the period of 2007–2013, the Centers for Disease Control and Prevention (CDC) and United Nations Children's Emergency Fund (UNICEF), in partnership with host country governments, communities, and academic institutions developed and administered Violence Against Children Surveys (VACS) in seven LAMICs (Cambodia, Haiti, Kenya, Malawi, Swaziland, Tanzania, and Zimbabwe). The investigators found more than 25% of girls and more than 10% of boys reported experiencing childhood sexual violence.[47] On balance available evidence shows that child maltreatment, particularly sexual abuse, is highly prevalent among individuals in LAMICs with potential long-term impact on onset and course of perinatal depression.

The adverse health sequelae of child abuse has been primarily studied in populations residing in higher income countries and very few have been conducted among populations in LAMICs.[4849] Pregnant women with a history of childhood abuse have increased risks of psychiatric disorders[50, 51], sleep disturbances,[51] health risk behaviors[52] and adverse pregnancy outcomes.[53] However, few studies have examined associations of child abuse with perinatal depression in LAMICS. These few studies have shown that women who experienced child abuse have increased risk of antepartum depression. For example, Lara *et al.,* in their study of pregnant Mexican women, found that a history of sexual abuse in childhood was associated with a 2.49-fold increased odds of antepartum depression (OR=2.49; 95% CI: 1.86-4.61) even after adjusting for history of depression, poor partner relations, and low social support.[54] Further, Barrios *et al.* recently reported that a history of sexual and physical abuse in childhood was associated with a 2.47-fold increased odds of antepartum depression (OR=2.47, 95% CI: 1.79-3.40) among Peruvian women.[51] Biological mechanisms underlying reported associations of child abuse with perinatal depression are thought to be related to disruptions of neurobiological stress response systems including the sympathetic nervous system, the serotonin system, and the hypothalamic-pituitary-adrenal axis.[55-57] Moreover, brain neuroimaging studies have shown alterations in brain structure and function and deficits in gray and white matter volumes among victims of early life abuse.[58]

Adult abuse

Intimate partner violence (IPV), encompassing physical, psychological and sexual abuse, is a common type of abuse experienced by women worldwide. [59] In the World Health Organization multi-country study on domestic violence conducted in nine LAMICs and Japan,[6061] the prevalence of physical IPV was reported to range from 10% to 52%.[61] Physical IPV is often accompanied by psychological abuse, and between 33-50% the cases

have experienced sexual abuse also.[61,62] These figures were further confirmed in a recently aggregated global and regional prevalence estimates.[63] Women who experience IPV are more likely to have a history of abuse in childhood. [51] A substantial literature indicates that young girls who survive abuse in childhood are more likely to experience further re-victimization in adulthood.[51,64,65] Few studies have examined the relationship between adult abuse and depression in pregnancy. Lara *et al.* noted that pregnant women who experienced abuse were significantly more likely to develop antepartum depression.[66] A study from Peru found that pregnant women who were victims of IPV had a 4.1-fold (95% CI 2.79-5.97) and 5.8-fold (95% CI 3.33-10.08) risk for moderately severe and severe depression, respectively.[14] Similar findings were reported by other investigators. [67-69] The mechanisms that underlie the relationship between exposure to IPV and perinatal depression include social, emotional and physical isolation, separation, loss, and the unpredictability exerted by the abuser upon the abused woman.[70] In sum, available evidence indicates that IPV is highly prevalent in LAMICs and is an important risk factor for perinatal depression. It is clear that programs aimed at addressing the burden of untreated antepartum and postpartum depression need to take into account ubiquitous stressors, such as IPV.

Other risk factors

In addition to childhood abuse and abuse by intimate partner, maternal low educational attainment,[54,71] low socioeconomic status at the time of pregnancy,[54,71,72] lack of social support[73] and history of mental illness have been consistently identified as risk factors of antepartum and postpartum depression in the LAMICS.[74] For instance, Melo *et al.* found that low educational attainment was associated with 2.38-fold increased odds of antepartum depression (OR=2.38; 95% CI: 1.38-4.12) among Brazilian women.[75] Furthermore, Lara *et al.* found that low maternal educational attainment was associated with more than 5-fold increased odds of postpartum depression among Mexican women (OR=5.61; 95% CI: 1.87-16.80).[54] Finally, few studies have reported culture-specific factors contributing to perinatal depression. In some Asian cultures, a gender bias exists where there is preference for a male first-born child.[76] This gender-preference has been reported to be stressful experience for some women. Of note, mothers who give birth to a female child are often blamed for the birth with increased risk of depression compared to mother who give birth to a male child.[71]

Perinatal depression in relation to infant and childhood outcomes—In the next sections we discuss studies that assessed risks of adverse infant and child health outcomes associated with maternal antepartum and/or postpartum depression. A total of 21 studies from LAMICs have examined associations of perinatal depression with infant and childhood outcomes with details indicated in the following sections.

Infant weight, prematurity and child growth—Consistent with the fetal programming hypothesis (discussed in the accompanying review article of this Series by Herba *et al*[77]), some investigators[78,79-83] have shown that women with untreated prenatal depressive disorders are more likely to have medical complications of pregnancy and to deliver low birth weight infants and have a preterm delivery as compared with their counterparts without such depressive disorders.[78,79,84] Rahman *et al.*, for example, in their study of Pakistani

women, found that those with antepartum depression (assessed using Schedules for Clinical Assessment in Neuropsychiatry) were nearly twice as likely to deliver low birth weight infants (OR=1.90; 95% CI: 1.30-2.90) as compared with non-depressed women.[79] Similarly, Wado *et al.* in their study of Ethiopian women, found that antepartum depression (assessed using EPDS) was associated with 1.87-fold increased risk of low birth weight (OR=1.87; 95% CI: 1.09-3.21).[78] Sanchez *et al.* in their case-control study of Peruvian women, found that antepartum depression (determined using the PHQ-9 instrument) was statistically significantly associated with increased odds of preterm birth (OR=3.67; 95% CI 2.09-6.46).[84] Notably, a recent meta-analysis of 11 LAMICs (conducted during the postpartum period) showed that children of mothers with depression or depressive symptoms were 1.5-times as likely to be underweight (OR=1.5; 95% CI: 1.2-1.8) or stunted (OR=1.4; 95% CI: 1.2-1.7) compared to children of non-depressed mothers.[85]

Antepartum and postpartum depression have also been implicated in impaired postnatal infant growth. For instance, Nasreen *et al.,* in their prospective cohort study of Bangladeshi women, found that depression (assessed using EPDS during the third trimester, 2-3, and 6-8 months postpartum) was associated with infant stunting.[80] Additionally, Uguz *et al.*, in their study of 90 Turkish women assessed at postpartum period found that newborns of women with major depression (determined using Structured Clinical interview for the Diagnostic and Statistical Manual of Mental Disorders (SCID)) had significantly lower gestational age at delivery (1.44 weeks, P-value=0.015) and lower birth weight (343 g, P-value=0.021) compared with infants of mothers without major depressive disorder.[81] In another study, Ndokera *et al.* reported that infants delivered of depressed Zambian mothers were 0.58 kg (95% CI: 0.09-1.08) lighter and 1.95 cm (95% CI: 0.49-3.50) shorter than infants of non-depressed mothers.[82] A recent study by Bakare *et al.* of infants (mean age=3.56±3.21 months) attending immunization clinics in Nigeria found that the mean weight and length of infants of depressed mothers were significantly lower than infants of non-depressed mothers.[83] However, Tomlinson *et al.* in South Africa found no evidence of association between postpartum depression (assessed using SCID) at 2 months with infant growth at 2 and 18 months of age although maternal nutritional status was not taken into account [86]. In summary, available evidence supports the notion that impaired intrauterine growth is associated with antepartum depression. Additionally, infants delivered of depressed mothers also appear to have deficits in postnatal growth as compared with infant delivered of mothers without depression.

Observations of depression during the postpartum period and impaired postnatal growth associations have been attributed to differences in breastfeeding practices and insecure infant-mother attachments among depressed and non-depressed mothers. Investigators have reported that depressed mothers are more likely to stop breastfeeding earlier than non-depressed mothers[87,88]. Tomlinson *et al.* in South Africa found that postpartum depression (at 2 months) was associated with insecure infant attachments assessed at age 18 months.[89] Notably, infants of depressed mothers are known to have more frequent episodes of diarrhea and other childhood illnesses as compared with infants of non-depressed mothers.[87,88] For instance, in Pakistan[90] children born to depressed mothers were 3-times as likely (OR=3.1; 95% CI: 1.8-5.6) to have 5 or more episodes of diarrhea per year as compared with children born to non-depressed mothers. Similarly, in a Nigerian study focused on infant growth

during the first 9 months of life, Adewuya *et al.*[87] reported a significant increase in the average number of episodes of diarrhea and other infectious illnesses in infants of depressed mothers as compared with infants of non-depressed mothers (mean (standard deviation: SD) 5.23 [2.37] vs. 3.70 [4.14]). Recently, in a birth cohort study of 654 mother/child dyads in Ghana and Cote d'Ivoire, Guo *et al.* found that children of depressed mothers were 32% more likely to experience febrile illness as compared with children of non-depressed mothers.[91] On balance, available epidemiologic evidence documents increased risks of diarrheal and febrile illnesses and impaired growth among children of mothers with antepartum and/or postpartum depression.

Child obesity—Another childhood outcome that merits consideration is childhood obesity. Childhood obesity is a growing concern and serious public health challenge in many LAMICs. [92]The literature examining the effects of maternal depression on childhood obesity largely comes from high-income countries and remains inconsistent.[93] Some,[94,95] though not all,[96] investigators have found statistically significant associations between maternal depressive symptoms and child obesity.[94] Inconsistencies across studies have been attributed to differences in population characteristics such as race/ethnicity, child sex, and family socioeconomic status.[94] Research, particularly those involving women and children from LAMICS, is needed to clarify the relationship of impaired and excess infant somatic growth in relation to maternal mood disorders.

Child neurodevelopmental and behavioral outcomes—Although there is a well-established body of evidence from high-income countries,[31] few investigators have assessed child neurodevelopmental outcomes in relation to perinatal depression in LAMICs settings. Furthermore, findings of these few studies have been inconsistent. Below, we provide a brief summary of selected available studies.

In their study of mother-infant dyads in Barbados, Galler *et al.*, found that maternal depressive symptoms predicted lower infant social and performance scores at 3 months. The authors also observed that depression at 6 months postpartum was statistically significantly associated with lower scores in motor development at the same age (P-value<0.05).[97] Similar findings were reported from studies conducted in India, Bangladesh, South Africa, Brazil and Pakistan. Briefly, Patel *et al.* reported that perinatal depression was significantly associated with reduced mental development quotient scores of infants in India.[88] Further, in their study among 221 mother-infant dyads enrolled in a Bangladesh micronutrient supplementation trial, Black *et al.* found that maternal postpartum depressive symptoms were inversely associated with infant developmental scores.[98] The authors noted that infants whose mothers reported depressive symptoms were more likely to have low scores on the Bayley Scales of Infant Development and more likely to have fewer cognitive, motor, and orientation/engagement skills at 6-12 months of age as compared with infants whose mother reported no depressive symptoms.[98] In South Africa, postpartum depression was statistically significantly associated with child behavior problems at age 2 years.[99] Further, Quevedro *et al.* in their study from Pelotas, Brazil, found that postpartum depression was associated with delayed language development in infants at 12 months of age.[100] Another study from Pelotas, Brazil found that postpartum depression at 2 months was associated with sleep

disturbances of infants at 12 months of age. [101] Using a community based cross-sectional survey conducted at 3-24 months, Hadley *et al* in Ethiopia found that children with mothers who had higher symptoms of depression and anxiety (assessed using Hopkins Symptoms checklist) were statistically significantly more likely to score low in all measures of development even after adjusting for nutritional stunting. [102] Maternal postpartum depression was noted to be associated with 6-fold increased odds of being delayed for emotional development (OR=5.9; 95% CI: 3.0-11.9), language development (OR=5.4; 95% CI: 2.3-12.4) and delayed gross motor development (OR=2.8; 95% CI: 1.2-6.6) in Pakistan.[103] We are aware of one recent study which failed to document an association between maternal prenatal psychological distress and infant temperament.[104] In summary, available studies indicate that perinatal depression, particularly postpartum depression, has significant clinical and developmental consequences for children. Causal inferences from available studies are hindered by small sample sizes, and incomplete control of confounding factors. Consequently, there is a clear need for rigorously designed longitudinal studies to improve our understanding of the relation between perinatal depression and child neurodevelopmental and behavioral outcomes, particularly among populations residing in LAMICs. There are several plausible biological mechanisms on how antepartum and postpartum depression may affect child development. These are fully discussed in the accompanying review article of this Series by Herba and colleagues. [77]

Conclusions

The results of our meta-analyses show that antepartum and postpartum depression in LAMICs are highly prevalent affecting about one in four and one in five women, respectively. This is consistent with recent systematic reviews that reported common mental disorders including depression during the perinatal period are more prevalent[3,15] compared with non-pregnancy periods.[3] Recently the US Preventive Services Task Force (USPSTF) published a clinically influential report recommending screening US pregnant and postpartum women for depression particularly in the presence of additional treatment supports (e.g., treatment protocols, care management, and availability of specially trained depression care clinicians).[105] No such evidence-based guideline exists for LAMICs. A broader guideline by the World Health Organization suggests integrating mental health services into primary care as the most viable way of closing treatment gap for mental health in the LAMICS.[106,107] One of the main challenges for such integration in the LAMICS has been the low recognition rates of mental disorders by primary care health workers, in part, due to shortage of clinicians with specialized training in assessing and managing the treatment of patients with mental health disorders. Developing protocols for early identification, treatment and preventing the damaging effects of perinatal depression in LAMICs settings are needed. Another remaining challenge is lack of cross-culturally valid perinatal depression screening and diagnostic instruments particularly during the antepartum period. There is a clear need for researchers to develop, refine and rigorously evaluate the predictive validity and reliability of perinatal depression assessment tools in the LAMICS. Such research will allow for identifying perinatal depression, and also measure the efficacy of traditional and novel treatment strategies in reproductive health systems. Integrated antenatal care programs aimed at identifying and treating women with antepartum and

postpartum depression are needed because for many women in LAMICS, antenatal care is typically the first and only time of interaction with the health care system. As such, antenatal care visits provide critically important opportunities for mental health interventions to occur. Moreover, the recent United Nations General Assembly Sustainable Development Goals (SDG) Agenda, for the first time, has included promotion of mental health and well-being..[108] Accordingly, mental health policy is likely to become part of country development plans and of bilateral and multilateral development assistance. The mental health of mothers during pregnancy and after childbirth ought to be included in this agenda.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Search strategy and selection criteria

We searched PubMed, Embase, CINAHL, and BIOSIS Online without language restrictions using the following medical subject heading (MeSH) terms and search terms : “antenatal”, “ante-natal”, “ante-partum”, “depressive disorder”[MeSH], “depression” [MeSH], “major depressive disorder“[MeSH], “pregnancy”, “prenatal”, ”antepartum”, “perinatal”, “postnatal”, “peripartum”, “postpartum”, “post-natal”, “post-partum”, with no date restrictions. The MeSH terms used to restrict to low-income and middle-income countries can be found in the appendix. To be included, studies had to: define depression as occurring sometime in pregnancy or during post-partum period using screening or diagnostic assessment; report prevalence of perinatal depression; be full-length papers (conference abstracts, case studies, grey literature, and editorials were excluded); be studies from low-income and middle-income countries as defined by the World Bank country income groups; and be in English or with sufficiently detailed English abstracts to allow comparison of methods and main findings with other studies. Figure 1 summarises the selection of studies reporting on the prevalence of perinatal depression.

We used all the aforementioned search terms and MeSH terms and key terms combined with all MeSH terms for child outcomes to look for studies of the associations of perinatal depression with infant and childhood outcomes. These terms included “child development” [MeSH], “pregnancy complications” [MeSH], “infant behaviour” [MeSH], and “mother child relations” [MeSH]. To be included, studies had to meet the above criteria and also report quantitative associations between perinatal depression and infant/ childhood outcomes. Figure 2 summarises the selection of studies reporting the association between perinatal depression and infant or childhood outcomes. We focus on infant and child outcomes measured up through the age of 5 years. The final search was done on March 31, 2016.

Key messages

- Studies in low-income and middle-income countries are needed to determine the prevalence and risk factors of perinatal depression
- Rigorously designed longitudinal studies are needed to investigate the association of perinatal depression with infant birthweight and growth, including childhood obesity, and to improve understanding of the relation between perinatal depression and child neurodevelopmental and behavioural outcomes, particularly in low-income and middle-income countries
- Integrated care programmes aimed at identifying and treating women with perinatal depression in low-income and middle-income countries are urgently needed

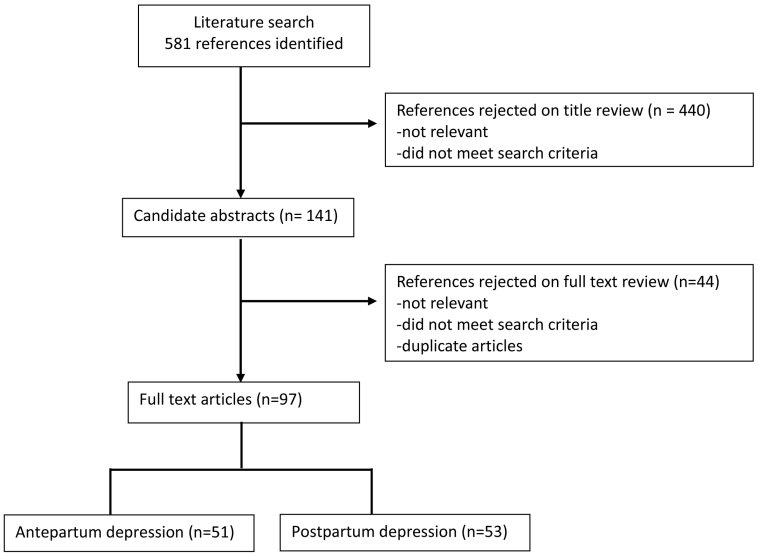

Figure 1.

Flow chart of systematic literature review of articles in perinatal depression prevalence in low-income and middle-income countries. The search was done on April 5, 2016. *Seven studies assessed both antepartum and post-partum depression.

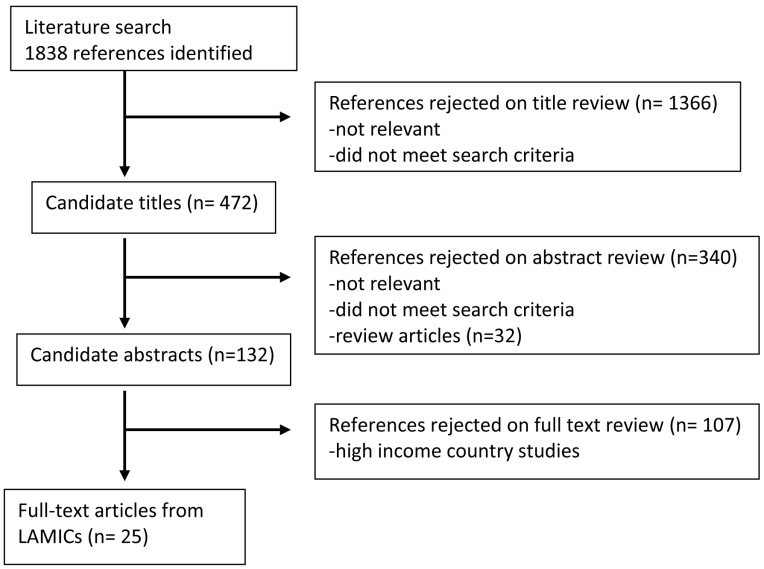

Figure 2.

Flow chart of systematic literature review of articles assessing associations of perinatal depression with infant and childhood outcomes in low-income and middle-income countries

Table 1

Prevalence of antepartum depression from low and middle income countries

Author, Year	Country	Depression Assessment	Prevalence% (95%CI)	Weight
Da-Silva, 1998	Brazil	EPDS	37.9 (22.4-56.4)	0.10
Chandran, 2002	Thailand	CIS-R	16.2 (12.7-20.4)	0.69
Lovisi, 2005	Brazil	CIDI	19.1 (14.5-24.7)	0.50
Azidah, 2006	Malaysia	EPDS	30.2 (26-34.8)	1.26
Gulseren, 2006	Turkey	EPDS	21.6 (15.2-29.7)	0.30
Limlomwongse 2006	Thailand	EPDS	20.5 (17.5-23.9)	1.41
Faisal-Cury, 2007	Brazil	BDI	19.6 (16.1-23.6)	0.97
Shakya 2008	Nepal	HAM-d	50.0 (35.6-64.4)	0.16
Karacam 2009	Turkey	BDI	27.9 (25.3-30.7)	2.97
Luna Matos, 2009	Peru	EPDS	40.1 (33.9-46.7)	0.76
Mitsuhiro, 2009	Brazil	CIDI	12.9 (11.0-15.1)	1.59
Qiao, 2009	China	HADS	4.8 (3.3-7.0)	0.34
Pottinger, 2009	Jamaica	EPDS	25.0 (21.2-29.2)	1.20
Soares, 2009	Brazil	PRIME-MD	27.8 (24.6-31.2)	2.03
Golbasi, 2010	Turkey	EPDS	27.5 (22.4-33.3)	0.73
Kaaya, 2010	Tanzania	HSCL	39.5 (36.1-43.0)	2.67
Kakirau-Hagali, 2010	Papa New Guinea	HSRQ	20.0 (11.1-33.3)	0.11
Manzolli, 2010	Brazil	PRIME-MD	27.8 (24.6-31.2)	2.03
Husain, 2011	Pakistan	EPDS	25.8 (23.5-28.2)	3.69
Mohammad, 2011	Jordan	EPDS	19.0 (15.2-23.4)	0.77
Narseen 2011	Bangladesh	EPDS	18.0 (15.4-21.0)	1.51
Rochat, 2011	South Africa	SCID	47.7 (38.5-57.0)	0.39
Senturk, 2011	Turkey	EPDS	33.1 (29.8-36.6)	2.29
Ali, 2012	Pakistan	HADS	16.8 (11.8-23.3)	0.33
da Silva, 2012	Brazil	HADS	23.6 (21.4-26.0)	3.41
Li, 2012	China	EPDS	39.0 (35.1-43.1)	1.94
Manikkam, 2012	South Africa	EPDS	38.5 (33.8-43.4)	1.30
Melo, 2012	Brazil	EPDS	24.3 (21.0-27.9)	1.57
Pinheiro, 2012	Brazil	MINI	17.8 (15.3-20.6)	1.72
Silva, 2012	Brazil	EPDS	20.5 (18.1-23.1)	2.36
Dibaba, 2013	Ethiopia	EPDS	19.9 (17.0-23.2)	1.42
Fadzil, 2013	Malaysia	MINI	8.6 (5.3-13.8)	0.20
Farias, 2013	Brazil	MINI	15.1 (11.1-20.2)	0.43
Fisher, 2013a	Vietnam	EPDS	41.4 (37.1-45.8)	1.70
Fisher, 2013b	Vietnam	EPDS	28.2 (24.1-32.7)	1.20
Mahenge, 2013	Pakistan	HSCL	55.9 (53.1-58.7)	4.13

Author, Year	Country	Depression Assessment	Prevalence% (95%CI)	Weight
Yanikkerem, 2013	Turkey	BDI	10.9 (8.7-13.5)	0.90
Abujilban, 2014	Jordan	EPDS	57.0 (50.3-63.4)	0.76
Akçal Aslan, 2014	Turkey	SCID	16.8 (13.7-20.5)	0.92
Guo, 2014a	Ghana	PHQ-9	26.5 (21.7-31.9)	0.79
Guo, 2014b	Cote d'Ivoire	PHQ-9	27.8 (23.5-32.6)	1.05
Stewart, 2014	Malawi	SCID	10.7 (8.4-13.5)	0.79
Tomlinson, 2014	South Africa	EPDS	37.0 (34.2-39.8)	3.79
Tsai, 2014a	South Africa	EPDS	42.0 (39.2-44.9)	3.95
Tsai, 2014b	South Africa	EPDS	46.0 (40.9-51.2)	1.27
Vaz, 2014	Brazil	MINI	17.0 (12.7-22.4)	0.47
Barrios, 2015	Peru	PHQ-9	29.4 (27.2-31.8)	4.43
Biratu, 2015	Ethiopia	EPDS	24.9 (20.8-29.3)	1.04
Couto, 2015	Brazil	EPDS	17.3 (13.1-22.6)	0.50
Ferreira, 2015	Brazil	CES-D	73.5 (67.1-79.1)	0.57
Fonseca-Machado, 2015	Brazil	EPDS	28.2 (23.8-33.1)	1.03
Lara, 2015	Mexico	SCID	9.0 (5.8-13.7)	0.24
Weobong, 2015	Ghana	PHQ-9	9.9 (9.5-10.3)	26.48
Zeng, 2015	China	SDS	28.5 (23.6-33.9)	0.84
Overall			25.3 (21.4-29.6)	100.00

Abbreviations: CIDI-Composite International Diagnostic Interview; CIS-R-Clinical Interview Schedule; EPDS- Edinburgh Postnatal Depression Scale; BDI-Beck depression inventory; HAM-d-Hamilton – Depression Scale; HADS-Hospital Anxiety and Depression Scale; HSCL-John Hopkins Symptoms Checklist; MINI- Mini-International Neuropsychiatric Interview; PHQ-9-Patient Health Questionnaire -9; PRIME-MD-Primary Care Evaluation of Mental Disorders; SCID- Structured Clinical Interview for DSM-IV Diagnoses; SDS-Self Rating Depression Scale; SRQ-Self Reporting Questionnaire.

Fisher 2013a and Fisher 2013b are from the same publication; Tsai, 2014a and Tsai, 2014b are from the same publication; Guo, 2014a and Guo, 2014b are from the same publication.

Table 2

Prevalence of postpartum depression from low and middle income countries

Author, Year	Country	Depression Assessment	Prevalence % (95%CI)	Weight
Pyasil, 1998a	Thailand	DSM-Screener	23.1 (16.0-32.2)	0.44
Pyasil, 1998b	Thailand	DSM-Screener	11.9 (6.8-19.9)	0.24
Cooper, 1999	South Africa	SCID	34.7 (27.5-42.7)	0.79
Chaaya, 2002	Lebanon	EPDS	21.0 (17.3-25.3)	1.56
Chandran, 2002	India	CIS—R	19.8 (16.0-24.2)	1.35
Ekuklu, 2004	Turkey	EPDS	40.4 (33.4-47.8)	1.02
Faisal-Cury, 2004	Brazil	BDI	15.9 (11.2-22.1)	0.55
Fisher, 2004	Viet Nam	EPDS	32.9 (29.0-37.1)	2.70
Adewuya, 2005	Nigeria	MBS	31.3 (27.4-35.5)	2.56
Agoub, 2005	Morocco	MINI	18.7 (13.1-25.9)	0.52
Aydin, 2005	Turkey	EPDS	34.6 (31.2-38.1)	3.91
Adewuya, 2006	Nigeria	EPDS	20.9 (17.5-24.8)	1.87
Azidah, 2006	Malaysia	EPDS	22.8 (19.0-27.1)	1.76
Ho-Yen, 2006	Nepal	EPDS	4.9 (3.2-7.4)	0.47
Husain, 2006	Pakistan	EPDS	36.0 (28.7-44.0)	0.81
Limlomwongse, 2006	Thailand	EPDS	16.8 (14.0-20.0)	2.03
Pitanupong, 2007	Thailand	EPDS	11.0 (8.4-14.2)	1.05
Xie, 2007	China	EPDS	17.3 (13.8-21.5)	1.26
Ebeigbe, 2008	Nigeria	EPDS	27.2 (21.7-33.5)	1.01
Kara, 2008	Turkey	BDI	17.0 (12.0-23.6)	0.55
Tannous, 2008	Brazil	EPDS	20.7 (16.3-25.9)	1.06
Ali, 2009	Pakistan	AKUADS	28.8 (24.7-33.3)	2.04
Gomez-Beloz, 2009	Peru	PHQ-9	41.3 (39.3-43.3)	13.33
Pollock, 2009	Mongolia	SRQ	9.1 (7.5-11.0)	2.05
Wan, 2009	China	EPDS	15.5 (12.3-19.4)	1.23
Chibanda, 2010	Zimbabwe	EPDS	33.0 (27.0-39.6)	1.10
Kirpinar, 2010	Turkey	EPDS	17.7 (14.5-21.4)	1.66
Dubey, 2011	India	EPDS	6.0 (4.2-8.4)	0.68
Lobato, 2011	Brazil	EPDS	24.3 (21.5-27.4)	3.54
Mohammad, 2011	Jordan	EPDS	19.0 (15.2-23.4)	1.29
Ozbasaran, 2011	Turkey	EPDS	28.3 (23.4-33.7)	1.41
Petrosyan, 2011	Armenia	EPDS	14.4 (11.0-18.6)	0.98
Pinheiro, 2011	Brazil	EPDS	22.7 (18.6-26.8)	1.65
Piyasil, 2011	Thailand	HRSR	22.0 (11.9-37.1)	0.17
da Rocha, 2012	Brazil	EPDS	26.4 (18.9-35.6)	0.49
Kakyo, 2012	Uganda	EPDS	43.0 (36.3-49.9)	1.17

Author, Year	Country	Depression Assessment	Prevalence % (95%CI)	Weight
Pio de Almeida, 2012	Brazil	EPDS	16.2 (11.9-21.6)	0.72
Silva, 2012	Brazil	EPDS	16.5 (14.4-18.8)	3.62
Tavares, 2012	Brazil	MINI	8.5 (6.9-10.5)	1.70
Zhang, 2012	China	EPDS	31.2 (25.4-37.7)	1.09
Dewing, 2013	South Africa	EPDS	31.7 (26.2-37.7)	1.28
Goshtasebi, 2013	Iran	EPDS	5.5 (3.4-8.9)	0.35
Abdollahi, 2014	Iran	EPDS	9.9 (8.7-11.3)	4.13
Masmoudi, 2014	Tunisia	EPDS	19.2 (15.1-24.0)	1.11
Sadat, 2014	Iran	EPDS	20.7 (16.5-25.7)	1.17
Wu, 2014	China	EPDS	9.4 (6.2-14)	0.45
Bodhare, 2015	India	PHQ-9	4.7 (2.7-7.9)	0.29
de Castro, 2015	Mexico	EPDS	10.6 (8.4-13.3)	1.36
Giri, 2015	Nepal	EPDS	30.0 (25.4-35.0)	1.72
Lara, 2015	Mexico	SCID	13.8 (9.9-18.8)	0.66
Mohamad, 2015	Malaysia	EPDS	14.3 (12.9-15.9)	6.02
Patel, 2015	India	EPDS	48.5 (40.2-56.9)	0.79
Turkcapar, 2015	Turkey	EPDS	15.4 (12.6-18.7)	1.67
Weobong, 2015	Ghana	PHQ-9	3.8 (3.5-4.1)	11.59
Overall			19.0 (15.5-23.0)	100.00

Abbreviations: AKUADS –Aga Khan University Anxiety and Depression Scale; BDI-Beck Depression Inventory; CES-D—Center for Epidemiological Studies Depression Scale; CIS-R-Clinical Interview Schedule; DSM-Screener—6 item Depression Screener Based on DSM IV; EPDS- Edinburgh Postnatal Depression Scale; HRSR—Health Related Self Report Scale; MBS—Maternity Blues Scale; MINI- Mini-International Neuropsychiatric Interview; PHQ-9-Patient Health Questionnaire -9; SCID- Structured Clinical Interview for DSM-IV Diagnoses; SRQ-Self Reporting Questionnaire

Pyasil, 1998a and Pyasil, 1998b are from the same publication.