RESEARCH ARTICLE

Antenatal depression and its association with adverse birth outcomes in low and middle-income countries: A systematic review and meta-analysis

Abel Fekadu Dadi[1,2]*, **Emma R. Miller**[2], **Lillian Mwanri**[2]

1 Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia,
2 College of Medicine and Public Health, Flinders University, Health Sciences Building, Adelaide, South Australia

* Fekten@yahoo.com

Abstract

Background

Depression in pregnancy (antenatal depression) in many low and middle-income countries is not well documented and has not been given priority for intervention due to competing urgencies and the belief that it does not immediately cause fatalities, which mainly emanated from lack of comprehensive research on the area. To fill this research gap, this systematic review was conducted to investigate the burden of antenatal depression and its consequences on birth outcomes in low- and middle-income countries.

Methods

We systematically searched the databases: CINHAL, MEDLINE, EMCare, PubMed, PSyc Info, Psychiatry online, and Scopus for studies conducted in low and middle-income countries about antenatal depression and its association with adverse birth outcomes. We have included observational studies (case control, cross-sectional and cohort studies), written in English-language, scored in the range of "good quality" on the Newcastle Ottawa Scale (NOS), and were published between January 1, 2007 and December 31, 2017. Studies were excluded if a standardized approach was not used to measure main outcomes, they were conducted on restricted (high risk) populations, or had fair to poor quality score on NOS. We used Higgins and Egger's to test for heterogeneity and publication bias. Primary estimates were pooled using a random effect meta-analysis. The study protocol was registered in PROSPERO with protocol number CRD42017082624.

Result

We included 64 studies (with 44, 035 women) on antenatal depression and nine studies (with 5,540 women) on adverse birth outcomes. Antenatal depression was higher in the lower-income countries (Pooled Prevalence (PP) = 34.0%; 95%CI: 33.1%-34.9%) compared to the middle-income countries (PP = 22.7%, 95%CI: 20.1%-25.2%) and increased

over the three trimesters. Pregnant women with a history of economic difficulties, poor marital relationships, common mental disorders, poor social support, bad obstetric history, and exposure to violence were more likely to report antenatal depression. The risk of having preterm birth (2.41; 1.47–3.56) and low birth weight (1.66; 1.06–2.61) was higher in depressed mothers compared to mothers without depression.

Conclusions

Antenatal depression was higher in low-income countries than in middle-income countries and was found to be a risk factor for low birth weight and preterm births. The economic, maternal, and psychosocial risk factors were responsible for the occurrence of antenatal depression. While there could be competing priority agenda to juggle for health policymakers in low-income countries, interventions for antenatal depression should be reprioritized as vitally important in order to prevent the poor maternal and perinatal outcomes identified in this review.

Introduction

Depression is a common mental health disorder worldwide, which can manifest as a depressed mood, feeling of guilt, loss of interest, low self-esteem, difficulty in getting adequate sleep, and lack of concentration in everyday life [1]. Globally, more than 300 million peoples of all age suffer from depression [1] with much higher prevalence in the African (9%) and South-east Asian (27%) regions [2, 3]. By 2030, depression is predicted to be the second and third leading cause of disease burden in developing and low-income countries, respectively [4]. Depression prevalence is higher in pregnant populations relative to general female populations, often due to hormonal changes during pregnancy [5]. A systematic review of studies conducted in developed and low-income countries reported an antenatal depression prevalence in the range of 5% to 30% [6–8] and 15.6% to 31.1%) [9–11], respectively. These estimates varied according to ethnicity, history of miscarriage, medically assisted pregnancy, ambivalent attitude about the current pregnancy, and socioeconomic condition of the women [6–8].

Maternal depression could affect household income, productivity, child development [12], and quality of life [13]. Pregnant women with depression can produce a high level of stress hormones such as cortisol that can subsequently affect fetal growth [14] and brain development [15, 16]. Depression during pregnancy has been reported as a risk factor for low birth weight [17] and preterm births [18–22] and may also affect the child stress coping ability in later life [23]. In contrast, some other studies have reported a lack of association between antenatal depression and adverse birth outcomes [24–28].

Depression manifests in different ways during pregnancy and the postnatal period [29], which could challenge its identification and treatment. One study reported a triadic pattern of depression during pregnancy including an increase during the first few weeks of pregnancy, a decrease mid-way during the pregnancy and another increase again after the final weeks of pregnancy [30]. A number of systematic reviews have been conducted on maternal mental health and its effect on birth outcomes. However, these were not specific to depression [9, 31, 32], did not focus on low and middle-income countries (where the problem is thought to be high) [7], and did not evaluate if there is any relationship between antenatal depression and risk of adverse birth outcomes [33]. Therefore, the current systematic review and meta-analysis

was conducted to explore the burden of antenatal depression, its risk factors and its association with adverse birth outcomes in low and middle-income countries.

Methods

Search strategy

CINHAL, MEDLINE, EMCare, PubMed, Psych INFO and, Psychiatry online, and Scopus data bases were systematically searched for the following key terms: Pregnan*, antenat*, depression, clinical depression, depressed mood, major depressive disorder, depressive symptom, adverse birth outcomes, stillbirth, preterm birth, and low birth weight. Example of full electronic search strategy in PubMed.

> Search ((((((Pregnant mothers*) OR (antenatal mothers*) OR (pregnant women*) OR (antenatal period*) OR pregnancy* OR (antepartum women*)) AND ((depression* OR (clinical depression*) OR (depressed mood*) OR(major depressive disorder*) OR (depressive symptom*) OR (psychological morbidity*) OR (major depression*) OR (unipolar depression*)) AND((exposure* OR (risk factor*) OR correlates* OR (associated factors*) OR predictors*) AND (((cross sectional*) OR (crosssectional*) OR survey* OR(case control*) OR (nested case control*)) Sort by: Publication Date Filters: Publication date from 2007/01/01 to 2017/12/31; Humans; English; MEDLINE; Field: Title/Abstract

Eligibility criteria

We included observational studies (case-control, cross-sectional, and follow up studies) that were conducted in low and middle-income countries, written in the English language and published between January 1, 2007 and December 31, 2017. The following were the other criteria for studies to be selected for the review: depression was measured using validated screening tools; low birth weight was measured and classified as birth weight less than 2500grams; preterm birth was studied and defined as birth occurring before 37 complete weeks of gestation. Studies were excluded if a standardized approach was not used to measure main outcomes, conducted on restricted (high risk) populations such as studies conducted in refugee camps, conducted following certain disasters, conducted on mothers living with HIV/TB, restricted studies such as those exclusively conducted on first time mothers, women with high complication during pregnancy, grey literatures or had fair to poor quality score on NOS. The study inclusion, exclusion and reason for exclusion is presented in Fig 1 and page 11 of the S1 File.

Study quality assessment

Identified studies were exported to Endnote version 7 and duplicates were removed. Two independent reviewers (AFD & BAD) conducted a full-text quality review. Disagreement between the two reviewers was found to be very low (1.5%) and they resolved this through discussion. The Newcastle-Ottawa Scale (NOS) [34, 35] for observational studies was used to assess the quality and risk of bias in included studies. The NOS includes 3 categorical criteria with a maximum score of 10 points: "selection" which accounts a maximum of 5 points, "comparability" which accounts a maximum of 2 points, and "outcome" which accounts a maximum of 3 points. The quality of each study was rated using the following scoring algorithm: ≥7 points was considered as "good" quality study, 2 to 6 points was considered as "fair" quality study, and ≤ 1 point was considered as "poor" quality study. Only studies of good quality
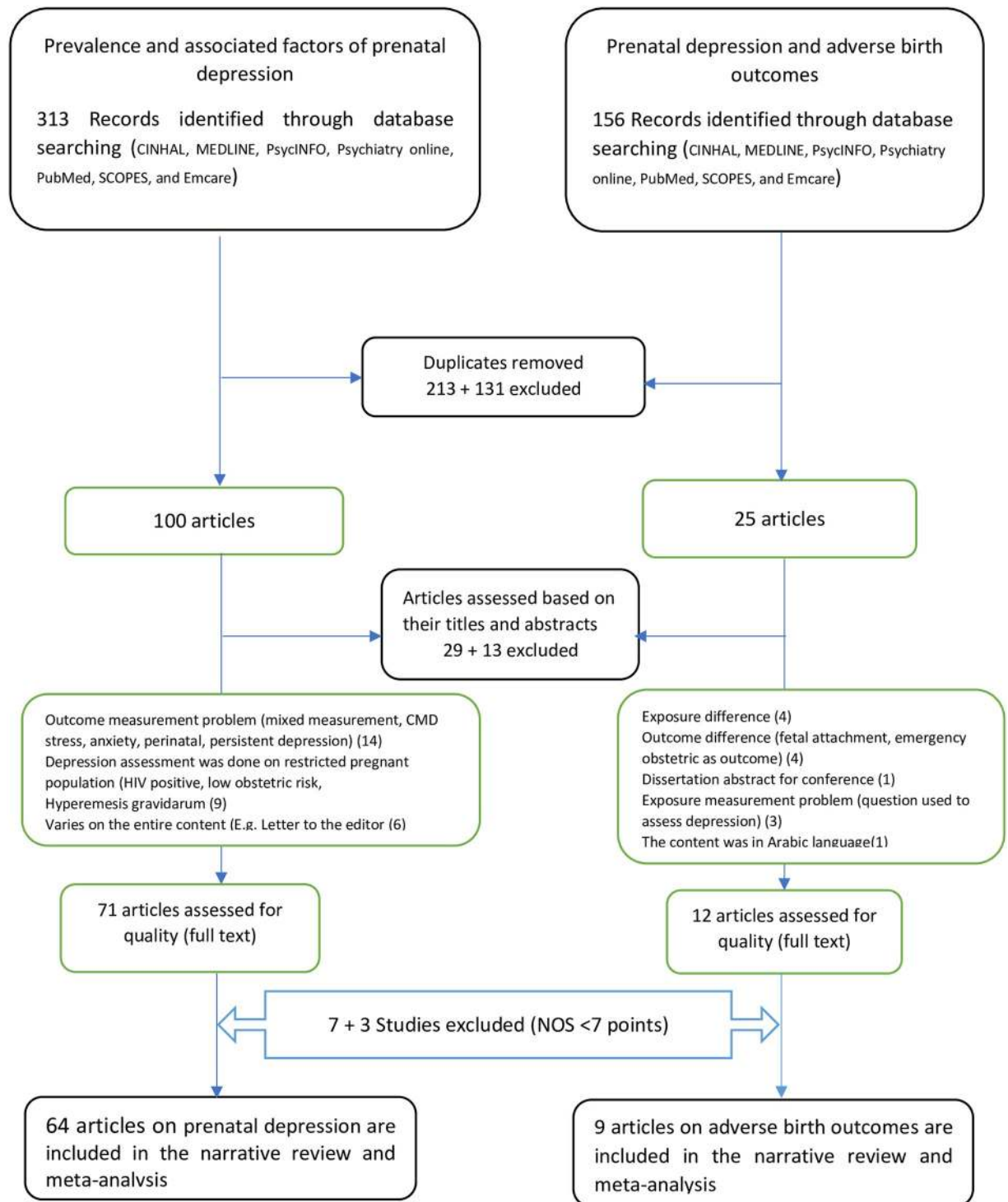
Fig 1. Flow chart of study inclusion for systematic review and meta-analysis of antenatal depression and its effect on birth outcomes.

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(NOS score ≥7 points) were included in this systematic review and meta-analysis. The scoring of each quality assessment component for each study was presented in a table. (See in S1 File) This systematic review and meta-analysis was based on the Meta-analysis Of Observational Studies in Epidemiology (MOOSE)[36] statement.

Data extraction

The following data from studies with good quality [NOS score ≥7 points] was extracted using a structured data extraction form and summarized in table format: Name of authors, year of publication, name of country in which the study was conducted, country income category, study design, sample size, type of screening tool used to identify depression and its cut of value, and the estimates (prevalences of antenatal depression with their confidence intervals and odds ratios with their confidence intervals for risk factors). (Tables 1 and 4)

Data synthesis

The data synthesis was separately conducted for antenatal depression and birth outcomes. Meta-analysis of proportions for antenatal depression, odds ratios for factors associated with antenatal depression, and relative risks for reporting adverse birth outcomes were calculated after log-transforming the estimates from primary studies. If multiple outcomes were reported in a single study, each outcome was analysed independently.

Risk of bias and adjustment

Funnel plot and Egger's regression test were conducted to check for the presence of potential publication bias [37, 38]. In the presence of publication bias, an estimate from Trim and Fill analysis was reported [39]. Galbraith plot [40] and Higgins test [41] were used to explore the presence of heterogeneity. Sub-analyses was conducted according to the identified sources of heterogeneity and the effect size from the random effect models was calculated [42]. Sensitivity analyses was also been conducted. All analysis was conducted in Stata 14 [43].

Protocol registration

This review was registered in PROSPERO with a protocol number CRD42017082624. Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42017082624.

Results

Our search strategy identified 313 records for antenatal depression and 156 records for the effect of antenatal depression on birth outcomes. After duplicates were removed and preliminary screening of the titles and abstracts, 83 articles fulfilled a criterion for full-text review and quality assessment. Finally, 73 articles were assessed as good quality and included in the systematic review and meta-analysis. From these articles, 64 were conducted on antenatal depression and 9 articles were conducted to investigate the effect of antenatal depression on birth outcomes. (Fig 1)

Antenatal depression prevalence and its associated factors

Among 64 articles conducted on antenatal depression, 49 (77%) were conducted in middle-income countries, 15 (23%) studies were conducted in low-income countries, and 46 (72%) were health institutional based studies. Half of the studies (32) investigated antenatal depression at all stages of pregnancy while 20 (31%) of the studies investigated antenatal depression during the last trimester of pregnancy. A relatively large number of studies, 20 (31%), were published in the year 2015–2016 and the majority of the studies, 34 (53%), used Edinburgh Postnatal Depression Scale (EPDS) for screening antenatal depression. (Table 1)

Because of a high heterogeneity index (I^2 = 96.7%, P<0.001) among included antenatal depression studies, we were unable to pool all the estimates but we conducted a sub-analysis based on the following characteristics: year of publication, country income category, study

Table 1. Summary of studies conducted on antenatal depression in low and middle-income countries, (N = 64, in the year 2007–2017).

	Author, P. year	Country by income	Study setting	Study design	Sample size	Trimester screened	Tool used for screening	Prevalence
1.	Adewuya, A. O. et al 2007[44]	Middle	HI	cross sectional	180	3	DSM-IV	8.3%
2.	Esimai, O. et al 2008[45]	Middle	HI	cross sectional	195	1,2,3	HADS	10.8%
3.	Gausia k et al, 2009[46]	Middle	Community	cross sectional	361	3	EPDS	33%
4.	Luna Matos M.L et al, 2009[47]	Middle	HI	cross sectional	222	1,2,3	EPDS	40.1%
5.	Mitsuhiro SS et al 2009[48]	Middle	HI	cross sectional	1000	1,2,3	CESD-10	12.9%
6.	Pereira PK et al 2009[49]	Middle	HI	cross sectional	331	3	CESD-10	14.2%
7.	Pottinger AM et al 2009[50]	Middle	HI	Longitudinal	452	1,2,3	EPDS	25%
8.	Golbasi Z et al 2009[51]	Middle	Community	cross sectional	258	1,2,3	EPDS	27.5%
9.	Silva RA et al 2010[52]	Middle	HI	cross sectional	1264	1,2,3	EPDS	21.1%
10.	Kaaya SF et al 2010[53]	Low	HI	cross sectional	560	2	HSC	39.5%
11.	Mohammad KI et al, 2011[54]	Low	HI	cross sectional	353	1,2,3	EPDS-R	67.2%
12.	Nasreen HE et al, 2011[55]	Low	Community	cross sectional	720	3	EPDS	18.3%
13.	Li J et al, 2011[13]	Middle	HI	cross sectional	454	1,2,3	EPDS	39.0%
14.	Lau Y et al 2011[56]	Middle	HI	cross sectional	1609	2	EPDS	35.9%
15.	Senturk V et al 2011[57]	Middle	HI	cross sectional	971	3	EPDS	33.1%
16.	Faisal-Cury A et al 2012[58]	Middle	HI	cross sectional	312	2	BDI	21.1%
17.	Melo Jr et al 2012[59]	Middle	HI	cross sectional	600	3	EPDS	24.3%
18.	Hartley M et al, 2011[60]	Middle	Community	cross sectional	1062	1,2,3	EPDS	39.0%
19.	Rochat TG et al, 2011[61]	Middle	HI	cross sectional	109	2	DSM-IV	47%
20.	Ajinkya s et al, 2012[62]	Middle	HI	cross sectional	185	1,2,3	BDI	9.2%
21.	Fisher J et al, 2012[63]	Middle	Community	Longitudinal	419	1	EPDS	22.4%
22.	Fisher J et al, 2012[63]	Middle	Community	Longitudinal	419	3	EPDS	10.7%
23.	Fisher J et al, 2012[63]	Middle	Community	Longitudinal	419	1,2,3	EPDS	17.4%
24.	Silva R et al, 2012[64]	Middle	Community	cross sectional	1264	1,2,3	EPDS	20.5%
25.	Lara MA et al, 2012[65]	Middle	Community	cross sectional	250	1,2,3	CESD-10	16.2%
26.	Manikkam L et al, 2012[66]	Middle	HI	cross sectional	387	3	EPDS	38.5%
27.	Fadzil A et al, 2013[67]	Middle	HI	cross sectional	175	1,2,3	HADS	10.3%
28.	Jeong H et al, 2013[68]	Middle	Community	cross sectional	1262	1,2,3	EPDS	20.2%
29.	Bindt C et al 2013[69]	Middle	HI	Longitudinal	719	3	PHQ	28.9%
30.	Dibaba Y et al 2013[70]	Low	Community	cross sectional	627	3	EPDS	19.9%
31.	Gemta A et al 2013[71]	Low	HI	cross sectional	660	1,2,3	EPDS	25.6%
32.	Guo N et al 2013[72]	Middle, cot devoir	HI	Longitudinal	654	3	PHQ	26.3%
33.	Guo N et al 2013	Middle, Ghana	HI	Longitudinal	654	3	PHQ	28.3%
34.	Dmitrovic BK et al, 2014[73]	Middle	HI	cross sectional	212	3	EPDS	21.7%
35.	Abujilban SA et al 2014[74]	Low	HI	cross sectional	218	3	EPDS	57%
36.	Actas S et al 2014[75]	Middle	HI	cross sectional	266	1,2,3	BDI	18.8%
37.	Stewart RS et al, 2014[76]	Low	HI	cross sectional	583	2	SRQ	21.1%
38.	Weobong B et al 2014[77]	Middle	Community	Longitudinal	2086	1	SRQ	9.9%
39.	Waqas A et al 2015[78]	Middle	HI	cross sectional	289	3	HADS	31.8%
40.	Barrios Y et al 2015[79]	Middle	HI	Longitudinal	1521	1	PHQ	29.1%
41.	de Oliveira F et al 2015[80]	Middle	HI	cross sectional	358	3	EPDS	28.2%
42.	Abdelhai R et al 2015[81]	Middle	HI	cross sectional	376	1,2,3	HADS	10.4%
43.	Mahenge B et al 2015[82]	Low	HI	cross sectional	1180	1,2,3	HSC	78.2%
44.	Rwakarema M et al; 2015[83]	Low	HI	cross sectional	397	1,2,3	EPDS	33.8%
45.	Heyningen T et al 2015[84]	Middle	HI	cross sectional	376	1,2,3	CIS-R	22.0%
46.	Biratu A et al 2015[85]	Low	HI	cross sectional	393	1,2,3	EPDS	24.9%
47.	Bavle A et al 2016[86]	Middle	HI	cross sectional	318	1,2,3	EPDS	12.3%

(Continued)

Table 1. (Continued)

	Author, P. year	Country by income	Study setting	Study design	Sample size	Trimester screened	Tool used for screening	Prevalence
48.	George C et al 2016[87]	Middle	Community	cross sectional	202	1,2,3	CIS-R	16.3%
49.	Moshki et al 2016[88]	Middle	HI	cross sectional	208	3	EPDS	37.0%
50.	Padmapriya N et al 2016[89]	Middle	Community	Longitudinal	1144	1	EPDS	7.3%
51.	Alvarado-EC et al 2016[90]	Middle	HI	cross sectional	270	1,2,3	EPDS	37.4%
52.	de Jesus Silva M et al 2016[91]	Middle	HI	cross sectional	209	1,2,3	HADS	14.8%
53.	de Moraes EV et al 2016[92]	Middle	HI	cross sectional	375	1,2,3	HADS	40.8%
54.	Malqvist M et al 2016[93]	Middle	Community	cross sectional	1038	3	EPDS	22.7%
55.	Thompson O et al 2016[94]	Middle	HI	cross sectional	314	1,2,3	EPDS	24.5%
56.	Ayele TA et al 2016[95]	Low	HI	cross sectional	388	1,2,3	BDI	23.0%
57.	Bisetegn TA et al 2016[96]	Low	Community	cross sectional	527	1,2,3	EPDS	11.8%
58.	Bitew T et al 2016[97]	Low	Community	cross sectional	1311	2	PHQ	29.5%
59.	Gelaye B et al 2017[98]	Middle	HI	cross sectional	1298	2	PHQ	10.3%
60.	Huanging H et al 2017[99]	Middle	HI	cross sectional	4210	1,2,3	HADS	12.5%
61.	Shidhaye P et al 2017[100]	Middle	HI	cross sectional	302	1,2,3	EPDS	16.9%
62.	Coll CVDN et al 2017[101]	Middle	Community	Longitudinal	4130	2	EPDS	16.0%
63.	Mossie Tb et al 2017[102]	Low	HI	cross sectional	196	1,2,3	BDI	31.1%
64.	Sahile MA et al 2017[103]	Low	HI	cross sectional	233	3	BDI	31.2%

HSC: Hopkins Symptom Checklist **CIS-R**: Clinical Interview Schedule–Revise **HI**: Health Institution **BDI**: Beck Depression Inventory

EPDS: Edinburgh Postnatal Depression scale **HADS**: Hospital Anxiety and Depression Scale **CIS-R**: Clinical Interview Schedule Revised

SRQ: Self Reporting Questionnaire **CESD-10**: Center for Epidemiological Studies Depression Scale **DSM-V**: Diagnostic and Stastical Manual of

Mental Disorder **PHQ**: Patient Health Questionnaire

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setting, sample size, tools used for screening, and time of pregnancy at which the screening has been conducted. As the Egger's test for publication bias was significant (P<0.001), Tweedie's and Duval's trim and fill analysis was used to report the final effect size under the random effect model. The pooled odds ratio was not affected when individual studies were omitted during the sensitivity analysis. (See in S1 File)

High prevalence of antenatal depression was estimated in the year 2011–2012, (pooled prevalence (PP), 95%CI: 28.6%; 22.3%-34.8%), followed by the year 2015–2016, (PP = 26.8%, 95% CI: 17.8%-35.8%). The antenatal depression was higher in low-income countries (PP = 34.1%, 95%CI: 22.7%-45.6%) and in health institution-based studies (PP = 27.6%, 95%CI: 23%-32.3%) as compared to high-income countries and community-based studies, respectively. Antenatal depression increased over the three trimesters; 17.1% (95%CI: 7.7%-26.5%) in the first trimester, 27.1% (95%CI: 19.7%-34.6%) in the second trimester, and 28.9% (95%CI: 23.7%-34.1%) in the third trimester. The antenatal depression prevalence was estimated to be higher among the studies with sample less than 600 participants (PP = 25.7%; 95%CI: 22.1%-29.5%) and those that used the Hopkins Symptom Checklist for screening depression (PP = 58.9%, 95%CI; 21%-96.8%). (Table 2)

We have also summarized and pooled the effect size for reported risk factors under relatively homogeneous groups. Accordingly, bad obstetric history (Pooled Odds Ratio (POR) = 2.01; 95%CI: 1.67, 2.42) in 16 studies and economic difficulties in 14 studies (POR = 2.03; 95% CI: 1.63, 2.53) were significantly associated with increased risk of antenatal depression. Similarly, having poor social support (POR = 1.77; 95%CI: 1.49, 2.10) and history of common mental disorders (POR = 3.27; 95%CI: 2.47, 4.33) were increased the risk of antenatal depression in 13 studies. Moreover, having a history of violence in 11 studies (POR = 2.99; 95%CI: 2.20,

Table 2. Sub-analysis of antenatal depression prevalence in the low- and middle-income countries (N = 64, 2007–2017), (random effect model).

Variables of sub-analysis	Number of studies (%)	Sample size	Pooled prevalence; 95%CI
Year of publication			
2007–2008	2(3.13)	375	9.46 (6.5–12.5)
2009–2010	8(12.50)	4,448	26.4(19.5–33.4)
2011–2012	16(25.00)	9,533	28.6(22.3–34.8)
2013–2014	12(18.75)	8,116	23.8(18.3–29.3)
2015–2016	20(31.25)	11,194	26.8(17.8–35.8)
2017	6(9.38)	10,369	18.2(14.6–21.8)
Income of the country			
Low income	15(23.44)	8346	34.1(22.7–45.6)
Middle income	49(76.56)	35,689	22.7(20.1–25.2)
Study setting			
Health institution	46(71.88)	26536	27.6(22.9–32.3)
Community based	18(28.13)	17499	19.8(16.1–23.5)
Time of screening			
First trimester	4(6.25)	5170	17.1 (7.7–26.5)
Second trimester	8(12.50)	9912	27.1(19.7–34.6)
Third trimester	20(31.25)	9532	28.9(23.7–34.1)
All trimester	32(50.00)	19421	23.9(18.2–29.5)
Median sample size			
< = 600	42(65.62)	13290	25.7(22.0–29.5)
>600	22(34.38)	30745	24.8(18.9–30.6)
Tool used for screening depression			
EPDS	34(53.13)	23,612	27.2(23.5–30.8)
CIS-R	2(3.13)	578	19.3(13.8–24.9)
PHQ-9	6(9.38)	6157	25.4(17.3–33.4)
SRQ-20	2(3.13)	2669	15.4(4.4–26.4)
Hopkins symptom checklist	2(3.13)	1740	58.9(20.9–96.8)
BDI	6(9.38)	1580	22.2(15.7–28.6)
HADS	7(10.94)	5829	18.6(11.8–25.4)
DSM-IV	2(3.13)	289	27.4(10.5–65.3)
CESD-10	3(4.69)	1581	13.6(11.9–15.3)

BDI: Beck Depression Inventory **EPDS**: Edinburgh Postnatal Depression scale **HADS**: Hospital Anxiety and Depression Scale **CIS-R**: Clinical Interview Schedule Revised **SRQ**: Self Reporting Questionnaire **CESD-10**: Center for Epidemiological Studies Depression Scale **DSM-V**: Diagnostic and Statistical Manual of Mental Disorder

4.07), unsatisfied with relationship in 9 studies (POR = 2.18; 95%CI: 1.64, 2.90), and male gender preference in four studies (POR = 1.41; 95%CI: 2.97; 6.26) were the other factors associated with an increased risk of antenatal depression. (Table 3)

Association of antenatal depression with adverse birth outcomes

From nine studies conducted to investigate the association of antenatal depression with adverse birth outcomes, six were from middle-income countries and community-based studies while half of them used the EPDS as a screening tool to measure depression. Almost all, 8 (90%) of the studies were prospective studies with a total sample of 5,540. The low birth weight was reported in seven studies but was found to be significantly associated with antenatal

Table 3. Risk factors associated with antenatal depression, a meta-analysis of studies in the low- and middle-income countries (N = 64, 2007–2017), (estimate from random effect model after trim and fill analysis).

Variable of sub-analysis	Number of studies	Sample size	POR, 95%CI	I², p-value
Poor obstetric history (*history of adverse birth outcome, unwanted pregnancy, obstetric complications*)	16	13450	2.01(1.67,2.42)	81.7%, p = 0.137
Economic difficulties	14	11207	2.03(1.63,2.53)	74.3%, p = 0.001
Poor social support	13	7372	1.77(1.49,2.10)	85.7%, p = 0.001
History of CMD(*depression, anxiety, stressful life events*)	13	11799	3.27(2.47,4.33)	89.9%, p = 0.001
History of all forms of violence	11	7428	2.99(2.20, 4.07)	71.7%, p = 0.001
Unsatisfied marital condition (*Unmarried, divorced, separated, shorter marital duration, polygamous*)	9	7533	2.18(1.64,2.90)	73.0%, p = 0.001
Male gender preference (the family preferred male than girl)	4	1135	2.97(1.41,6.26)	88.2%, p = 0.001

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depression in five of the studies. Similarly, two of four studies reported a significant association between antenatal depression and risk of preterm birth. (Table 4)
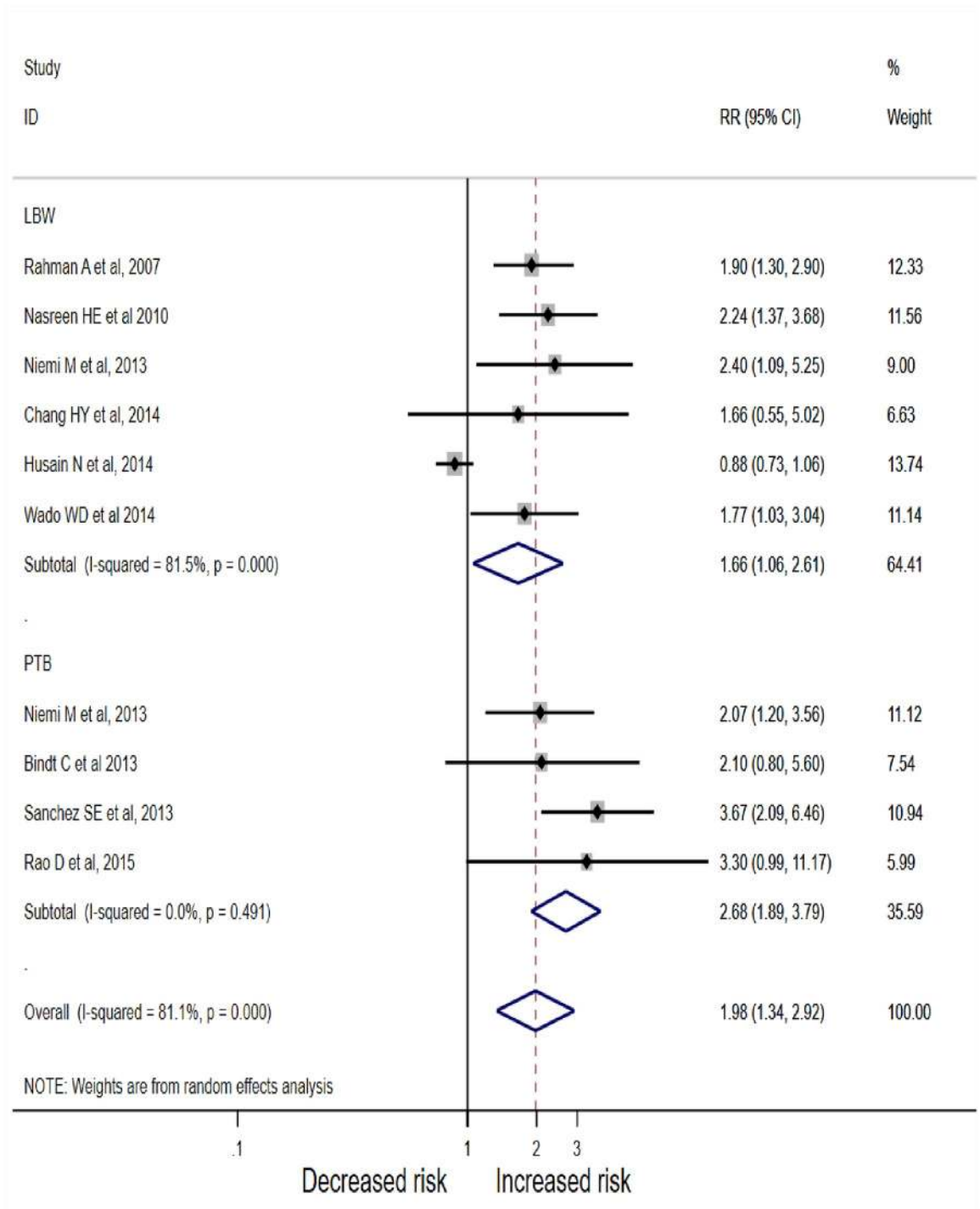
The risk of adverse birth outcomes (low birth weight or preterm birth) was 1. 59 times (95% CI: 1.34–2.92) higher among pregnant mothers who had signs of depression as relative to those did not. (Fig 2). Compared to LBW, the risk of PB was significantly higher among pregnant mothers with signs of depression (Pooled Relative Risk (PRR) = 2.41; 95%CI: 1.47–3.56). As the test for heterogeneity (I^2; 81.1%, p = 0.0) and small study effect were significant (P<0.001), the final effect size was reported from Tweedie's and Duval's trim and fill analysis in the random effect model. (Figs 3 and 4) We did not find any influential study in our sensitivity analysis. (Fig 5)

Table 4. Summary of studies conducted on the association of antenatal depression with adverse birth outcomes in the low and middle-income countries, (N = 9, in the year 2007–2017).

Author, Year	Country, income	Study setting	Study design	Sample size	Follow up start time	Tool used for screening	LBW (<2500gm) Estimate (RR/OR)	PB(<37weeks), Estimate (OR)
Rahman A et al, 2007[104]	Pakistan, Low	Community	Prospective cohort	290	3rd	ICD-10	1.9;1.3–2.9)	
Nasreen HE et al 2010[105]	Bangladesh, Middle	Community	Prospective cohort	720	2nd and 3rd	EPDS> = 10	2.24, 1.37–3.68	
Niemi M et al, 2013[106]	Vietnam, Middle	Community	Prospective cohort	334	3rd	EPDS > = 3	2.40;1.09–5.25	2.07, 1.2–3.56
Sanchez SE et al, 2013[107]	Peru, Middle	HI	Case control	959	3rd	PHQ-9> = 10		3.67, 2.09–6.46
Chang HY et al, 2014[26]	Korea, Low	HI	Prospective cohort	691	3rd	CESD-10> = 10	1.66; 0.55–5.02	
Husain N et al, 2014[27]	Pakistan, Low	Community	Prospective cohort	763	3rd	EPDS > = 12	0.88; 0.73–1.06	
Rao D et al, 2015 [108]	India, Middle	HI	Prospective cohort	150	2nd & 3rd	PHQ-9> = 5		3.3, 0.99–11.17
Bindt C et al 2013[69]	Ghana, Middle	HI	Longitudinal, birth cohort	719	3rd	PHQ-9 > = 10	β = 52.2; 18.2–122.6	2.1, 0.8–5.6
Wado WD et al 2014[109]	Ethiopia, Low	Community	Longitudinal, birth cohort	537	2nd & 3rd	EPDS> = 13	1.77; 1.03–3.04	

LBW: Low Birth weight **HI**: Health Institutions **ICD-10**: International classification of Disease 10th **EPDS**: Edinburgh Postnatal Depression Scale **SRQ**: Self Reporting Questionnaire **CESD-10**: Center for Epidemiological Studies Depression Scale **DSM-V**: Diagnostic and Stastical Manual of Mental Disorder **PHQ**: Patient Health Questionnaire

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Fig 2. Association between antenatal depression and adverse birth outcomes (N = 9, 2007–2017).

RR: relative risk, PTB: Preterm birth, LBW: Low birth weight
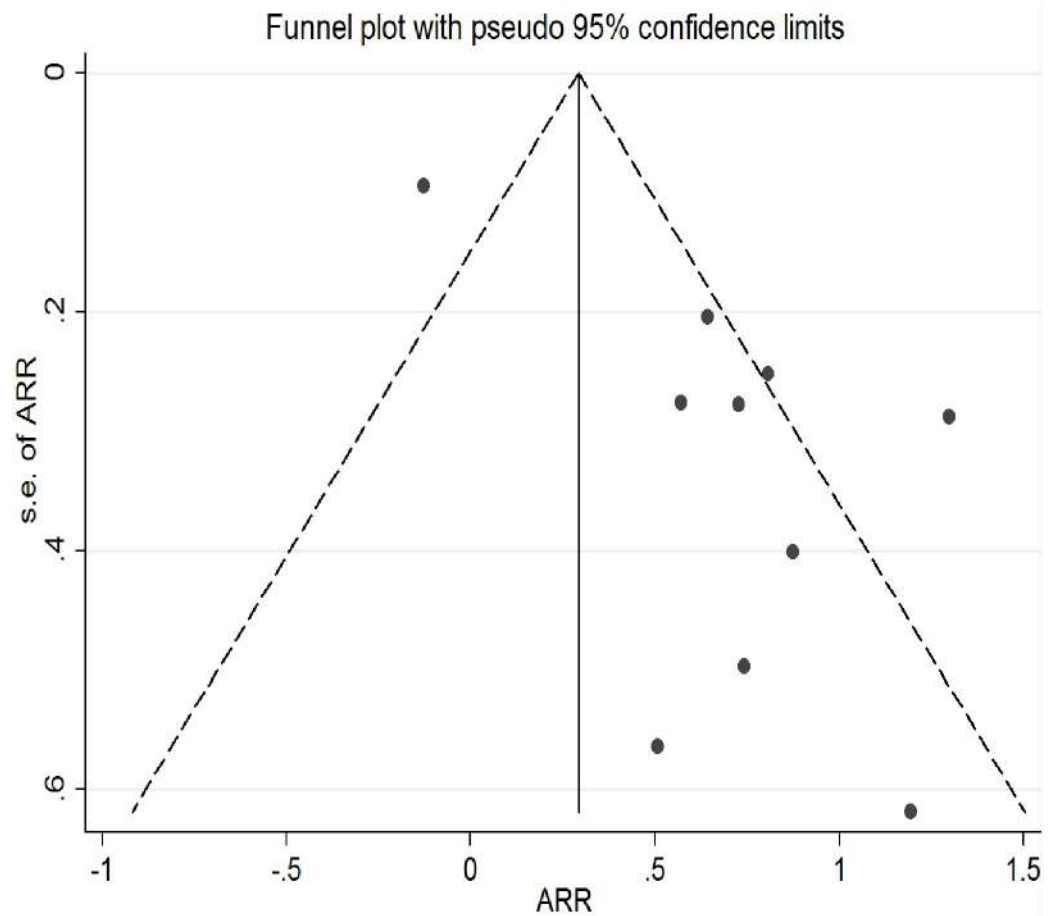
Fig 3. Funnel plot before Tweedie's and Duval's trim and fill analysis.

https://doi.org/10.1371/journal.pone.0227323.g003

In the sub-analyses, relative to high income countries, the risk of adverse birth outcomes was significantly higher among mothers from middle-income countries (PRR = 2.51; 95%CI: 1.92–3.28), in health institution-based studies (PRR = 2.92; 95%CI: 1.92–4.43), and when depression commenced in the second trimester (PRR = 2.47; 95%CI: 1.76–3.46). The association between antenatal depression and adverse birth outcomes did not differ between studies in which pregnant mothers were clinically diagnosed with depression and were identified based on a self-reported scale of depression symptom. (Table 5)

Discussion

This review has provided strong evidence for the burden of antenatal depression and its association with adverse birth outcomes in low and middle-income countries. To our knowledge, this review represents the first attempt to quantify this information and provides valuable impetus for the development of interventions aimed at addressing issue which has so far been neglected in the countries with greatest antenatal depression prevalence.

We found the prevalence of antenatal depression in the low-income countries was higher than that of middle-income countries and has increased from 9.5% in 2007 to 18.2% in 2017. The increase in prevalence over time might be attributed to the increase in number of studies on the topic as a result of the problem got more attention by researchers or the prevalence has
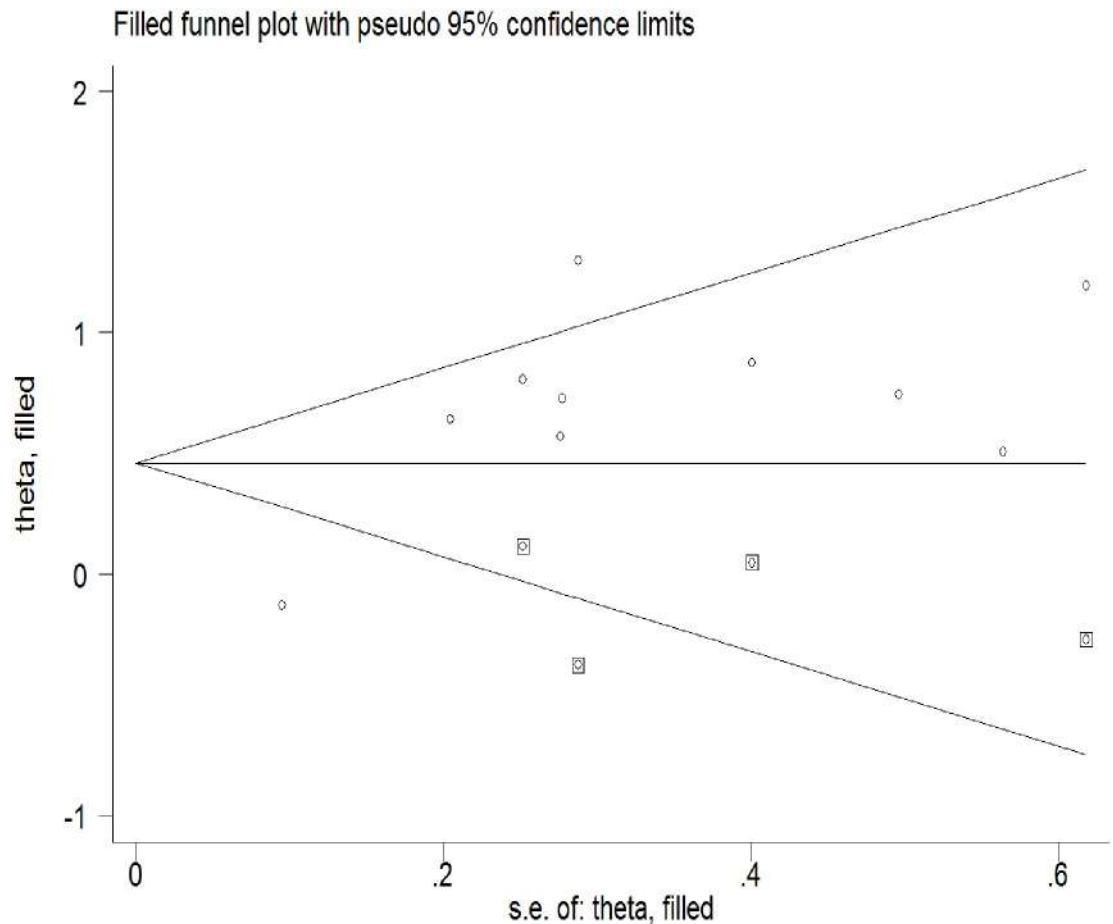
Fig 4. Funnel plot after Tweedie's and Duval's trim and fill analysis (Filled by four studies).

been increasing overtime because of low attention has been given for the problem by different countries. This could be also exemplified in the sub-analysis table in the result section of this article. The increase does, however, support the prediction that depression will become the third leading cause of disease burden in the low-income countries by 2030 [110, 111]. Consistent with previous reviews [10, 112], we found significantly higher antenatal depression prevalence in low-income countries relative to middle-income countries. This might be because depression has not previously been prioritized as an area for intervention relative to other problems during pregnancy [112]. It is also likely that risk factors associated with mental health disorders are more common in low-income countries [10].

We found that antenatal depression prevalence increases from the first to the third trimester of pregnancy, which contrast with the quadratic pattern (increase during the first trimester, drop in the second, and increase during the third trimester) noted elsewhere [30]. This might associate with the number of included studies during different trimesters, the pooled prevalence was high where large number of studies included and low where small studies were included as adjustment was not made on the number of studies. Consistent with our findings, one study reported an increased pattern of depression from the first to the second trimester due to increases in a range of risk factors during the three trimesters of pregnancy [113]. Further study could assist in prevention planning in identifying the appropriate timing and frequency of screening and intervention. Further investigation could also help to identify risk
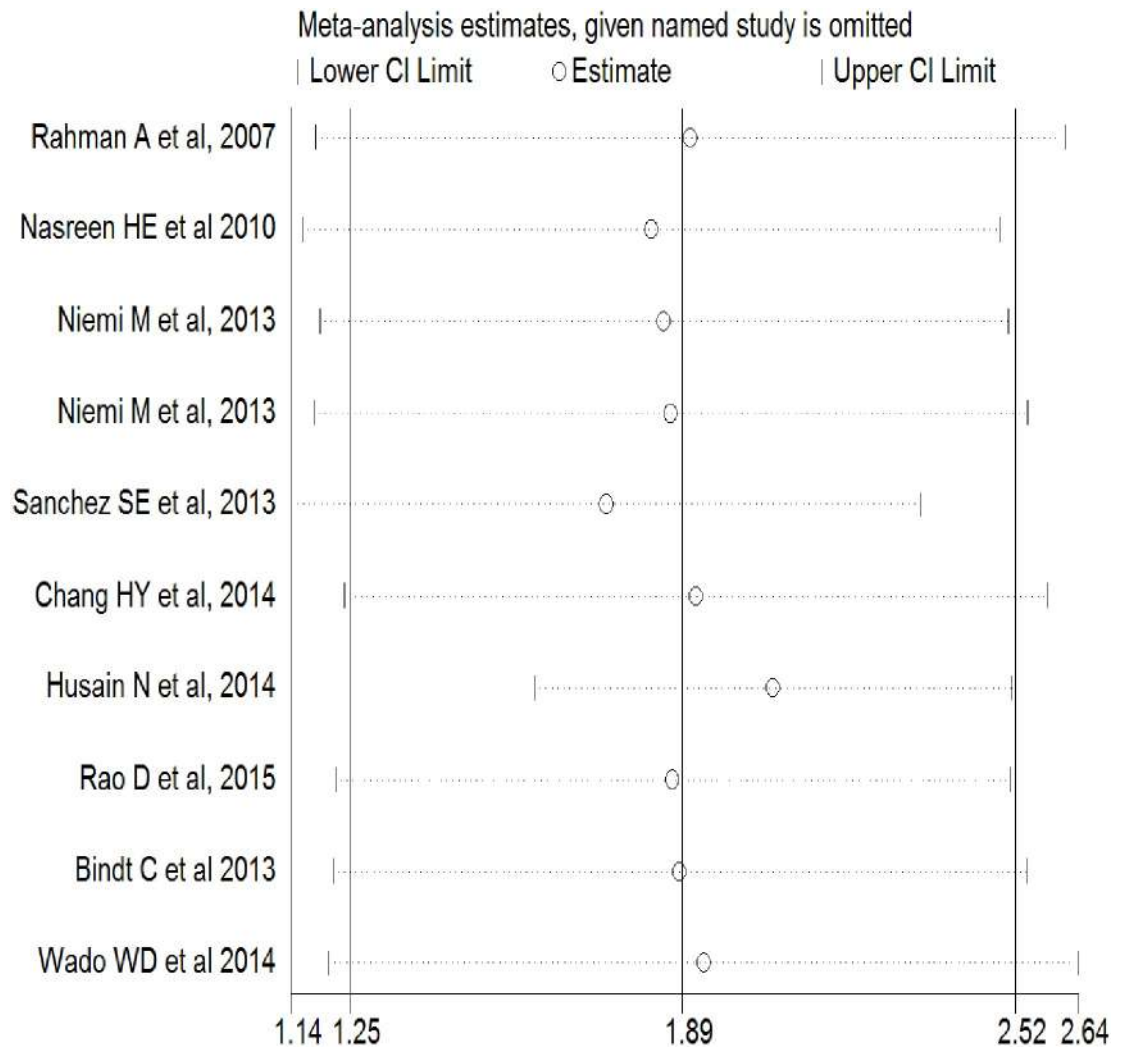
Fig 5. Sensitivity analysis for studies on antenatal depression and its effect on adverse birth outcomes (N = 9, 2007–2017).

factors that might change in the level of influence over the pregnancy, which could better target interventions across the three trimesters.

However, there are some methodological issues that might cause variation in estimations. For instance, we noted that institutional based studies reported higher prevalence relative to community-based studies and studies with smaller sample sizes reported higher prevalence relative to larger studies and these are mainly explained by the inherence limitations of cross-sectional studies. Estimate size also varied according to the tools used to measure depression. While the estimates from EPDS were the most consistent one with previous similar reviews, there was greater variation among estimates from studies using other tools [10, 114, 115].

We found that previous medical conditions (bad obstetric history and history of the previous episode of common mental disorders) and social or cultural factors (poor social support, financial difficulties, exposure to all forms of violence during pregnancy or childhood, unfavorable marital conditions, and male gender preference) were an important risk factors for antenatal depression.

Table 5. Sub-analysis of the association of antenatal depression with adverse birth outcomes in the low- and middle-income countries (N = 9, in the year 2007–2017), (random effect model).

Variable of sub-analysis	Number of studies (%)	Sample size	Pooled RR; 95%CI	I^2, p-value
Income of the country				
Low income	4	2324	1.42(0.85,2.38)	81.3%, p = 0.029
Middle income	5	3216	2.51(1.92,3.28)	0.0%, p = 0.736
Study setting				
Health institution	4	2519	2.92(1.92,4.43)	0.0%, p = 0.607
Community based	5	3021	1.72(1.11,2.67)	83.6%, p = 0.002
Time follow up started				
2nd and 3rd trimester	3	2366	2.47(1.76, 3.46)	19.3%, p = 0.454
Third trimester	6	3174	1.66(1.04,2.66)	78.9%%, p = 0.026
Tool used for depression screening				
EPDS	4	2688	1.70(1.01,2.83)	84.1%, p = 0.01
PHQ-9	3	1828	3.20(2.04,5.04)	0.0%, p = 0.633
CESD-10/ICD-10	2	1024	1.87(1.28,2.73)	0.0%, p = 0.843
Type of adverse birth outcome				
Low birth weight	6	3712	1.66(1.06,2.61)	81.5%%, p = 0.008
Preterm birth	4	2496	2.41(1.47,3.56)	0.0%, p = 0.620
Sample size				
<350	3	1151	2.07(1.55,2.77)	0.0%, p = 0.83
> = 350	6	4389	1.84(1.05,3.25)	85.9%, p = 0.001

Bad obstetric histories such as unwanted pregnancy, multiparity, history of miscarriage, still and preterm birth, and other un specified complications were reported in 15 studies. Having greater numbers of children might have considerable economic impact and stress and could be further exacerbated by an additional unwanted pregnancy [112]. History of miscarriage, still- and preterm birth (defined here as a negative obstetric history) may be associated with trauma and fear in relation to the current pregnancy outcome [9]. Other pregnancy complications such as hyperemesis gravidarum, hypertension, and diabetes mellitus could also pose additional stress on mothers [116].

Maternal or familial history of common mental disorders (such as depression, anxiety, stressful life event, and any other psychiatric issue) predicted the current depression episodes in 13 studies. This provides support for the familial and recurrent nature of depression and other mental health morbidities as pointed out by Shyn and Hamilton [117]. Concomitant exposure to stressful life events could also trigger the occurrence of depression by playing an additive role in the causal process [10, 118, 119].

Good social support [120] could positively affect the mother's stress coping ability by playing a buffering role in the causal model [10, 120, 121] means social support significantly reduces the risk of antenatal depression. Moreover, studies have shown a preventive effect of balanced nutritional interventions [122, 123] during pregnancy on antenatal depression. However, mothers in low income countries are living in economic pressure which also indirectly affect their adherence to proper nutrition during pregnancy. Exposure to sexual, physical, and emotional violence before or during pregnancy or history of childhood abuse was associated with an increased risk of antenatal depression. This is associated with disruption of neurobiological and stress response system through changing of brain structure and function [124–126] and the prevalence of such forms of violence in low and middle-income countries is known to be high [127].

Reduced relationship satisfaction with partners was reported as a risk factor for having depression symptoms. The risk of depression was also higher when the pregnant mothers are from a family that prefers male than a girl in the current pregnancy. This gender preference could directly affect maternal support and combined with a problem with partner relationship could brought maternal distress, loneliness and, ultimately, depression throughout the pregnancy [10, 119].

After accounting for publication bias, an exposure history of antenatal depression was associated with a 59% higher risk of adverse birth outcomes. In the sub-analysis according to a type of adverse birth outcomes, the risk of preterm birth was higher compared to the risk of low birth weight. A significant association between antenatal depression and low birth was also reported in two systematic reviews [33, 128], however, Kathleen et al reported absence of association between antenatal depression and adverse birth outcomes [129].

An increased preterm birth risk (1.4) among mothers with depression history was consistent with a meta-analysis published by Grigoriadis et al [130]. Similarly, a 1.2 times risk of preterm birth and 1.3 times risk of low birth weight was reported in a meta-analysis conducted by Grote, which is also in line with our finding [131]. More importantly, this review found that the association of antenatal depression on adverse birth outcomes was similar among studies that used clinical investigation and studies that used self-reported screening tool to identify pregnant mothers with depression.

The causal mechanisms between antenatal depression and adverse birth outcomes could be explained in multiple ways: (1) Depression may exert an influence on adverse birth outcomes via dysregulation of the Hypothalamic-Pituitary-Adrenocortical Axis [132] that stimulates the release of stress hormone such as cortisol, which could prevents adequate oxygen and nutrient flow to the fetus [129, 133]; (2) Antenatal depression might also disrupt immune system dysfunction that leads the mothers to develop different type of infections and, potentially, affects fetal growth [131]; (3) Depressed mothers may be more likely to smoke and drink while being less likely to attend medical care [134–136] and have poor appetite all of which can lead to malnourishment and impact on fetal development [137].

Limitations

We included all available high-quality studies on antenatal depression and its effect on adverse birth outcomes, however, our estimation may still have been subject to measurement bias due to variation in diagnostic approaches among studies. Moreover, language restrictions might also introduce the risk of publication bias. Nonetheless, our analytical approach addressed heterogeneity and publication bias and provides some confidence in our estimates of the burden and consequences of antenatal depression in low and middle-income countries.

Conclusion

We found that antenatal depression is highly prevalent and increases over the duration of pregnancy. We also noted increases in prevalence over the last ten years. Antenatal depression prevalence was found to be higher in low-income countries relative to middle-income countries. The current review has identified risk factors for pregnant mothers at higher risk of developing antenatal depression such as; bad obstetric history, previous episode of common mental disorders, poor social support and financial difficulties. Similarly, women reporting a history of exposure to violence (during pregnancy or earlier) and unsatisfactory relationships were more at risk of developing depression. A strong association between antenatal depression and adverse birth outcomes, which was not affected by method of depression identification in pregnant mothers, was also noted in the current review. While there could be competing

priority agenda to juggle for health policymakers in low-income countries, interventions for antenatal depression should be reprioritized as vitally important in order to prevent the poor maternal and perinatal outcomes identified in this review.

Supporting information

S1 File.
(DOCX)

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Author Contributions

Conceptualization: Abel Fekadu Dadi, Emma R. Miller, Lillian Mwanri.

Data curation: Abel Fekadu Dadi.

Formal analysis: Abel Fekadu Dadi.

Methodology: Abel Fekadu Dadi.

Project administration: Abel Fekadu Dadi.

Supervision: Emma R. Miller, Lillian Mwanri.

Validation: Emma R. Miller, Lillian Mwanri.

Writing – original draft: Abel Fekadu Dadi.

Writing – review & editing: Abel Fekadu Dadi, Emma R. Miller, Lillian Mwanri.

References

1. WHO. Depression and other common mental disorders: global health estimates. World Health Organization; 2017.

2. Wang H, Naghavi M, Allen C, Barber RM, Bhutta ZA, Carter A, et al. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. 2016; 388(10053):1459–544.

3. Vos T, Allen C, Arora M, Barber RM, Bhutta ZA, Brown A, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. 2016; 388(10053):1545–602.

4. GBD. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. The lancet. 2015(388):1459–544.

5. Sunday EM, Okoli PC, Dinwoke VO. Level of awareness and treatment of anxiety and depression during pregnancy in southeast Nigeria. S Afr J Psychiatr. 2018; 24:1192. https://doi.org/10.4102/sajpsychiatry.v24i0.1192 PMID: 30473881

6. Mukherjee S, Trepka M, Pierre-Victor D, Bahelah R, Avent T. Racial/Ethnic Disparities in Antenatal Depression in the United States: A Systematic Review. Maternal & Child Health Journal. 2016; 20(9):1780–97.

7. Chatillon O, Even C. [Antepartum depression: prevalence, diagnosis and treatment]. Encephale. 2010; 36(6):443–51. https://doi.org/10.1016/j.encep.2010.02.004 PMID: 21130227

8. Mitchell-Jones N, Gallos I, Farren J, Tobias A, Bottomley C, Bourne T. Psychological morbidity associated with hyperemesis gravidarum: a systematic review and meta-analysis: BJOG: An International Journal of Obstetrics and Gynaecology. 124(1) (pp 20–30), 2017.

9.   Biaggi A, Conroy S, Pawlby S, Pariante CM. Identifying the women at risk of antenatal anxiety and depression: A systematic review. Journal of Affective Disorders. 2016; 191:62–77. https://doi.org/10.1016/j.jad.2015.11.014 PMID: 26650969

10. Gelaye B, Rondon MB, Araya R, Williams MA. Epidemiology of maternal depression, risk factors, and child outcomes in low-income and middle-income countries. The Lancet Psychiatry. 2016; 3(10):973–82. https://doi.org/10.1016/S2215-0366(16)30284-X PMID: 27650773

11. Woody CA, Ferrari AJ, Siskind DJ, Whiteford HA, Harris MG. A systematic review and meta-regression of the prevalence and incidence of perinatal depression. J Affect Disord. 2017; 219:86–92. https://doi.org/10.1016/j.jad.2017.05.003 PMID: 28531848

12. Slomian J, Honvo G, Emonts P, Reginster J-Y, Bruyère O. Consequences of maternal postpartum depression: A systematic review of maternal and infant outcomes. Womens Health (Lond). 2019; 15:1745506519844044.

13. Li J, Mao J, Du Y, Morris JL, Gong G, Xiong X. Health-related quality of life among pregnant women with and without depression in Hubei, China. Matern Child Health J. 2012; 16(7):1355–63. https://doi.org/10.1007/s10995-011-0900-z PMID: 22045020

14. Franke K, Bergh Bvd, de Rooij SR, Roseboom TJ, Nathanielsz PW, Witte OW, et al. Effects of Prenatal Stress on Structural Brain Development and Aging in Humans. bioRxiv. 2017 Jan 1:148916.

15. Sikander S, Ahmad I, Bates LM, Gallis J, Hagaman A, O'Donnell K, et al. Cohort Profile: Perinatal depression and child socioemotional development; the Bachpan cohort study from rural Pakistan. BMJ Open. 2019; 9(5).

16. Wen DJ, Poh JS, Ni SN, Chong YS, Chen H, Kwek K, et al. Influences of prenatal and postnatal maternal depression on amygdala volume and microstructure in young children. Translational Psychiatry. 2017; 7(4).

17. Latendresse G, Wong B, Dyer J, Wilson B, Baksh L, Hogue C. Duration of Maternal Stress and Depression. Nursing Research. 2015; 64(5):331–41. https://doi.org/10.1097/NNR.0000000000000117 PMID: 26325275

18. Diego MA, Field T, Hernandez-Reif M, Schanberg S, Kuhn C, Gonzalez-Quintero VH. Prenatal depression restricts fetal growth. Early Human Development. 2009; 85(1):65–70. https://doi.org/10.1016/j.earlhumdev.2008.07.002 PMID: 18723301

19. Field T, Diego M, Hernandez-rief M, Figueiredo B, Schanberg. Kuhn C, et al. Chronic prenatal depression and neonatal outcome. International Journal of Neuroscience. 2008; 118(1):95–103. https://doi.org/10.1080/00207450601042144 PMID: 18041608

20. Stringer E, Johnson J, Jackson C, Meltzer-Brody S. 646: Antenatal depression in an urban population of pregnant adolescents and young adults may contribute to preterm birth. American Journal of Obstetrics & Gynecology. 2016; 214(1):S344.

21. Kim DR, Sockol LE, Sammel MD, Kelly C, Moseley M, Epperson C. Elevated risk of adverse obstetric outcomes in pregnant women with depression. Archives of Women's Mental Health. 2013; 16(6):475–82. https://doi.org/10.1007/s00737-013-0371-x PMID: 23934018

22. Feinberg ME, Jones DE, Roettger ME, Hostetler ML, Sakuma KL, Paul IM, et al. Preventive Effects on Birth Outcomes: Buffering Impact of Maternal Stress, Depression, and Anxiety. Matern Child Health J. 2016; 20(1):56–65. https://doi.org/10.1007/s10995-015-1801-3 PMID: 26194453

23. Raisanen S, Lehto SM, Nielsen HS, Gissler M, Kramer MR, Heinonen S. Risk factors for and perinatal outcomes of major depression during pregnancy: a population-based analysis during 2002–2010 in Finland. BMJ Open. 2014; 4(11)

24. Quispel C, Bangma M, Kazemier BM, Steegers EAP, Hoogendijk WJG, Papatsonis DNM, et al. The role of depressive symptoms in the pathway of demographic and psychosocial risks to preterm birth and small for gestational age. Midwifery. 2014; 30(8):919–25. https://doi.org/10.1016/j.midw.2014.03.008 PMID: 24742634

25. Szegda K, Bertone-Johnson ER, Pekow P, Powers S, Markenson G, Dole N, et al. Depression during pregnancy and adverse birth outcomes among predominantly puerto rican women. Maternal and child health journal. 2017 Apr 1; 21(4):942–52. https://doi.org/10.1007/s10995-016-2195-6 PMID: 27995411

26. Chang HY, Keyes KM, Lee KS, Choi IA, Kim SJ, Kim KW, et al. Prenatal maternal depression is associated with low birth weight through shorter gestational age in term infants in Korea. Early Human Development. 2014; 90(1):15–20. https://doi.org/10.1016/j.earlhumdev.2013.11.006 PMID: 24331828

27. Husain N, Munshi T, Jafri F, Husain M, Parveen A, Saeed Q, et al. Antenatal depression is not associated with low birth weight: A study from urban Pakistan. Frontiers in psychiatry. 2014 Dec 10; 5:175. https://doi.org/10.3389/fpsyt.2014.00175 PMID: 25540627

28. Saeed A, Raana T, Saeed AM, Humayun A. Effect of antenatal depression on maternal dietary intake and neonatal outcome: a prospective cohort. Nutrition Journal. 2016; 15(1):64. https://doi.org/10.1186/s12937-016-0184-7 PMID: 27401187

29. Stewart DE. Depression during Pregnancy. New England Journal of Medicine. 2011; 365(17):1605–11. https://doi.org/10.1056/NEJMcp1102730 PMID: 22029982

30. Amiel Castro RT, Pinard Anderman C, Glover V, O'Connor TG, Ehlert U, Kammerer M. Associated symptoms of depression: patterns of change during pregnancy. Archives of Women's Mental Health. 2017; 20(1):123–8. https://doi.org/10.1007/s00737-016-0685-6 PMID: 27878386

31. Araujo DM, Vilarim MM, Sabroza AR, Nardi AE. [Depression during pregnancy and low birth weight: a systematic literature review]. Cad Saude Publica. 2010; 26(2):219–27. https://doi.org/10.1590/s0102-311x2010000200002 PMID: 20396838

32. Hanlon C, Medhin G, Alem A, Tesfaye F, Lakew Z, Worku B, et al. Impact of antenatal common mental disorders upon perinatal outcomes in Ethiopia: The P-MaMiE population-based cohort study. Tropical Medicine and International Health. 2009; 14(2):156–66. https://doi.org/10.1111/j.1365-3156.2008.02198.x PMID: 19187514

33. Gelaye B, Rondon M, Araya R, Williams MA. Epidemiology of maternal depression, risk factors, and child outcomes in low-income and middle-income countries. The lancet Psychiatry. 2016; 3(10):973–82. https://doi.org/10.1016/S2215-0366(16)30284-X PMID: 27650773

34. Bae J-M. A suggestion for quality assessment in systematic reviews of observational studies in nutritional epidemiology. Epidemiology and Health. 2016; 38.

35. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. Eur J Epidemiol. 2010; 25(9):603–5. https://doi.org/10.1007/s10654-010-9491-z PMID: 20652370

36. Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group. JAMA. 2000; 283(15):2008–12. https://doi.org/10.1001/jama.283.15.2008 PMID: 10789670

37. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. Bmj. 1997; 315(7109):629–34. https://doi.org/10.1136/bmj.315.7109.629 PMID: 9310563

38. Loannidis JP. Interpretation of tests of heterogeneity and bias in meta-analysis. Journal of evaluation in clinical practice. 2008; 14(5):951–7. https://doi.org/10.1111/j.1365-2753.2008.00986.x PMID: 19018930

39. Duval S, Tweedie R. Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. Biometrics. 2000; 56(2):455–63. https://doi.org/10.1111/j.0006-341x.2000.00455.x PMID: 10877304

40. Galbraith RF. Graphical display of estimates having differing standard errors. Technometrics. 1988; 30(3):271–81.

41. Higgins J, Thompson S, Deeks J, Altman D. Statistical heterogeneity in systematic reviews of clinical trials: a critical appraisal of guidelines and practice. Journal of health services research & policy. 2002; 7(1):51–61.

42. Fletcher J. What is heterogeneity and is it important? BMJ: British Medical Journal. 2007; 334 (7584):94–6. https://doi.org/10.1136/bmj.39057.406644.68 PMID: 17218716

43. Stata A. Stata Base Reference Manual Release 14. 2015.

44. Adewuya AO, Ola BA, Aloba OO, Dada AO, Fasoto OO. Prevalence and correlates of depression in late pregnancy among Nigerian women. Depression & Anxiety. 2007; 24(1):15–21.

45. Esimai O, Fatoye F, Quiah A, Vidal O, Momoh R. Antepartum anxiety and depressive symptoms: a study of Nigerian women during the three trimesters of pregnancy. J Obstet Gynaecol. 2008; 28.

46. Gausia K, Fisher C, Ali M, Oosthuizen J. Antenatal depression and suicidal ideation among rural Bangladeshi women: a community-based study. Archives of Women's Mental Health. 2009; 12(5):351–8. https://doi.org/10.1007/s00737-009-0080-7 PMID: 19468825

47. Luna Matos ML, Salinas Pielago J, Luna Figueroa A. [Major depression in pregnant women served by the National Materno-Perinatal Institute in Lima, Peru]. Pan American Journal of Public Health. 2009; 26(4):310–4. https://doi.org/10.1590/s1020-49892009001000004 PMID: 20107678

48. Mitsuhiro SS, Chalem E, Moraes Barros MC, Guinsburg R, Laranjeira R. Brief report: Prevalence of psychiatric disorders in pregnant teenagers. Journal of Adolescence. 2009; 32(3):747–52. https://doi.org/10.1016/j.adolescence.2008.12.001 PMID: 19349073

49. Pereira PK, Lovisi GM, Pilowsky DL, Lima LA, Legay LF. Depression during pregnancy: prevalence and risk factors among women attending a public health clinic in Rio de Janeiro, Brazil. Cadernos de

Saude Publica. 2009; 25(12):2725–36. https://doi.org/10.1590/s0102-311x2009001200019 PMID: 20191163

50. Pottinger AM, Trotman-Edwards H, Younger N. Detecting depression during pregnancy and associated lifestyle practices and concerns among women in a hospital-based obstetric clinic in Jamaica. General Hospital Psychiatry. 2009; 31(3):254–61. https://doi.org/10.1016/j.genhosppsych.2009.02.002 PMID: 19410104

51. Golbasi Z, Kelleci M, Kisacik G, Cetin A. Prevalence and Correlates of Depression in Pregnancy Among Turkish Women. Maternal and Child Health Journal. 2010; 14(4):485–91. https://doi.org/10.1007/s10995-009-0459-0 PMID: 19238527

52. Silva RA, Jansen K, Souza LD, Moraes IG, Tomasi E, Silva GD, et al. Depression during pregnancy in the Brazilian public health care system. Brazilian Journal of Psychiatry. 2010 Jun; 32(2):139–44 https://doi.org/10.1590/s1516-44462010000200008 PMID: 20658053

53. Kaaya SF, Mbwambo JK, Kilonzo GP, Van Den Borne H, Leshabari MT, Fawzi MC, et al. Socio-economic and partner relationship factors associated with antenatal depressive morbidity among pregnant women in Dar es Salaam, Tanzania. Tanzania journal of health research. 2010; 12(1):23–35. https://doi.org/10.4314/thrb.v12i1.56276 PMID: 20737826

54. Mohammad KI, Gamble J, Creedy DK. Prevalence and factors associated with the development of antenatal and postnatal depression among Jordanian women. Midwifery. 2011; 27(6)

55. Nasreen HE, Kabir ZN, Forsell Y, Edhborg M. Prevalence and associated factors of depressive and anxiety symptoms during pregnancy: a population based study in rural Bangladesh. BMC Womens Health. 2011; 11:22. https://doi.org/10.1186/1472-6874-11-22 PMID: 21635722

56. Lau Y, Yin L, Wang Y. Antenatal Depressive Symptomatology, Family Conflict and Social Support Among Chengdu Chinese Women. Maternal & Child Health Journal. 2011; 15(8):1416–26.

57. Senturk V, Abas M, Berksun O, Stewart R. Social support and antenatal depression in extended and nuclear family environments in Turkey: a cross-sectional survey. BMC Psychiatry. 2011; 11.

58. Faisal-Cury A, Savoia MG, Menezes PR. Coping style and depressive symptomatology during pregnancy in a private setting sample. The Spanish journal of psychology. 2012; 15(1):295–305. https://doi.org/10.5209/rev_sjop.2012.v15.n1.37336 PMID: 22379719

59. Melo EF Jr, Cecatti JG, Pacagnella RC, Leite DFB, Vulcani DE, Makuch MY. The prevalence of perinatal depression and its associated factors in two different settings in Brazil. Journal of Affective Disorders. 2012; 136(3):1204–8. https://doi.org/10.1016/j.jad.2011.11.023 PMID: 22169251

60. Hartley M, Tomlinson M, Greco E, Comulada WS, Stewart J, le Roux I, et al. Depressed mood in pregnancy: Prevalence and correlates in two Cape Town peri-urban settlements. Reproductive Health. 2011; 8(1):9.

61. Rochat TJ, Tomlinson M, Barnighausen T, Newell ML, Stein A. The prevalence and clinical presentation of antenatal depression in rural South Africa. Journal of Affective Disorders. 2011; 135(1–3):362–73. https://doi.org/10.1016/j.jad.2011.08.011 PMID: 21880372

62. Ajinkya S, Jadhav PR, Srivastava NN. Depression during pregnancy: Prevalence and obstetric risk factors among pregnant women attending a tertiary care hospital in Navi Mumbai. Industrial Psychiatry Journal. 2013; 22(1):37–40. https://doi.org/10.4103/0972-6748.123615 PMID: 24459372

63. Fisher J, Tran T, Duc Tran T, Dwyer T, Nguyen T, Casey GJ, et al. Prevalence and risk factors for symptoms of common mental disorders in early and late pregnancy in Vietnamese women: A prospective population-based study. Journal of Affective Disorders. 2013; 146(2):213–9. https://doi.org/10.1016/j.jad.2012.09.007 PMID: 23026129

64. 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. Revista Brasileira de Psiquiatria. 2012; 34(2):143–8. https://doi.org/10.1590/s1516-44462012000200005 PMID: 22729409

65. Lara MA, Natera-Rey G, Berenzon S, Juarez-Garcia F, Villatoro-Velazquez JA, Nieto L, et al. Intimate partner violence and depressive symptoms in pregnant Mexican women: national survey results. Revista de investigacion clinica; organo del Hospital de Enfermedades de la Nutricion. 2014; 66 (5):431–8. PMID: 25695386

66. Manikkam L, Burns JK. Antenatal depression and its risk factors: an urban prevalence study in Kwa-Zulu-Natal. S Afr Med J. 2012; 102.

67. Fadzil A, Balakrishnan K, Razali R, Sidi H, Malapan T, Japaraj RP, et al. Risk factors for depression and anxiety among pregnant women in Hospital Tuanku Bainun, Ipoh, Malaysia: Asia-Pacific Psychiatry. 5 (pp 7–13), 2013. https://doi.org/10.1111/appy.12036 PMID: 23857831

68. Jeong H-G, Lim J-S, Lee M-S, Kim S-H, Jung I-K, Joe S-H. The association of psychosocial factors and obstetric history with depression in pregnant women: Focus on the role of emotional support.

General Hospital Psychiatry. 2013; 35(4):354–8. https://doi.org/10.1016/j.genhosppsych.2013.02.009 PMID: 23541804

69. Bindt C, Guo N, Bonle MT, Appiah-Poku J, Hinz R, Barthel D, et al. No association between antenatal common mental disorders in low-obstetric risk women and adverse birth outcomes in their offspring: results from the CDS study in Ghana and Cote D'Ivoire. PLoS One. 2013; 8(11).

70. Dibaba Y, Fantahun M, Hindin MJ. The association of unwanted pregnancy and social support with depressive symptoms in pregnancy: evidence from rural Southwestern Ethiopia. BMC pregnancy and childbirth. 2013; 13.

71. Assefa Gemta W. Prevalence and factors associated with antenatal depression among women following antenatal care at Shashemane health facilities, South Ethiopia. Annals of Global Health. 2015; 81(1):90.

72. Guo N, Bindt C, Te Bonle M, Appiah-Poku J, Hinz R, Barthel D, et al. Association of antepartum and postpartum depression in Ghanaian and Ivorian women with febrile illness in their offspring: a prospective birth cohort study. Am J Epidemiol. 2013; 178(9):1394–402. https://doi.org/10.1093/aje/kwt142 PMID: 24013202

73. Dmitrovic BK, Dugalić MG, Balkoski GN, Dmitrovic A, Soldatovic I. Frequency of perinatal depression in Serbia and associated risk factors. International Journal of Social Psychiatry. 2013; 60(6):528–32. https://doi.org/10.1177/0020764013511067 PMID: 24300083

74. Abujilban SK, Abuidhail J, Al-Modallal H, Hamaideh S, Mosemli O. Predictors of Antenatal Depression Among Jordanian Pregnant Women in Their Third Trimester. Health Care for Women International. 2014; 35(2):200–15. https://doi.org/10.1080/07399332.2013.817411 PMID: 24020729

75. Aktas S, Yesilcicek Calik K. Factors Affecting Depression During Pregnancy and the Correlation Between Social Support and Pregnancy Depression. Iranian Red Crescent Medical Journal. 2015; 17(9).

76. Stewart RC, Umar E, Tomenson B, Creed F. A cross-sectional study of antenatal depression and associated factors in Malawi. Archives of Women's Mental Health. 2014; 17(2):145–54. https://doi.org/10.1007/s00737-013-0387-2 PMID: 24240635

77. Weobong B, Soremekun S, Ten Asbroek AH, Amenga-Etego S, Danso S, Owusu-Agyei S, et al. Prevalence and determinants of antenatal depression among pregnant women in a predominantly rural population in Ghana: The DON population-based study. Journal of Affective Disorders. 2014; 165:1–7. https://doi.org/10.1016/j.jad.2014.04.009 PMID: 24882170

78. Waqas A, Raza N, Lodhi HW, Muhammad Z, Jamal M, Rehman A. Psychosocial factors of antenatal anxiety and depression in Pakistan: is social support a mediator? PLoS ONE; 2015; 10(1).

79. Barrios YV, Gelaye B, Zhong Q, Nicolaidis C, Rondon MB, Garcia PJ, et al. Association of childhood physical and sexual abuse with intimate partner violence, poor general health and depressive symptoms among pregnant women.[Erratum appears in PLoS One. 2015; 10(3)

80. De Oliveira Fonseca-Machado M, Alves LC, dos Santos Monteiro JC, Stefanello J, Nakano AMS, Haas VJ, et al. Depressive disorder in pregnant Latin women: Does intimate partner violence matter? Journal of Clinical Nursing. 2015; 24(9–10):1289–99. https://doi.org/10.1111/jocn.12728 PMID: 25581085

81. Abdelhai R, Mosleh H. Screening for antepartum anxiety and depression and their association with domestic violence among Egyptian pregnant women. Journal of the Egyptian Public Health Association. 2015; 90(3):101–8. https://doi.org/10.1097/01.EPX.0000471670.64665.8f PMID: 26544838

82. Mahenge B, Stockl H, Likindikoki S, Kaaya S, Mbwambo J. The prevalence of mental health morbidity and its associated factors among women attending a prenatal clinic in Tanzania. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2015; 130(3):261–5.

83. Rwakarema M, Premji SS, Nyanza EC, Riziki P, Palacios-Derflingher L. Antenatal depression is associated with pregnancy-related anxiety, partner relations, and wealth in women in Northern Tanzania: a cross-sectional study. BMC Women's Health. 2015; 15:68. https://doi.org/10.1186/s12905-015-0225-y PMID: 26329331

84. Heyningen TV, Myer L, Onah M, Tomlinson M, Field S, Honikman S. Antenatal depression and adversity in urban South Africa. Journal of Affective Disorders. 2016; 203:121–9. https://doi.org/10.1016/j.jad.2016.05.052 PMID: 27285725

85. Biratu A, Haile D. Prevalence of antenatal depression and associated factors among pregnant women in Addis Ababa, Ethiopia: a cross-sectional study. Reprod Health. 2015; 12:99. https://doi.org/10.1186/s12978-015-0092-x PMID: 26514827

86. Bavle AD, Chandahalli AS, Phatak AS, Rangaiah N, Kuthandahalli SM, Nagendra PN. Antenatal Depression in a Tertiary Care Hospital. Indian Journal of Psychological Medicine. 2016; 38(1):31–5. https://doi.org/10.4103/0253-7176.175101 PMID: 27011399

87. George C, Lalitha AR, Antony A, Kumar AV, Jacob KS. Antenatal depression in coastal South India: Prevalence and risk factors in the community. International Journal of Social Psychiatry. 2016; 62(2):141–7. https://doi.org/10.1177/0020764015607919 PMID: 26443716

88. Moshki M, Cheravi K. Relationships among depression during pregnancy, social support and health locus of control among Iranian pregnant women. International Journal of Social Psychiatry. 2016; 62(2):148–55. https://doi.org/10.1177/0020764015612119 PMID: 26582784

89. Padmapriya N, Bernard JY, Liang S, Loy SL, Shen Z, Kwek K, et al. Association of physical activity and sedentary behavior with depression and anxiety symptoms during pregnancy in a multiethnic cohort of Asian women. Archives of Women's Mental Health. 2016; 19(6):1119–28. https://doi.org/10.1007/s00737-016-0664-y PMID: 27664104

90. Alvarado-Esquivel C, Sifuentes-Alvarez A, Salas-Martinez C. Unhappiness with the fetal gender is associated with depression in adult pregnant women attending prenatal care in a public hospital in Durango, Mexico. International Journal of Biomedical Science. 2016; 12(1):36–41. PMID: 27127452

91. de Jesus Silva MM, Carvalho Leite EPR, Nogueira DA, Clapis MJ. Depression in pregnancy. Prevalence and associated factors. Investigacion & Educacion en Enfermeria. 2016; 34(2):342–50.

92. de Moraes EV, Campos RN, Avelino MM. Depressive symptoms in pregnancy: The influence of social, psychological and obstetric aspects. Revista Brasileira de Ginecologia e Obstetricia. 2016; 38(6):293–300. https://doi.org/10.1055/s-0036-1585072 PMID: 27399924

93. Målqvist M, Clarke K, Matsebula T, Bergman M, Tomlinson M. Screening for Antepartum Depression Through Community Health Outreach in Swaziland. Journal of Community Health. 2016; 41(5):946–52. https://doi.org/10.1007/s10900-016-0175-9 PMID: 26942766

94. Thompson O, Ajayi I. Prevalence of Antenatal Depression and Associated Risk Factors among Pregnant Women Attending Antenatal Clinics in Abeokuta North Local Government Area, Nigeria. Depression Research and Treatment. 2016.

95. Ayele TA, Azale T, Alemu K, Abdissa Z, Mulat H, Fekadu A. Prevalence and Associated Factors of Antenatal Depression among Women Attending Antenatal Care Service at Gondar University Hospital, Northwest Ethiopia. PLOS ONE. 2016; 11(5)

96. Bisetegn TA, Mihretie G, Muche T. Prevalence and predictors of depression among pregnant women in debretabor town, northwest Ethiopia. PLoS ONE. 2016; 11(9).

97. Bitew T, Hanlon C, Kebede E, Medhin G, Fekadu A. Antenatal depressive symptoms and maternal health care utilisation: a population-based study of pregnant women in Ethiopia. BMC Pregnancy & Childbirth. 2016; 16(1):301.

98. Gelaye B, Addae G, Neway B, Larrabure-Torrealva GT, Qiu C, Stoner L, et al. Poor sleep quality, antepartum depression and suicidal ideation among pregnant women. Journal of Affective Disorders. 2017; 209:195–200. https://doi.org/10.1016/j.jad.2016.11.020 PMID: 27930912

99. Hu HQ, Zhang J, Zhao W, Tian T, Huang AQ, Wang LL. [The occurrence and determinants of anxiety and depression symptoms in women of six counties/ districts in China during pregnancy]. Chung-Hua Yu Fang i Hsueh Tsa Chih [Chinese Journal of Preventive Medicine]. 2017; 51(1):47–52. https://doi.org/10.3760/cma.j.issn.0253-9624.2017.01.010 PMID: 28056270

100. Shidhaye P, Shidhaye R, Phalke V. Association of gender disadvantage factors and gender preference with antenatal depression in women: a cross-sectional study from rural Maharashtra. Social Psychiatry & Psychiatric Epidemiology. 2017; 09:09.

101. Coll CD, da Silveira MF, Bassani DG, Netsi E, Wehrmeister FC, Barros FC, et al. Antenatal depressive symptoms among pregnant women: Evidence from a Southern Brazilian population-based cohort study. Journal of Affective Disorders. 2017; 209:140–6. https://doi.org/10.1016/j.jad.2016.11.031 PMID: 27914247

102. Mossie TB, Sibhatu AK, Dargie A, Ayele AD. Prevalence of Antenatal Depressive Symptoms and Associated Factors among Pregnant Women in Maichew, North Ethiopia: An Institution Based Study. Ethiopian Journal of Health Sciences. 2017; 27(1):59–66. https://doi.org/10.4314/ejhs.v27i1.8 PMID: 28458491

103. Sahile MA, Segni MT, Awoke T, Bekele D. Prevalence and predictors of antenatal depressive symptoms among women attending Adama Hospital Antenatal Clinic, Adama, Ethiopia. International Journal of Nursing and Midwifery. 2017; 9(5):58–64.

104. Rahman A, Bunn J, Lovel H, Creed F. Association between antenatal depression and low birthweight in a developing country. Acta Psychiatrica Scandinavica. 2007; 115(6):481–6. https://doi.org/10.1111/j.1600-0447.2006.00950.x PMID: 17498160

105. Nasreen HE, Kabir ZN, Forsell Y, Edhborg M. Low birth weight in offspring of women with depressive and anxiety symptoms during pregnancy: Results from a population based study in Bangladesh. BMC Public Health. 2010; 10.

106. Niemi M, Falkenberg T, Petzold M, Chuc NT, Patel V. Symptoms of antenatal common mental disorders, preterm birth and low birthweight: a prospective cohort study in a semi-rural district of Vietnam. Tropical Medicine & International Health. 2013; 18(6):687–95.

107. Sanchez SE, Puente GC, Atencio G, Qiu C, Yanez D, Gelaye B, et al. Risk of spontaneous preterm birth in relation to maternal depressive, anxiety, and stress symptoms. Journal of Reproductive Medicine. 2013; 58(1–2):25–33. PMID: 23447915

108. Rao D, Kumar S, Mohanraj R, Frey S, Manhart LE, L. Kaysen D. The impact of domestic violence and depressive symptoms on preterm birth in South India. Social Psychiatry and Psychiatric Epidemiology. 2016; 51(2):225–32. https://doi.org/10.1007/s00127-015-1167-2 PMID: 26747253

109. Wado YD, Afework MF, Hindin MJ. Effects of maternal pregnancy intention, depressive symptoms and social support on risk of low birth weight: A prospective study from Southwestern Ethiopia. PLoS ONE. 2014; 9(5).

110. Mathers C. The global burden of disease: 2004 update: World Health Organization; 2008.

111. Mathers CD, Loncar D. Projections of Global Mortality and Burden of Disease from 2002 to 2030. PLoS medicine. 2006; 3(11):e442. https://doi.org/10.1371/journal.pmed.0030442 PMID: 17132052

112. Fisher J, Cabral de Mello M, Patel V, Rahman A, Tran T, Holton S, et al. Prevalence and determinants of common perinatal mental disorders in women in low- and lower-middle-income countries: a systematic review. Bulletin of the World Health Organization. 2012; 90(2):139–49H.

113. Truijens SEM, Spek V, van Son MJM, Guid Oei S, Pop VJM. Different patterns of depressive symptoms during pregnancy. Archives of Women's Mental Health. 2017; 20(4):539–46. https://doi.org/10.1007/s00737-017-0738-5 PMID: 28593361

114. Bergink V, Kooistra L, Lambregtse-van den Berg MP, Wijnen H, Bunevicius R, van Baar A, et al. Validation of the Edinburgh Depression Scale during pregnancy. Journal of Psychosomatic Research. 2011; 70(4):385–9. https://doi.org/10.1016/j.jpsychores.2010.07.008 PMID: 21414460

115. Chorwe-Sungani G, Chipps J. A systematic review of screening instruments for depression for use in antenatal services in low resource settings. BMC Psychiatry. 2017; 17(1).

116. Chou F-H, Kuo S-H, Wang R-H. A Longitudinal Study of Nausea and Vomiting, Fatigue and Perceived Stress in, and Social Support for, Pregnant Women Through the Three Trimesters. The Kaohsiung Journal of Medical Sciences. 24(6):306–14. https://doi.org/10.1016/S1607-551X(08)70157-8 PMID: 18635416

117. Shyn SI, Hamilton SP. The genetics of major depression: Moving beyond the monoamine hypothesis. The Psychiatric clinics of North America. 2010; 33(1):125–40. https://doi.org/10.1016/j.psc.2009.10.004 PMID: 20159343

118. Underwood L, Waldie K, D'Souza S, Peterson ER, Morton S. A review of longitudinal studies on antenatal and postnatal depression. Archives of Women's Mental Health. 2016; 19(5):711–20. https://doi.org/10.1007/s00737-016-0629-1 PMID: 27085795

119. Roomruangwong C, Epperson CN. Perinatal depression in Asian women: Prevalence, associated factors, and cultural aspects. Asian Biomedicine. 2011; 5(2):179–93.

120. Stuart-Parrigon K, Stuart S. Perinatal Depression: An Update and Overview. Current Psychiatry Reports. 2014; 16(9):468. https://doi.org/10.1007/s11920-014-0468-6 PMID: 25034859

121. Sparling TM, Henschke N, Nesbitt RC, Gabrysch S. The role of diet and nutritional supplementation in perinatal depression: a systematic review. Maternal & Child Nutrition. 2017; 13(1).

122. Rechenberg K, Humphries D. Nutritional interventions in depression and perinatal depression. The Yale journal of biology and medicine. 2013; 86(2):127–37. PMID: 23766734

123. Kaplan BJ, Crawford SG, Field CJ, Simpson JS. Vitamins, minerals, and mood. Psychological bulletin. 2007; 133(5):747–60. https://doi.org/10.1037/0033-2909.133.5.747 PMID: 17723028

124. Hart C, de Vet R, Moran P, Hatch SL, Dean K. A UK population-based study of the relationship between mental disorder and victimisation. Soc Psychiatry Psychiatr Epidemiol. 2012; 47(10):1581–90. https://doi.org/10.1007/s00127-011-0464-7 PMID: 22202973

125. Teicher MH, Samson JA, Polcari A, McGreenery CE. Sticks, stones, and hurtful words: relative effects of various forms of childhood maltreatment. Am J Psychiatry. 2006; 163(6):993–1000. https://doi.org/10.1176/ajp.2006.163.6.993 PMID: 16741199

126. Teicher MH, Samson JA. Annual Research Review: Enduring neurobiological effects of childhood abuse and neglect. Journal of child psychology and psychiatry, and allied disciplines. 2016; 57(3):241–66. https://doi.org/10.1111/jcpp.12507 PMID: 26831814

127. World Helath Organization. Global and regional estimates of violence against women: prevalence and health effects of intimate partner violence and nonpartner sexual violence. 2013.

128. Accortt EE, Cheadle ACD, Dunkel Schetter C. Prenatal Depression and Adverse Birth Outcomes: An Updated Systematic Review. Maternal and Child Health Journal. 2015; 19(6):1306–37. https://doi.org/10.1007/s10995-014-1637-2 PMID: 25452215

129. Szegda Kathleen, Markenson Glenn, Bertone-Johnson Elizabeth R., Chasan-Taber Lisa. Depression during pregnancy: a risk factor for adverse neonatal outcomes? A critical review of the literature. The Journal of Maternal-Fetal & Neonatal Medicine. 2014; 27(9):960–7.

130. Grigoriadis S, VonderPorten EH, Mamisashvili L, Tomlinson G, Dennis CL, Koren G, et al. The impact of maternal depression during pregnancy on perinatal outcomes: A systematic review and meta-analysis. Journal of Clinical Psychiatry. 2013; 74(4):e321–e41. https://doi.org/10.4088/JCP.12r07968 PMID: 23656857

131. Grote NK, Bridge JA, Gavin AR, Melville JL, Iyengar S, Katon WJ. A meta-analysis of depression during pregnancy and the risk of preterm birth, low birth weight, and intrauterine growth restriction. Arch Gen Psychiatry. 2010; 67.

132. Wadhwa PD, Glynn L, Hobel CJ, Garite TJ, Porto M, Chicz-DeMet A, et al. Behavioral perinatology: biobehavioral processes in human fetal development. Regulatory peptides. 2002; 108(2–3):149–57. https://doi.org/10.1016/s0167-0115(02)00102-7 PMID: 12220739

133. Wadhwa PD, Entringer S, Buss C, Lu MC. The contribution of maternal stress to preterm birth: issues and considerations. Clin Perinatol. 2011; 38(3):351–84. https://doi.org/10.1016/j.clp.2011.06.007 PMID: 21890014

134. Azale T, Fekadu A, Hanlon C. Treatment gap and help-seeking for postpartum depression in a rural African setting. BMC Psychiatry. 2016; 16(1):196.

135. Neggers Y, Goldenberg R, Cliver S, Hauth J. The relationship between psychosocial profile, health practices, and pregnancy outcomes. Acta Obstet Gynecol Scand. 2006; 85(3):277–85. https://doi.org/10.1080/00016340600566121 PMID: 16553174

136. Kelly RH, Russo J, Holt VL, Danielsen BH, Zatzick DF, Walker E, et al. Psychiatric and substance use disorders as risk factors for low birth weight and preterm delivery. Obstet Gynecol. 2002; 100(2):297–304. https://doi.org/10.1016/s0029-7844(02)02014-8 PMID: 12151153

137. Borders AE, Grobman WA, Amsden LB, Holl JL. Chronic stress and low birth weight neonates in a low-income population of women. Obstet Gynecol. 2007; 109(2 Pt 1):331–8. https://doi.org/10.1097/01.AOG.0000250535.97920.b5 PMID: 17267833