



Research paper

Depression in pregnancy: A multinational prospective cohort study



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ABSTRACT

Introduction: Depression in pregnancy is associated with adverse outcomes for both mother and baby. Estimates of the prevalence of depression in pregnancy vary considerably across low- and middle-income countries. We set out to prospectively determine the prevalence of depression in pregnancy in two low- and middle-income countries, and to investigate its association with adverse pregnancy outcomes.

Methods: This multinational prospective cohort study was conducted in Pakistan and South Africa from 2021 to 2023 in two tertiary referral centres. The Edinburgh Postnatal Depression Scale was administered to women between 20- and 34- weeks' gestation. Women were followed up and pregnancy outcomes collected. A Bayesian model accounting for the sensitivity and specificity of the Edinburgh Postnatal Depression Scale was used to estimate prevalence.

Results: 1537 participants were recruited. The adjusted prevalence of depression in pregnancy was 17.1 % (95 % credible interval [CrI] 13.3 % – 21.1 %). Estimates varied across sites, in Pakistan, 10.8 % (95 % CrI 7.7 % – 14.3 %), and in South Africa, 25.9 % (95 % CrI 20.8 % – 31.1 %) of women experienced depression in pregnancy. There were no associations between screening positive on the Edinburgh Postnatal Depression Scale (score \geq 11) and spontaneous preterm birth (adjusted odds ratio [aOR] 1.20 95 % confidence interval [CI] 0.79–1.83), low birthweight (aOR 1.25 95 % CI 0.91–1.72), or admission to a special care/neonatal intensive care unit (aOR 0.95 95 % CI 0.59–1.52).

Conclusion: Within our study cohort, spanning two centres in Pakistan and South Africa, one in six women experienced depression in pregnancy. Reassuringly, depression was not associated with an increase in adverse pregnancy outcomes; spontaneous preterm birth, low birthweight or admission to neonatal intensive care/special care nursery. Our study provides robust estimates of the burden of depression in pregnancy in two low- and middle-income countries; an important first step in addressing maternal mental health.

1. Introduction

Depression in pregnancy is associated with adverse outcomes for both mother and baby. It is a leading contributor to maternal morbidity and mortality, yet is often a silent burden (Gelaye et al., 2016). Pregnancy provides a unique opportunity where mental health can be integrated into routine pregnancy care to potentially mitigate adverse consequences for mothers and babies (World Health Organization, 2022; Manolova et al., 2023).

The impact of untreated depression in pregnancy can be significant

and long-lasting (Kariuki and Newton, 2022). For women, it is associated with recurring depression and anxiety, substance use disorders and suicide (Eastwood et al., 2017; Howard and Khalifeh, 2020; Yin et al., 2021; Moore Simas et al., 2023). In offspring, depression in pregnancy has been linked to preterm birth, poorer neurodevelopmental outcomes, and depression later in life though these findings have been inconsistent (Spry et al., 2020; Gelaye et al., 2020; Raposa et al., 2014; Bluett-Duncan et al., 2021). There is some evidence to suggest that depression in pregnancy may be a risk factor for newborn admission to the neonatal intensive care unit (Bua et al., 2024). Additionally, in low- and middle-

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income countries (LMICs) associations with impaired infant growth and low birthweight have been reported, again however, results have been conflicting, with other studies reporting no association (Gelaye et al., 2020; Ghimire et al., 2021; Stein et al., 2014). Understanding the magnitude of the burden of depression in pregnancy, and its associated sequelae across diverse settings is key in addressing these harmful effects. Prospectively collected studies that account for confounders are needed to better characterise these potential associations.

The prevalence of depression during pregnancy varies across the globe (Howard et al., 2014). In high-income settings it is estimated to affect 10–20 % of pregnant women (World Health Organization, 2015; Abel et al., 2019). In LMICs prevalence is thought to be higher (Gajaria and Ravindran, 2018; Biaggi et al., 2016). However, across LMICs reported estimates vary substantially (Woody et al., 2017; Bindt et al., 2012). Accurate estimates of the prevalence of depression in pregnancy are fundamental to informing prevention strategies, interventions and guiding policy. A recent meta-analysis by our team on the prevalence of perinatal depression in LMICs, found that most studies describing prevalence were of poor methodological quality (Roddy Mitchell et al., 2023). They were predominantly cross-sectional, conducted at a single site, and most reported crude results of screening tools as prevalence estimates. There is a clear need for high-quality, prospective studies examining the prevalence of depression in LMIC settings, and further to investigate its impact on pregnancy and birth outcomes. Thus, we aimed to determine the prevalence of depression in pregnancy in two large referral centres in Pakistan and South Africa and to examine its associations with adverse pregnancy outcomes.

2. Methods

2.1. Study design

This multinational prospective cohort study aimed to determine the prevalence of depression during pregnancy among the patient population attending tertiary referral centres in Pakistan and South Africa. Women attending Fatima Memorial Hospital in Lahore, Pakistan and Tygerberg Hospital in Cape Town, South Africa for pregnancy care were enrolled between October 2021 and December 2023. Tygerberg Hospital has around 8500 births annually, it is the only tertiary hospital in the district and manages only high-risk pregnancies (Heitkamp et al., 2022). Fatima Memorial Hospital has between 5000 and 7000 births annually and is one of several referral hospitals in Lahore and provides care to a range of patients including high-risk and low-risk pregnancies (Fatima Memorial Hospital, n.d.). Local ethical approval was obtained from Fatima Memorial Hospital College of Medicine and Dentistry in Pakistan (FMH-08-2021-IRB-937-M) and Stellenbosch University in South Africa (N23/02/010). All included participants signed informed consent. This study is reported as per the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (Supplementary Table 1).

2.2. Participants

Pregnant women were eligible if they were over 18 years, between 20- and 34- weeks' gestation and planned to birth at the recruitment site. Women were excluded if they were unable to provide informed consent or did not complete the study screening tool (Edinburgh Postnatal Depression Scale).

2.3. Procedure

Eligible women were approached by hospital research staff when attending antenatal appointments. They were given a verbal introduction and written information about the study. Consenting participants were then interviewed by members of the research team trained in conducting interviews and mental health first aid (Mental Health First

Aid Australia, n.d.), to gather baseline maternal demographic and clinical data, and to complete the Edinburgh Postnatal Depression Scale. Women were followed up until birth and hospital discharge, with additional pregnancy and birth data obtained from medical records post-birth. Gestational ages were taken from medical records and calculated using last menstrual period. All data were collected and managed on the secure online database Research Electronic Data Capture (Harris et al., 2019; Harris et al., 2009) hosted at the University of Melbourne and Stellenbosch University. All data collected were cross checked by members of the research team.

2.4. Assessment of depression

The Edinburgh Postnatal Depression Scale was used to assess depressive symptoms. The Edinburgh Postnatal Depression Scale is the most widely used screening tool globally for both depression in pregnancy and postnatal depression (Biaggi et al., 2016; Cena et al., 2021). The self-reported questionnaire uses a Likert-scale for 10 questions relating to symptoms experienced over the preceding 7 days (Cox et al., 1987). A cut-off value of ≥ 11 out of 30 was used to indicate probable depression based on a recent individual participant data meta-analysis which found that a cut-off of ≥ 11 maximised sensitivity and specificity, at 81 % (95 % confidence interval [CI] 75 % - 87 %) and 88 % (95 % CI 85 % - 91 %) respectively (Levis et al., 2020). The Edinburgh Postnatal Depression Scale is validated for use in Pakistan in Urdu (Dosani et al., 2022) and in South Africa in English, Afrikaans and isiXhosa (Pellowski et al., 2019; de Bruin et al., 2004). The English or translated versions of the Edinburgh Postnatal Depression scale were used based on women's preferences. Any woman that was identified to be at risk of harm to herself was referred for urgent medical care within the hospital as per the standard hospital procedure at each site. Women were identified via either a positive response to question 10 on the Edinburgh Postnatal Depression Scale: *The thought of harming myself occurred to me*, or disclosure to research staff.

2.5. Outcomes

The primary outcome of the study was prevalence of depression in pregnancy. Secondary outcomes then used Edinburgh Postnatal Depression Scale results to assess whether there was an association with adverse pregnancy outcomes including: spontaneous preterm birth (<37 weeks' gestation), low birth weight (<2500 g), and admission to a special care nursery or neonatal intensive care unit.

2.6. Covariates

Covariates included maternal age at the time of recruitment, gravidity, parity, body mass index, relationship status (married/cohabitating, single, divorced), highest level of education obtained (primary school, high school, university, no formal education), smoking status, alcohol use, and gestational age at booking visit.

2.7. Statistical analysis

A statistical analysis plan was developed a priori and agreed upon by authors (Supplementary File 1). A sample size of 1500 was decided upon using a Bayesian model with uniform prior in R (R Core Team, 2025; Devleeschauwer et al., 2015), and examining the precision of estimates based upon prevalences of 15, 20, 25 and 30 %, informed by available literature (Gelaye et al., 2016; Fisher et al., 2012; World Health Organization, 2008).

Maternal characteristics were compared between screen negative women, scoring <11, and screen positive women, scoring ≥ 11 on the Edinburgh Postnatal Depression Scale and described as mean with standard deviation (SD), or median and interquartile range (IQR), based on distribution, and frequencies for categorical variables.

The primary outcome, prevalence of depression, was calculated using a Bayesian model with crude measures from the Edinburgh Postnatal Depression Scale. The Bayesian model aims to account for the misclassification of a screening tool by using predetermined sensitivity and specificity parameters to inform priors. Sensitivity and specificity estimates of 0.81 (95 % CI 0.75–0.87) and 0.88 (95 % CI 0.85–0.91) respectively were drawn from a 2020 individual participant data meta-analysis of the Edinburgh Postnatal Depression Scale (Levis et al., 2020). An estimated prevalence of 25 % was taken from our team's meta-analysis of depression prevalence in LMICs (Roddy Mitchell et al., 2023) and used as a prior. Additionally, we performed sensitivity analyses by examining the impact on point estimates of using priors of 10, 15 and 20 % prevalence. Estimates were calculated using EpiTools (Sergeant, 2018) and are presented as posterior means and 95 % credible intervals.

Associations between screening positive on the Edinburgh Postnatal Depression Scale and secondary outcomes were assessed via univariate logistic regression and reported as odds ratios and corresponding 95 % confidence intervals. Adjusted odds ratios were also calculated based on variables identified as potential confounders with the use of directed acyclic graphs and specified in our statistical analysis plan. Directed acyclic graphs are schematic diagrams used in epidemiological research to illustrate possible associations between variables. They aid in identifying confounders and other potential causes of bias. Covariates selected as likely confounders included: study site, maternal age, body mass index, smoking status and alcohol use. Clustered standard errors were used for neonatal outcomes to account for the inclusion of multiple pregnancies. Analyses were performed using EpiTools, R Version 4.4.2 and StataSE version 17.

2.8. Missing data

The data were largely complete, with less than 5 % missing data across all variables. No imputation was performed.

2.9. Role of the funding source

National Health and Medical Research Council of Australia provided salary support to ST, RH and AL. The Funders had no role in the study design nor execution.

3. Results

Between October 2021 and December 2023, 1596 women were recruited, of which 1537 (96.3 %) were included in the final cohort, 756 women from Pakistan and 781 from South Africa. Fifty-nine women (3.7 %) were excluded from the final analysis due to a) age under 18 years old ($n = 1$), b) outside the target gestation (20- and 34- weeks' gestation) at recruitment ($n = 43$) or c) failure to complete the Edinburgh Postnatal Depression Scale ($n = 15$).

Table 1 shows the clinical characteristics of participants. The median gestational age at recruitment was 28 weeks and 5 days (IQR 26 + 2–31 + 0 weeks). Most participants were multiparous (74.7 %) and were on average 30.2 years old (SD 5.7). Women who screened positive for depressive symptoms (EPDS score ≥ 11) were more likely to have a body mass index of ≥ 30 kg/m² (53.7 % vs. 43.2 %), to report being single (42.1 % vs. 20.6 %), and to smoke (14.3 % vs. 6.6 %), compared with women that screened negative. Regarding reported mental health, women that screened positive were significantly more likely to have a history of depression (11.0 % vs. 3.7 %) and were twice as likely to report a family history of mental illness (9.2 % vs. 4.6 %) compared to women that screened negative (Table 1).

In comparison to the Pakistani cohort, women in the South African cohort were older, more likely to have a BMI ≥ 30 kg/m² and were less likely to have completed a university degree. A higher proportion of the South African cohort were multiparous and there was a higher

Table 1
Maternal and neonatal characteristics by Edinburgh Postnatal Depression Scale <11 and ≥ 11 .

Characteristic	Total cohort N = 1537	EPDS < 11 n = 1209	EPDS ≥ 11 n = 328
Maternal age (years)			
mean (SD)	30.2 (5.7)	30.1 (5.5)	30.9 (6.0)
missing	2 (0.1)	2 (0.2)	0
Body Mass Index (kg/m ²)	29.0	28.5	30.9
median (IQR)	(24.5–35.8)	(24.4–35.1)	(25.1–39.8)
≥ 30 kg/m ² n (%)	698 (45.8)	522 (43.2)	176 (53.7)
missing	12 (0.8)	6 (0.5)	6 (1.8)
Relationship status n (%)			
Married/cohabitating	1132 (73.6)	946 (78.3)	186 (56.7)
Single	387 (25.2)	249 (20.6)	138 (42.1)
Divorced	18 (1.2)	14 (1.2)	4 (1.2)
Highest level of education obtained n (%)			
Primary school	88 (5.7)	74 (6.1)	14 (2.3)
High school	928 (60.4)	680 (56.2)	248 (75.6)
University	510 (33.2)	446 (36.9)	64 (19.5)
No formal education	11 (0.7)	9 (0.7)	2 (0.6)
Current smoker n (%)	127 (8.3)	80 (6.6)	47 (14.3)
missing	3 (0.2)	3 (0.3)	0
Current alcohol use n (%)	94 (6.1)	67 (5.5)	27 (8.2)
missing	3 (0.2)	3 (0.3)	0
Pregnancy characteristics			
Parity n (%)			
Nulliparous	389 (25.3)	314 (26.0)	74 (22.6)
Multiparous	1150 (74.2)	895 (74.0)	254 (77.4)
Gestational age at booking visit (weeks) median (IQR)	15 (9–21)	15 (10–21)	13 (8–20)
missing	4 (0.3)	5 (0.4)	1 (0.3)
Gestational age at recruitment (weeks + days) median (IQR)	28 + 5 (26 + 2–31 + 0)	28 + 6 (26 + 4–31 + 0)	28 + 1 (25 + 5–30 + 5)
Mental Health			
Past history of depression n (%)	81 (5.3)	45 (3.7)	36 (11.0)
Antidepressant use in pregnancy n (%)	28 (1.8)	12 (1.0)	16 (4.9)
Family history of mental illness n (%)	86 (5.6)	56 (4.6)	30 (9.2)
Neonatal characteristics	Total cohort N = 1631	EPDS < 11 n = 1281	EPDS ≥ 11 n = 350
Livebirth n (%)	1558 (95.5)	1222 (95.4)	336 (96.0)
missing	35 (2.2)	26 (2.0)	9 (2.6)
Stillbirth n (%)	38 (2.3)	33 (2.6)	5 (1.4)
Antepartum stillbirth	26 (68.4)	22 (1.7)	4 (1.1)
Intrapartum stillbirth	12 (31.6)	11 (0.9)	1 (0.3)
Sex n (%)			
Female	760 (46.6)	605 (47.2)	155 (44.3)
Male	827 (50.7)	643 (50.2)	184 (52.6)
Indeterminate	8 (0.5)	6 (0.5)	2 (0.6)
missing	36 (2.2)	27 (2.1)	9 (2.6)
Gestational age at birth (weeks + days)	38 + 2	38 + 2	38 + 2
median (IQR)	(37 + 0–39 + 2)	(37 + 1–39 + 2)	(36 + 5–39 + 3)
missing	34 (2.1)	25 (2.0)	9 (2.6)
Mode of birth n (%)			
Vaginal birth	706 (45.9)	553 (45.7)	153 (46.6)
Caesarean section	796 (51.8)	629 (51.8)	167 (51.0)
missing	35 (2.3)	27 (2.2)	8 (2.4)
Birthweight (g) median (IQR)	2985 (2560–3300)	3000 (2600–3300)	2900 (2360–3397.5)
missing	44 (2.7)	34 (2.7)	10 (2.9)
Baby outcome n (%)			
Discharged	1470 (90.1)	1156 (90.2)	314 (89.7)
Transferred to NICU/SCN	75 (4.6)	57 (4.5)	18 (5.1)
Transferred to other hospital	4 (0.3)	3 (0.2)	1 (0.3)
Died in hospital	9 (0.6)	6 (0.5)	3 (0.9)
missing	73 (4.5)	59 (4.6)	14 (4.0)

Discrepancy in N of women and neonates is due to the inclusion of multiple births. NICU = neonatal intensive care unit, SCN = special care nursery.

incidence of hypertensive disorders of pregnancy (28.2 % vs. 10.2 %) compared to the Pakistani cohort. The proportion of women with a self-reported past history of depression, however, was similar across the sites (Pakistan, 5.4 % vs. South Africa, 5.1 %) (Supplementary Table 2).

Investigating prevalence, overall, 328 (21.3 %) women screened positive for depressive symptoms, with a score ≥ 11 on the Edinburgh Postnatal Depression Scale. To account for the imprecision of a screening tool, we applied a Bayesian approach that incorporated the estimated sensitivity and specificity of the Edinburgh Postnatal Depression Scale, and an estimated prevalence of depression in pregnancy of 25 %. Briefly, Bayesian statistics is a method to make predictions using new data and prior knowledge. Typically, there are three elements to this approach. First available knowledge on the subject is used to inform a *prior* probability distribution. The second component is the analysis the observed study data and finally, these are combined to produce a more informed result, known as the *posterior* distribution (van de Schoot et al., 2021; Flor et al., 2020). Using such a model, we estimated the overall true prevalence of depression in pregnancy to be 17.1 %, with a 95 % credible interval (CrI) of 13.3 % – 21.1 % (Table 2).

Next, we investigated the prevalence in each country. In Pakistan, 12.2 % of women screened positive on the Edinburgh Postnatal Depression Scale. Using the Bayesian model, the true prevalence of depression in pregnancy in Pakistan was estimated at 10.8 % (95 % CrI 7.7–14.3). In South Africa, 30.2 % of women screened positive on the Edinburgh Postnatal Depression Scale and the Bayesian adjusted true prevalence was estimated at 25.9 % (95 % CrI 20.8–31.1) (Table 2). Additionally, we performed sensitivity analyses by substituting alternative prior prevalence estimates (10 %, 15 % and 20 %) into the Bayesian model and examining the impact on the posterior mean prevalence estimate. Posterior mean prevalence estimates for overall prevalence of depression in pregnancy ranged from 11.9 % (with a prior of 10 %) to 15.6 % (with a prior of 20 %) (Supplementary Table 3).

Our cohort included 1631 babies. Of these, 1558 (95.5 %) were liveborn, 38 (2.3 %) were stillborn and 35 (2.2 %) were lost to follow-up. The median gestational age at birth was 38 weeks and 2 days for babies of both screen negative and screen positive mothers. Birthweights were also similar between the groups (screen negative median, 2900 g vs. screen positive median, 3000 g) (Table 1). Neonatal outcomes were similar across sites (Supplementary Table 2).

Our investigation of secondary outcomes among those who screened positive for depressive symptoms, found no association between screening positive and spontaneous preterm birth (11.3 % vs. 7.7 %; adjusted odds ratios (aOR) 1.20 [95 % confidence interval [CI] 0.79–1.83]), having a low birthweight baby (<2500 g) (27.9 % vs. 20.1 %; aOR 1.25 [95 % CI 0.91–1.72]), nor having a baby that required admission to a special care or neonatal intensive care unit (8.9 % vs. 10.8 %; aOR 0.95 [95 % CI 0.59–1.52]) (Table 3). Additionally, stratifying by country, there were no significant associations between screening positive on the Edinburgh Postnatal Depression Scale and secondary outcomes (Supplementary Tables 4 & 5).

Table 2
The prevalence of depression in pregnancy.

Total cohort (N = 1537)		Pakistan (N = 756)		South Africa (N = 781)	
Crude, % (95 % confidence interval)	Adjusted*, % (95 % credible interval)	Crude, % (95 % confidence interval)	Adjusted*, % (95 % credible interval)	Crude, % (95 % confidence interval)	Adjusted*, % (95 % credible interval)
21.3 (19.3–23.5)	17.1 (13.3–21.1)	12.2 (9.9–14.7)	10.8 (7.7–14.3)	30.2 (27.0–33.6)	25.9 (20.8–31.1)

* Priors used beta distributions with parameters (α , β); sensitivity 0.81 (95 % CI 0.75–0.87) equating to beta distribution (118, 29); specificity 0.88 (95 % CI 0.85–0.91) equating to beta distribution (347, 48), prior prevalence beta distribution (25,75).

Table 3
Secondary outcomes.

Secondary outcomes	EPDS < 11 n (%)	EPDS ≥ 11 n (%)	Crude odds ratio (95 % CI)	Adjusted* odds ratio (95 % CI)
Spontaneous preterm birth (<37 weeks)	93 (7.7)	37 (11.3)	1.53 (1.02–2.28)	1.20 (0.79–1.83)
Low birth weight (<2500 g)	251 (20.1)	95 (27.9)	1.54 (1.14–2.07)	1.25 (0.91–1.72)
Admission to NICU/SCN	132 (10.8)	30 (8.9)	0.81 (0.52–1.25)	0.95 (0.59–1.52)

* Adjusted for study site, maternal age, maternal education, body mass index, smoking status and alcohol use.

4. Discussion

This multinational prospective cohort study of 1537 women from two LMICs found that depression affects one in every six pregnant women (17.1 %, 95 % CrI 13.3 % – 21.1 %). By country, we found prevalence to be 10.8 % (95 % CrI 7.7 % – 14.3 %), in Pakistan and 25.9 % (95 % CrI 20.8 % – 31.1 %) in South Africa. Reassuringly, we did not find evidence of an association between screening positive on the Edinburgh Postnatal Depression Scale and the risk of adverse pregnancy outcomes – spontaneous preterm birth, low birthweight or admission to a special care or neonatal intensive care unit.

Previous meta-analyses have examined the prevalence of depression in pregnancy in LMICs. A 2023 meta-analysis by our team found the pooled prevalence of depression in pregnancy across LMICs to be 26.3 % from over 300 included studies (Roddy Mitchell et al., 2023). In Pakistan, a meta-analysis found a pooled prevalence of 37 % from 25 included studies (Atif et al., 2021). Comparatively, a meta-analysis of studies conducted across Africa reported a prevalence of depression in pregnancy of 26.3 % from 28 studies (Dadi et al., 2020). An important consideration of studies measuring depression prevalence, however, is the use of screening tools to identify cases. Screening tools are not diagnostic and thus yield both false positives and negatives. Using screening tools as diagnostic proxies often overestimates prevalence (Zimmerman, 2024; Arias de la Torre et al., 2023). This is highlighted by our previous meta-analysis that found a pooled prevalence of depression of 17.8 % (51 studies included) among studies using diagnostic interviews, compared to 25.3 % among studies that used screening tools (537 studies included) (Roddy Mitchell et al., 2023).

Notwithstanding their limitations, screening tools often provide a feasible method of identifying women with probable depression during pregnancy. Particularly in settings where there may be limited health-care infrastructure, competing clinical pressures, or a lack of staff with expertise in diagnostic interviews (Fellmeth et al., 2021). Depression screening tools offer a fast, cheap and relatively simple method of detecting patients at high risk. Hence, their use, particularly in resource constrained settings is warranted (Howard et al., 2014). In addition to their clinical utility, screening tools are widely used in surveys to measure and monitor population-based health (Arias-de la Torre et al., 2023). Given accurate estimates of depression during pregnancy in LMICs are scarce (Gelaye et al., 2016), we argue that screening tools also

have a place in measuring depression prevalence but that consideration of the psychometric properties of the screening tool is essential.

In our study prevalence estimates varied by country. Whilst both recruitment sites are large tertiary referral hospitals, there are notable differences in the patient populations of each site. These differences are reflected in the characteristics of our samples and likely impact the prevalence of depression in pregnancy. Among the Pakistani cohort, 99 % of women were married or cohabitating, in contrast half of the women in the South African cohort were single. Educational attainment also varied substantially between the sites, with less than 10 % of women in the South African cohort having a university degree, compared with almost 60 % of women in the Pakistani cohort. The rates of pregnancy complications, such as hypertensive disorders of pregnancy and twin pregnancies, were considerably higher among women from South Africa. These observations were largely expected given Tygerberg Hospital in South Africa only provides care for high-risk pregnancies, and predominantly to women with low socioeconomic status (Heitkamp et al., 2022). Whereas Fatima Memorial Hospital in Pakistan provides care to women with low- and high-risk pregnancies and across of greater range of socioeconomic positions (Fatima Memorial Hospital, n.d.). Poor relationships, a lack of support, socioeconomic deprivation and lower levels of educational attainment are well-established risk factors for perinatal depression (Gelaye et al., 2016; Biaggi et al., 2016; Dadi et al., 2020; Shahzad et al., 2025). Therefore, the variation in prevalence estimates may reflect unequal exposure to risk factors between the settings. Additionally, broader social and structural determinants such as intimate partner violence, stigma around mental health and gender inequity can impact prevalence, and reporting of prevalence, in pregnancy (Biaggi et al., 2016; Asefa et al., 2024). In Africa, adolescent pregnancy, mistreatment during childbirth and a lack of integration between healthcare services have been identified as key challenges that may contribute to a higher prevalence of perinatal depression across the region (Asefa et al., 2024; Bohren et al., 2019). Whilst, research from Pakistan has highlighted traditional gender norms and stigma around mental health as barriers to women disclosing mental health concerns (Atif et al., 2021; Shahzad et al., 2025). Thus, the varied demographics between our cohorts and socio-cultural differences between the settings likely contribute to the differences found in prevalence estimates.

Our study thus includes a diverse cohort from two LMICs and across two continents, substantially adding to understanding of likely prevalence in comparable settings. Additionally, sensitivity analyses performed using a range of prior prevalence estimates of depression in pregnancy in the Bayesian model, demonstrate the impact information about background prevalence can have on point estimates. Therefore, inferences about population prevalence can be improved with accurate prevalence data.

4.1. Strengths and limitations

There were several strengths to our study. To our knowledge, this is the first study to apply established psychometric properties of a screening tool in a Bayesian model and estimate the prevalence of depression during pregnancy. This novel approach significantly increases the robustness of our estimates. Our study also included two countries with distinct health care systems and socio-cultural landscapes. Our diverse cohort, in terms of both demographics and pregnancy complications, we believe, increases the generalisability of our results. Third, we sampled women during mid pregnancy and prospectively collected birth outcome data, reducing the chances of selection bias.

Our study was limited by the potential for referral bias. Participants were recruited from large referral hospitals, meaning that our study samples may not represent the wider pregnant populations in each country. Additionally, we did not collect data on the number of women that declined participation, introducing potential selection bias. Our use of a screening tool for case identification means that some

misclassification is also plausible. However as discussed, we used a Bayesian model that aimed to account for this. Further, we recruited women between 20- and 34- weeks' gestation, hence it is possible that we missed depression occurring earlier in pregnancy that may have resolved by recruitment. Prevalence estimates could differ if screening occurred earlier or later in pregnancy. Finally, we did not observe any associations between screening positive on the Edinburgh Postnatal Depression Scale and our secondary outcomes, yet it is possible that our study was underpowered to detect small effect sizes, or as pregnancies were dated using last menstrual period, misclassification of secondary outcomes, particularly spontaneous preterm birth is also a possibility.

Accurate estimates of disease prevalence are a cornerstone of public health – they inform resource allocation, policy and health research. The World Health Organization recommends incorporating perinatal mental health care into routine maternal and child health care (World Health Organization, 2022). Identification and treatment of women with depression is a critical part of pregnancy care. In settings of high prevalence, universal screening for depression in pregnancy is likely to improve outcomes where interventions and treatment are available (Biaggi et al., 2016). While resource constraints remain a major barrier in many LMIC settings, several evidence-based approaches exist. One such example is the *Thinking Healthy* program, developed by the World Health Organization, in which community health workers are trained to manage perinatal depression (World Health Organization, 2015). Additionally, with the advancement of technology, there is a growing number of digital interventions available for the treatment of perinatal depression (Rahman et al., 2025). Though these must be tailored to ensure effectiveness and cultural appropriateness within specific contexts, it is a promising avenue for increasing accessibility to mental health support during the perinatal period. We also strongly advocate for the inclusion of perinatal mental health indicators, including the prevalence of depression in pregnancy, into existing systems monitoring and evaluating maternal health. Future research investigating context specific interventions aimed at preventing and treating perinatal mental health disorders is needed. Perinatal mental health remains a neglected aspect of maternal health. Bringing it out of the shadows is essential to achieving the maternal and mental health targets of the Sustainable Development Goals (Asefa et al., 2024).

5. Conclusion

In this prospective cohort study conducted in two LMICs – Pakistan and South Africa, we found that depression affects one in six pregnant women. Our study provides robust estimates of the burden of depression in pregnancy; an important first step in addressing maternal mental health. Reassuringly, we did not find any associations between screening positive on the Edinburgh Postnatal Depression Scale and spontaneous preterm birth, low birthweight or admission to a special care/neonatal intensive care unit. Our findings should be used to inform resource allocation and policy in these settings to improve perinatal mental health.

CRedit authorship contribution statement

Alexandra Roddy Mitchell: Writing – original draft, Visualization, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Farhat-Ul-Ain Ahmed:** Writing – review & editing, Investigation, Data curation, Conceptualization. **Catherine Cluver:** Writing – review & editing, Supervision, Data curation, Conceptualization. **Richard J. Hiscock:** Writing – review & editing, Visualization, Software, Methodology, Formal analysis. **Anthea Lindquist:** Writing – review & editing, Supervision. **Kerry-Ann Louw:** Writing – review & editing, Methodology. **Lina Bergman:** Writing – review & editing, Supervision. **Nenekazi Masikantsi:** Writing – review & editing, Investigation. **Ami Dudley:** Writing – review & editing, Investigation. **Anam Bashir:** Writing – review & editing, Investigation. **Malika Hassan:**

Writing – review & editing, Investigation. **Susan P. Walker:** Writing – review & editing, Supervision. **Stephen Tong:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Roxanne Hastie:** Writing – review & editing, Visualization, Supervision, Methodology, Funding acquisition, Formal analysis, Conceptualization.

Funding

National Health and Medical Research Council of Australia provided salary support to Stephen Tong, Roxanne Hastie and Anthea Lindquist. The Funders had no role in the study design nor execution.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Roxanne Hastie, Stephen Tong, Anthea Lindquist reports financial support was provided by National Health and Medical Research Council. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jad.2025.120592>.

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