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ORIGINAL ARTICLE

Association between screening for antenatal depressive symptoms and delivery outcomes: The Born in Queensland Study

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Background: Evidence shows that depressive symptoms during pregnancy increase the risk of an intervention during delivery (induction, the use of forceps or vacuum, and caesarean sections (CS)). Many women with depression during pregnancy are not identified and therefore will not receive appropriate follow up of their symptoms. We hypothesised that routine screening for depressive symptoms during pregnancy could reduce detrimental consequences of depressive symptoms on delivery outcomes.

Aim: We explored the association between screening for depressive symptoms during pregnancy and delivery outcomes.

Materials and Methods: A cross-sectional analysis of state-wide administrative data sets. The population included all women who delivered a singleton in Queensland between the July and December of 2015. Logistic regression analyses were run in 27 501 women (93.1% of the total population) with information in all variables. The following were the main outcomes: onset of labour, CS, instrumental vaginal delivery, and all operative deliveries (including both CS and instrumental vaginal deliveries).

Results: Women who completed the screening had increased odds of a spontaneous onset of labour (adjusted odds ratio (aOR) 1.18; 95% CI 1.09–1.27) and decreased odds of an operative delivery (instrumental or CS) (aOR 0.88; 95% CI 0.81–0.96). Among women who had a vaginal delivery, those who completed the screening had decreased odds of having an instrumental delivery (aOR 0.84; 95% CI 0.74–0.97). Sensitivity analyses in women who did not have a formal diagnosis of depression showed similar results.

Conclusion: Our findings suggest that screening may decrease interventions during delivery in women with depressive symptoms.

KEYWORDS

depression, pregnancy, caesarean section, delivery, labour

INTRODUCTION

Depression is widely recognised as being associated with disability and premature mortality. During pregnancy, maternal depression not only affects the mother but also the unborn child.[1,2] Around 12–15% of pregnant women suffer from depressive symptoms[3] and/or anxiety[4] and a significant proportion of them will not receive a proper diagnosis or follow up of their symptoms.[5]

Physical factors are often considered to be the main contributor to adverse obstetric outcomes, such as the need for instrumental delivery (vacuum and forceps assisted vaginal birth), caesarean section (CS) or induced labour.[6] However, maternal psychological factors also play an important role in these delivery outcomes. For instance, depressive symptoms during pregnancy are associated with instrumental deliveries (forceps, vacuum), inductions and CS.[7,8] A meta-analysis found that both depression and depressive symptoms during pregnancy, as assessed by a screening tool, increased the risk of having an intervention during delivery.[8]

This is of concern given that the above-mentioned operative deliveries are associated with a range of serious short- and long-term health consequences for the mother and the child.[9,10] Despite this, rates of spontaneous onset of labour have decreased while operative deliveries have increased worldwide over the last decades[11] in many countries including Australia.[12]

A recent review found that screening for depressive symptoms improved referral rates, service use and emotional health outcomes.[13] Routine screening for depressive symptoms during pregnancy has therefore been introduced in some countries to improve detection and access to appropriate care. For instance, universal screening for depressive symptoms during pregnancy has been included in Australian perinatal guidelines since 2011, and in the USA since 2016.[14–16]

In this study, we hypothesised that improving detection and follow up with universal screening for depressive and anxiety symptoms would decrease the detrimental obstetric consequences of depression, such as CS, instrumental delivery and inductions. We examined the potential association between screening for depressive symptoms during pregnancy and operative birth interventions.

MATERIALS AND METHODS

We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines for cross-sectional observational studies.

This study is part of a birth cohort study called the Born in Queensland Study. This study is based on two linked state-wide population-based health administrative data collections: the Queensland Hospital Admitted Patient Data Collection (QHAPDC),[17] and the Queensland Perinatal Data Collection (QPDC).[18]

We used information on all singleton births in Queensland during the second half of 2015. The QPDC contains sociodemographic and clinical information of women who gave birth to a child of at least 20 weeks gestation or 400 g birth weight born in Queensland during the study period. The QHAPDC includes any inpatient admission of the mother or offspring from the first antenatal care visit until June 2016. Queensland Department of Health performed probabilistic record linkages for individuals across the two data collections. The full sample included 29 543 women who gave birth to a singleton in Queensland between 1 July 2015 and 31 December 2015. We created four binary outcome variables: onset of labour, CS, instrumental vaginal delivery, and all operative deliveries (including both CS and instrumental vaginal deliveries). Onset of labour was categorised as 'Yes' for women who had spontaneous onset of labour and 'No' for induced labour or CS; operative deliveries was 'Yes' for women who had a CS or instrumental delivery and 'No' for those with a vaginal non-instrumental delivery; CS only was 'Yes' for women who had a C-section and 'No' for all others; instrumental delivery only included vaginal deliveries and was defined as 'Yes' with vacuum or forceps, and 'No' for vaginal delivery with no intervention.

The recommended tool to screen for depressive symptoms in the perinatal period is the Edinburgh Postnatal Depression Scale (EPDS). The EPDS is a self-report 10-item questionnaire where women report about their feelings over the previous seven days.[19] Each item has a score from zero to three, which produces an overall score between zero and 30. The cut-off scores for antenatal screening have been statistically predetermined for different languages and cultures and vary across populations. Health professionals recorded whether the women completed the EPDS or not. This binary variable (whether women were screened for depressive symptoms) was coded 'Yes' when the health professional recorded that EPDS was completed and 'No' otherwise. The EPDS does not confirm diagnosis; it is sensitive to symptoms of depression and anxiety, rather than disorders, and further assessment is needed to establish a clinical diagnosis. Australian guidelines released in 2011 (which were current during the study period) recommended that EPDS screening should be completed at least once, preferably twice, during pregnancy as a component of the assessment of all pregnant women.[15] Additionally, women who scored between 10–12 should repeat the screening within 2–4 weeks, those who scored 13 or 14 twice during pregnancy should be referred for further follow up and assessment and those who scored 15 or more should get mental health assessment and follow up.[15] These guidelines were updated in 2017;[16] however these were not applicable during the study period.

Sociodemographic explanatory variables included the following: private or public patient; marital status (categorised as married/in a de facto relationship, or not married/separated); Indigenous status (categorised as 'Yes' if a woman identified herself as being Australian Indigenous or 'No' otherwise); maternal age (categorised as ≤25 years old, 26–35 years old, and 36 or more years old); parity (categorised as 0, 1, 2 or 3+); socio-economic

status from the Socio-Economic Index for Areas (SEIFA) derived from place of residence, based on the Index of Relative Socio-economic Disadvantage (categorised as SEIFA scores of 1–2 being most disadvantaged, 3–4, 5–6, 7–8, and 9–10 being least disadvantaged); remoteness (categorised as major cities, inner regional, outer regional, remote, or very remote).

Maternal health explanatory variables included the following: body mass index (BMI) using women's height (cm) and weight (kg) as recorded during the first antenatal consultation (categorised as <18.5 for underweight, 18.5–25 for normal weight, >25–<30 for overweight, and ≥30 for obese); smoked during pregnancy ('Yes' or 'No'); assisted conception ('Yes' or 'No') and spontaneous delivery ('Yes' or 'No'). Baby health explanatory variables included the following: baby birth weight (categorised as low (LBW) for babies with a birth weight <2500 g, normal (NBW) for babies 2500–4000 g and high (HBW) for babies >4000 g); and fetal presentation (categorised as vertex or other).

Statistical analysis

We first excluded observations with missing information in variables of interest from multivariable analyses. We ran descriptive analyses to explore characteristics of the sample and rates of the outcomes of interest. Binary logistic regressions were conducted to explore the association between the outcomes and the explanatory variables as given above. Multivariable logistic regressions were run to explore the association between each outcome and screening for depressive symptoms during pregnancy, adjusting for significant explanatory variables ($P < 0.05$). Variables were selected for inclusion in the multivariable models based on the literature and on significant association of the explanatory variable with both the outcome and the predictor variable in univariate regressions. We ran sensitivity analyses, excluding women with formal diagnosis of depression recorded as a current medical condition, to avoid the effect any antidepressant treatment may have on delivery.

Ethics approval was granted by Children's Health Queensland (Human Research Ethics Committee Reference number: HREC/16/QRCH/231) and ratified by the University of Queensland Ethics Committee (Clearance Number: 2016001629). The Born in Queensland Study was approved by the office of the Director-General of Queensland Health (Reference: QCOS/029817/RD006796).

RESULTS

Of the 29 543 singleton births that occurred in Queensland between July and December 2015, 27 501 (93.1%) (Fig. 1) had information for all variables of interest. Sociodemographic and health characteristics of the sample are provided in Table 1. The mean age of participants included in the analysis was 29.8 years (*SD* 5.6, range 14–50 years). Most of the women were public patients (70.7%), married or in a de facto relationship (83%) and did not identify as Indigenous Australian (93.6%). Around half of the sample had a spontaneous onset of labour; 32.6% had a CS and 10.3% had an instrumental delivery.

Unadjusted logistic regressions showed an association between completing the EPDS during pregnancy and spontaneous onset of labour. This association remained after adjusting for relevant confounders (adjusted odds ratio (aOR) 1.18; 95% CI 1.09–1.27) (Table 2). In the fully adjusted model, women who completed the EPDS had decreased odds of having an operative delivery (instrumental or CS) (aOR 0.88; 95% CI 0.81–0.96;) (Table 2). We also explored the association looking only at CS as the outcome and we found similar results (aOR 0.87; 95% CI 0.80–0.95) (Table 2). The association between screening during pregnancy and instrumental delivery was explored only in women who had a vaginal delivery (n = 18 542 women; 67.4% of the total sample). Among women who had a vaginal delivery, those who completed the EPDS during pregnancy had decreased odds of having an instrumental delivery in both unadjusted (uOR) and adjusted models (aOR) (uOR 0.60; 95%

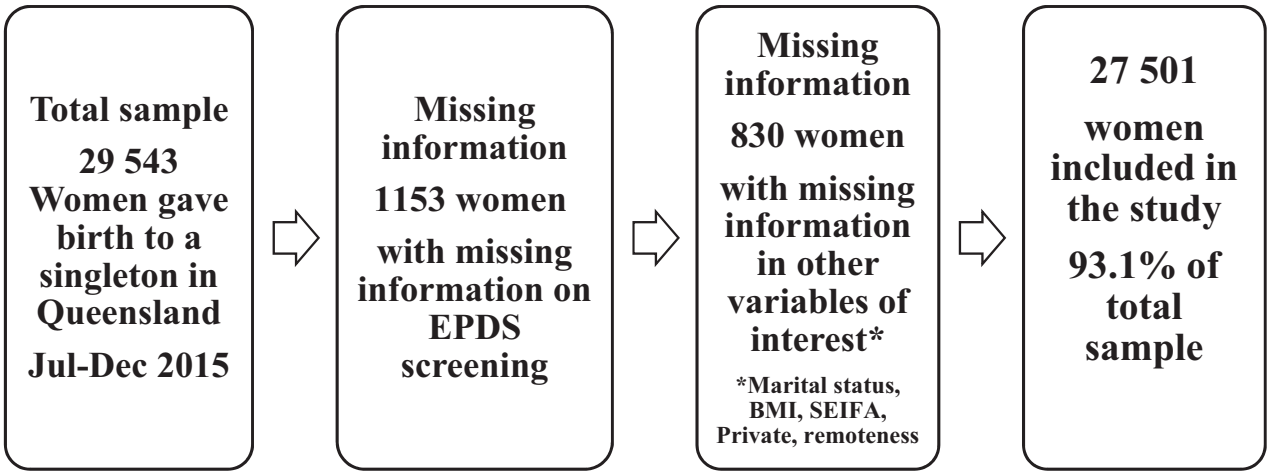

FIGURE 1 Flow diagram. BMI, body mass index; EPDS, Edinburgh Postnatal Depression Scale; SEIFA, Socio-Economic Index for Areas

TABLE 1 Sociodemographic and health characteristics of women in the sample (*N* = 27 501)

Variable	*n*	(%)
Onset of labour		
Spontaneous	14 340	52.1
Induced	7644	27.8
Caesarean section	5517	20.1
Birth method		
Vaginal (non-instrumental)	15 710	57.1
Instrumental delivery (vacuum or forceps)	2832	10.3
Caesarean section	8959	32.6
Edinburgh Postnatal Depression Scale screened		
No	6937	25.2
Yes	20 564	74.8
Hospital		
Public	19 432	70.7
Private	8069	29.3
Marital status		
Married/de facto	22 822	83.0
Not married/separated/divorced/widowed	4679	17.0
Indigenous status		
Not Indigenous	25 746	93.6
Indigenous	1755	6.4
Maternal age		
≤25	6367	23.2
26–35	16 782	61.0
≥36	4352	15.8
Parity		
0	11 239	40.9
1	9580	34.8
2	3954	14.4
3+	2728	9.9
Body mass index		
Underweight	1725	6.3
Normal	14 155	51.5
Overweight	6222	22.6
Obese	5399	19.6
Socio-Economic Index for Areas		
1–2 (most disadvantaged)	5609	20.4
3–4	5108	18.6
5–6	5432	19.8
7–8	6320	23.0
9–10 (least disadvantaged)	5032	18.3
Baby birth weight		
Low	1319	4.8
Normal	23 018	83.7
High	3164	11.5
Remoteness		
Major cities	17 016	61.9
Inner regional	5693	20.7
Outer regional	4172	15.2
Remote/very remote	620	2.3
Smoked during pregnancy		
No	24 171	87.9
Yes	3330	12.1
Assisted conception		
No	26 239	95.4
Yes	1262	4.6
Fetal presentation		
Vertex	26 010	94.6
Other	1491	5.4

CI 0.55–0.66;/aOR 0.84; 95% CI 0.74–0.97) (Table 2). Sensitivity analyses restricted to women who did not have a formal diagnosis of depression (*n* = 26 789; 97.4% of the total sample) showed similar results for all the outcomes (Table S1) when compared to analysis including all the sample (*n* = 26 786) (Table 2). Complete models presented in Table 2 including all covariates can be found in Table S2.

DISCUSSION

Main findings

This is the first study to explore the association between screening for depressive symptoms during pregnancy and delivery outcomes. Our findings suggest that antenatal depression screening may have a protective effect on these adverse delivery outcomes, with women who were screened for depressive symptoms during pregnancy having decreased odds for operative deliveries (CS and instrumental delivery) and increased odds for a spontaneous onset of labour. These associations remained after considering important predisposing sociodemographic and medical factors described in the literature.[6,8]

Interpretation

The association between depression and the need of operative interventions during delivery is not completely understood. One proposed explanation between antenatal depression and delivery outcomes is that anxiety, which is commonly comorbid with depression during pregnancy,[20] alters normal uterine blood flow and affects the efficiency of uterine action, which affects labour outcome.[21,22] Depression and anxiety affect delivery of the baby by prolonging labour length,[23] altering pain perception and increasing fear of childbirth,[24] which can result in operative delivery

TABLE 2 Unadjusted odds ratio (uOR) and adjusted OR (aOR) logistic regression models for screening and delivery outcomes

Variable	uOR (95% CI)	*P*-value	aOR (95% CI)	*P*-value
Spontaneous labour onset				
N = 27 501				
Screened				
No	1		1†	
Yes	1.90 (1.80–2.00)	<0.0001	1.18 (1.09–1.27)	<0.0001
Operative delivery (caesarean sections and instrumental delivery)				
N = 27 501				
Screened				
No	1		1†	
Yes	0.50 (0.47–0.53)	<0.0001	0.88 (0.81–0.96)	0.003
Caesarean section				
N = 27 501				
Screened				
No	1		1†	
Yes	0.52 (0.49–0.54)	<0.0001	0.87 (0.80–0.95)	0.001
Instrumental delivery (only vaginal deliveries)				
N = 18 542				
Screened				
No	1		1‡	
Yes	0.60 (0.55–0.66)	<0.0001	0.84 (0.74–0.97)	0.015

†Adjusted for: Private/Public, marital status, Australian indigenous status, mother age, parity, body mass index (BMI), Socio-Economic Index for Areas (SEIFA), birth weight, remoteness, smoking during pregnancy, assisted conception, fetal presentation.
‡Adjusted for: private/public, marital status, Australian indigenous status, mother age, parity, BMI, SEIFA, remoteness, smoking during pregnancy, assisted conception.

or encourage women to opt for a unnecessary operative delivery. Screening and corresponding follow up and support for women with depressive symptoms may decrease the severity of depressive symptom, help pregnant women deal with expectations of labour and pain, decreasing fear and negative emotions during childbirth, and thus improving their labour experience. It is important to take in consideration that universal screening in Australia is implemented alongside training for health professionals and increased follow up and care for women with high scores on the EPDS screening.[15]

The interview or the process of completing the screening might have in itself some benefit. For instance, Marsay et al. measured improvements in mood in women who participated in a EPDS screening interview during pregnancy.[25] They found that 50% of the women in their study described a release of stress during and after the interview, even though most women did not receive further treatment. The process of screening could therefore be beneficial, by normalising depressive symptoms, and increasing awareness of depressive symptoms and providing the opportunity to address them. The same study by Marsay et al. found that nearly 20% of the women said that screening helped to put words to their feelings and experiences.[25]

Another possible link between depression during pregnancy and interventions during delivery is that women who did not complete the screening may have not attended regular antenatal health checks. Regardless of Australia's universal healthcare system, some women consistently choose not to attend antenatal care. Australian antenatal guidelines recommend ten antenatal visits for a primiparous uncomplicated pregnancy and seven for subsequent uncomplicated pregnancies. In 2015 35% of pregnant women did not attend their initial antenatal visit in the first trimester, 13% had less than seven antenatal care visits and 5% had less than five.[12] Antenatal care visits have been associated with reductions in induced labour and instrumental delivery,[26] while under-attendance at antenatal care can increase the risk of adverse pregnancy outcomes.[27] Risk factors for depression and under-attendance are similar (such as lack of insurance, low income, low educational level, low social class, unmarried status, ethnicity, remoteness, alcohol and drug consumption),[27,28] making depressed women more likely to skip antenatal checks. Unrecognised depression during pregnancy has been associated with poor nutrition, non-use of prenatal vitamins, smoking, alcohol and substance misuse and failing to follow antenatal care recommendations,[29] which also affect labour outcomes. The process of screening and corresponding follow up may increase the continuity of crucial maternal care in women with elevated EPDS scores, reduce withdrawal from antenatal care in women with depressive symptoms, and decrease interventions during delivery. Therefore, screening may improve continuity of care and engagement with essential

prenatal and mental health care, thereby reducing adverse pregnancy outcomes.

Another possible factor that may affect this association is that private patients, Indigenous Australians and women born overseas are less likely to complete the screening during pregnancy in Australia.[30] Private patients in particular have also higher rates of CS, and instrumental delivery.[12]

It is important to note that this study does not infer causality; it looks at the association between receiving or not receiving screening for depressive symptoms and obstetric outcomes.

Implications

Between 2005 and 2015, rates of spontaneous onset of labour decreased in Australia from 57% to 50%; correspondingly, induction and no labour onset (CS with no labour onset) have increased (29–29% for induction and 18–21% for no labour onset). Although not explicitly examined in this study, if depressive symptoms lead to increases in operative deliveries, screening might be an important tool to decrease this rate and thus the resulting burden on health systems and costs. At the very least, lack of screening should be seen as an indicator of an increased risk of adverse obstetric outcomes. Early identification of women with depression may also help them address labour expectations and better prepare them, decreasing detrimental consequences of depression on delivery and subsequent wellbeing of both mother and child.

Strengths

The strength of our study is the use of a very large dataset of pregnant women with comprehensive data on maternal prenatal depressive symptoms and delivery outcomes. Administrative data allowed us to include 93% of all women who gave birth in Queensland during the second half of 2015, and thus to analyse a diverse group of women and produce generalisable findings. The outcome rates for spontaneous onset of labour (52%) and induced labour (29%) in our sample were very similar to Australia's national rates for the same year, as were those for CS (32.6%), making our findings generalisable to a national level.[12] Our statistical models were adjusted for maternal BMI, which has been recognised as an important predictor for operative deliveries.[8]

Limitations

We could not control for antidepressant use as we did not have this information, and women who did not complete the screening may have already had a mental health diagnosis and be using antidepressant medications. We did not have information on the number of antenatal visits. We did not have information on the exact EPDS score for each woman or whether women received a referral or any follow up or treatment for their depressive symptoms. The Australian guidelines from 2011, which were current during the study period, recommended a threshold of over 15, or scores of 13 or 14 on two separate occasions, for further follow up and mental health assessment. For scores between 10–12, the EPDS should be repeated 2–4 weeks later.[15] We did not have the information on whether CS was elective or an emergency CS.

Our findings suggest that screening may improve delivery outcomes in women with depressive symptoms. They also highlight the importance of early screening and timely follow up to improve continuity of antenatal care and support for women with regard to their concerns about childbirth, to ultimately decrease interventions during delivery.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1 Sensitivity analyses: unadjusted odds ratio (uOR) and adjusted OR (aOR) logistic regression models for screening and obstetric outcomes in women without a diagnosis of depression
Table S2 Unadjusted odds ratio (uOR) and adjusted OR (aOR) logistic regression models for screening and delivery outcomes (including covariates).