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## Research Article

# The Effects of Episodic Versus Continuous and Major Versus Mild Depression and Anxiety Symptoms on Pregnancy and Labour Complications

### Abstract

**Background:** Depression occurs in approximately 20% of pregnant women, with up to 25% experiencing anxiety. Various pregnancy and labour complications have been associated with maternal mood problems.

**Methods:** This population study of antenatal and early postpartum depression and maternal, child outcomes involved 649 women assessed three times: the second trimester, the third trimester, and in the early postpartum. Our objective was to determine the occurrence and outcomes on pregnancy and labour of major and mild depression.

**Results:** Major depression in the second trimester was significantly associated with developing gestational diabetes and swelling/edema. Major depression that occurred continuously throughout pregnancy was significantly associated with induced labour and antenatal bleeding/abruption. Mild depression in the second trimester was significantly associated with antenatal bleeding/abruption and premature rupture of the membranes. Mild depression in the third trimester was associated with caesarean birth. Mild depression that occurred continuously throughout pregnancy was significantly associated with the use of vacuum/forceps or operative delivery.

**Conclusions:** Our findings show that either episodic depression or mild depression can have significant negative impact on pregnancy and labour complications.

## Background

The prevalence of antenatal depression ranges between 10% and 20%, depending on the population studied and the stage in pregnancy [1,2]. Anxiety during pregnancy is also common, and is experienced by 12% to 60% of women [3,4]. Antenatal depression and anxiety have been associated with several pregnancy complications. Andersson et al. report that women with antenatal depression and/or anxiety were twice as likely to have nausea, vomiting, and more absenteeism from work [5]. They were also more likely to visit their obstetrician, and express feelings of excessive fear of childbirth [5]. Depression and anxiety in pregnancy are associated with an increase in somatic symptoms such as headaches, dizziness, difficulty breathing, and stomach pain [5]. Other researchers describe an association with antenatal depression and obstetrical complications such as gestational diabetes [7-9]. Depression and anxiety are also reported to be associated with hypertension, preeclampsia [10], bleeding and placental abruption [11], as well as preterm labour and birth [10,12-16].

In addition to these pregnancy complications, women who are depressed or anxious are less likely to access prenatal care [10]. They are also more likely to engage in more risk behaviours during pregnancy, such as smoking [17], alcohol, and recreational drug

use [18]. The literature also links antenatal depression and anxiety to complications during labour [10]. For example, women suffering from depression appear to feel pain more acutely, request more pain medications, and often report their deliveries to be more painful than women without mood problems [10]. Consequently, antenatal depression and anxiety are often associated with an increased use of epidural or pain medication during labour [5,19]. Lastly, depression and anxiety during pregnancy are associated with an increased rate of caesarean birth [5,9], and instrument use (i.e., vacuum or forceps) [20].

There is a paucity in knowledge about the impact of continuous versus episodic depression (mild or major) or anxiety on pregnancy and labour complications. This study sought to explore this issue and to begin to fill this gap.

## Objective

This study had three key objectives and hypotheses: We sought to examine the association between pregnancy and labour complications and major depression symptoms, when depression is episodic (occurs once in pregnancy) compared to when the depression is chronic (occurs each time measured in pregnancy). We hypothesized that women with chronic major depression symptoms would be more likely to have associated complications, compared to those with

episodic major depression. The second objective was to determine if there is a difference between pregnancy and labour complications and mild depression, when the mild depression is episodic (occurs once in pregnancy) compared to when the depression symptoms are chronic (occurs multiple times throughout pregnancy). We hypothesized that women with chronic mild depression would be more likely to have associated complications, compared to those with episodic mild depression. Finally, the third objective was to determine if there is difference between pregnancy and labour complications and anxiety symptoms, when the anxiety is episodic (occurs once in pregnancy) compared to when anxiety is chronic (occurs throughout pregnancy). We hypothesized that women with chronic anxiety would be more likely to have associated complications, than those with episodic anxiety.

## Methodology

### Data

Data were collected for the Feelings in Pregnancy and Motherhood Study (FIP), a longitudinal study of antenatal and early postpartum depression in Canada. The study was approved by the University Behavioural Research Ethics Board. Participants were recruited from doctor's offices, maternity stores, posters, radio advertising, and prenatal classes. Participants were interviewed at three times: Time 1, in the second trimester; Time 2, in the third trimester; and Time 3, in the early postpartum. Women were given similar questionnaires at each Time; however, Time 1 and Time 3 questionnaires included additional self-reported information about health history and pregnancy outcomes.

The Edinburgh Postnatal Depression Scale (EPDS) was used at all three times to screen for possible depression and anxiety. The EPDS has been translated into multiple languages and is validated for use in several populations, both antenatal and postnatal [21]. Each item on the EPDS has four possible answers, which are scored between 0-3. The total possible score for all ten items can range between 0-30. The scale has a 87% sensitivity and 78% specificity [22]. For this study, a cut-off score of  $\geq 12$  on the EPDS scale was used to indicate major depression symptoms and 10-11 for mild depression symptoms [21,23], we have used 10.

The EPDS contains an anxiety subscale comprised of items 3, 4, and 5 and for this study; a cut-off score of  $\geq 4$  was used, which has been used in previous studies [24]. We suggested that women who scored greater than 12 talk to their family doctor or to our local Maternal Mental Health Program for further assessment and appropriate management.

Other data included sociodemographic factors (age, marital status, education, ethnicity, and household income). Psychosocial questions about history of mental illness, and whether the person was currently seeking treatment or counselling for depression, anxiety and other mental health issues were asked. These questions also reflected whether the person was taking medication for mental health. Summative emotional support was reported as the number of supports a woman had (partner, mother, friend, or other). A summative stress variable was calculated by the number of stressors a woman reported experiencing including items such as the relationship

with their partner, money issues, other children etc. Self-report obstetrical and medical questions included nausea and vomiting, gestational diabetes, gestational hypertension, bleeding, infections, and hospitalizations. Finally, we asked about health behaviours such as physical activity, tobacco, alcohol, and recreational drug use, and prenatal vitamins and lessons.

### Data analysis

To analyze the association between major depression, mild depression, or anxiety symptoms, the outcome variables of interest included pregnancy complications. The predictor variable of interest for examining associated complications was the EPDS, mild or major depression, and anxiety. Other variables of interest included sociodemographic factors, history of mental illness, mental health treatment, stress, and emotional support.

Prospective multivariate logistic regression models were built to understand the association between the predictor and outcome variables. Once a model with only significant predictors (those with  $p \leq 0.05$ ) was established, the variables were tested for possible interactions. This was completed for primary predictor of interest (major depression, mild depression, and anxiety symptoms) at Time 1, Time 2, and then at both times.

## Results

### Participants

There were 649 (100%) women who completed Time 1 (second trimester), 604 (93.1%) women completed Time 2 (third trimester), and 596 (91.8%) women completed Time 3 (early postpartum). Time 1 was completed at  $17.37 (\pm 4.95)$  mean gestational weeks, Time 2 was completed at  $30.63 (\pm 2.67)$  mean gestational weeks, and Time 3 was completed at  $4.17 (\pm 2.12)$  mean postpartum weeks. Five hundred and eighty-one women completed all three questionnaires. The age range of the women within the study was 15-44 years and the mean age was  $28.99 \pm 4.83$ . As seen in Table 1, participants were highly educated, more likely to be in a relationship, many reported a higher than average income and most reported completing post-secondary education.

The prevalence of mild and major depression symptoms decreased over pregnancy with a minority of women depressed chronically throughout pregnancy. At Time 1 (episodic second trimester), 10.2% of women experienced mild depression symptoms, while 14.0% scored in the range for major depression symptoms. At Time 2 (episodic late third trimester), 9.3% were considered to have mild depression, while 10.3% were experiencing major depression symptoms. Only 1.8% and 4.8% of women scored in the range for chronic mild and major depression symptoms respectively. The prevalence of anxiety in this study was substantially higher than depression, 47.5% (Time 1), 38.5% at Time 2, and lastly 26.6% of participants scored within the range for chronic anxiety symptoms, i.e., occurred at Time 1 and Time 2. Figure 1 shows the pregnancy complications, while Figure 2 shows the labour complications.

Four pregnancy complications were significantly associated with major depression symptoms: gestational diabetes, induced labour, swelling/edema, and bleeding/abruption. See Table 2 for

**Table 1:** Socio-demographic Characteristics of the Participants.

	%(n)
Marital Status	
Married/Common-Law:	90.1% (585)
Single/Divorced:	9.9% (64)
Ethnicity	
Caucasian:	83.8% (544)
Aboriginal:	8.6% (56)
Other:	7.6% (49)
Education	
Post-Secondary:	66.7% (433)
Some Post-Secondary:	15.6% (101)
High School Diploma:	12.6% (82)
Grade 9-11:	4.9% (32)
< Grade 8:	0.2% (1)
Income (CAD \$)	
≥ \$60,000:	46.6% (298)
\$40,000-\$59,000:	20.9% (134)
\$20,000-\$39,000:	19.1% (122)
< \$20,000 or Social Assistance:	13.1% (84)
<sup>a</sup> Reference category is No Depression <sup>b</sup> Reference category is Never Smoked or Quit Smoking <sup>c</sup> Reference category is Married <sup>d</sup> Reference category is 15-28 years <sup>e</sup> Reference category is No Exercise	

the logistic regression models. Women who experienced episodic major depression symptoms at Time 1 were 3.5 times more likely to suffer from gestational diabetes; those who smoked were three times more likely to have gestational diabetes. Finally, social support was protective of having gestational diabetes.

Participants who were chronically experiencing major depression symptoms were 2.4 times more likely to have induced labour compared to women who did not have depression in either trimester. The greater the amount of stress the participants experienced, the more likely they were to have induced labour.

Participants with episodic major depression symptoms at Time 1 were twice as likely to have swelling/edema during their pregnancy. Married participants were 50% less likely to experience swelling/edema during pregnancy. Participants in the older age category (29-44 years) were 1.43 times more likely to have swelling/edema during pregnancy. Additionally, engaging in physical activity was lowered the risk of swelling/edema during pregnancy; the more exercise a woman engaged in, the less likely she was to have swelling and/or edema.

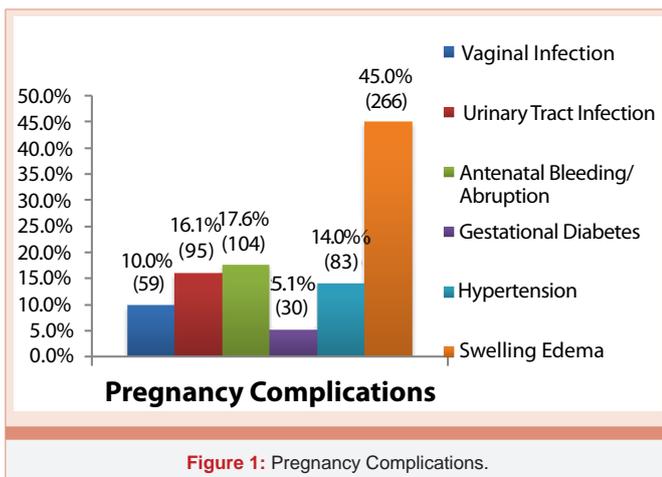
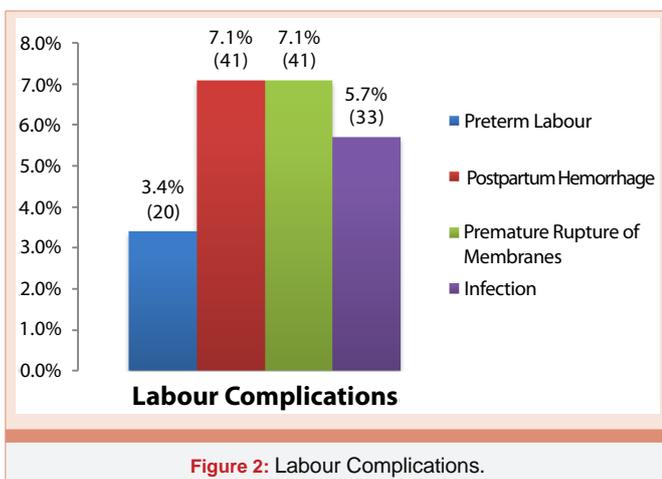
As shown in **Table 2**, participants who experienced chronic depression symptoms were 2.7 times more likely to experience abortion or bleeding during pregnancy. Support at Time 1 had a protective association over having bleeding/abruption during pregnancy.

Four complications were significantly associated with episodic mild depression symptoms at Time 1: antenatal bleeding/abruption, premature rupture of membranes (PROM-membranes rupture prior to going into labour), caesarean birth, and vacuum/forceps. The next four models depicted in **Table 3** explain in detail the association between the above complications and mild depression symptoms.

Participants with an episodic mild depression symptoms at Time 1 were 2.1 times more likely to have antenatal bleeding and those with a history of depression were 1.9 times more likely to have antenatal bleeding. Lastly, the summative support had a negative association with depression symptoms. The PROM model was tested with all possible covariates, but the only variable that remained significant was episodic mild depression symptoms at Time 2 ( $p = 0.042$ , OR 2.5).

Participants with episodic mild depressive symptoms (EPDS of 10 or 11) at Time 3 were 70% less likely to have an unplanned caesarean birth compared to participants who did not have mild depression symptoms. There was a positive association between summative stress and unplanned caesarean birth, and participants aged 29-44 years were 1.8 times more likely to have an unplanned caesarean birth.

The last model explored the probability of operative deliveries or the use of vacuum or forceps instruments during delivery. These were chronic mild depression symptoms, summative support, and treatment for mood disorders. Participants with chronic mild depression symptoms were 4.8 times more likely to have an operative delivery. Continuous summative support in the third trimester had a positive association, and participants who were receiving some type

**Figure 1:** Pregnancy Complications.**Figure 2:** Labour Complications.

**Table 2:** Final Models from Multivariate Logistic Regression for Complications Associated With Major Depression.

Variable	$\beta$ (S.E.)	p-value	Odds Ratio	95% Confidence Interval
Gestational Diabetes				
Depression				
2nd Trimester a	1.258 (0.173)	0.002	3.518	1.560-7.936
Smoking				
2nd Trimester b	1.104 (0.453)	0.015	3.017	1.241-7.332
Summative Support				
2nd Trimester	-0.370 (0.173)	0.032	0.691	0.492-0.969
Induced Labour				
Depression				
2nd Trimester a	-0.116(0.352)	0.741	0.890	0.447-1.774
3rd Trimester a	-0.380(0.452)	0.401	0.684	0.282-1.661
Both Trimesters a	0.883(0.457)	0.053	2.417	0.988-5.916
Summative Stress				
3rd Trimester	0.141(0.058)	0.015	1.152	1.028-1.290
Swelling/Edema				
Depression				
2nd Trimester a	0.0741(0.314)	0.018	2.099	1.134-3.885
3rd Trimester a	0.189(0.307)	0.609	1.208	0.585-2.494
Both Trimesters a	0.600(0.463)	0.196	1.821	0.735-4.515
Summative Support				
3rd Trimester	0.204(0.077)	0.008	1.226	1.055-1.424
Marital Status c	-0.684(0.335)	0.041	0.504	0.261-0.973
Age				
29-44 years d	0.358(0.177)	0.043	1.430	1.011-2.022
Exercise 2nd Trimester				
2-3x a week e	0.397(0.252)	0.114	1.488	0.908-2.437
Occasionally/Never e	0.869(0.240)	0.000	2.385	1.491-3.817
Bleeding/Abruption				
Depression				
2nd Trimester a	-0.196 (0.411)	0.633	0.822	0.367-1.840
3rd Trimester a	0.635 (0.415)	0.126	1.887	0.837-4.254
Both Trimesters a	1.003 (0.467)	0.032	2.727	1.092-6.812
Summative Support				
2nd Trimester	-0.267 (0.099)	0.007	0.766	0.630-0.930

**Table 3:** Final Models from Multivariate Logistic Regression for Complications Associated with Mild Depression.

Variable	$\beta$ (S.E.)	p- value	Odds Ratio	95% Confidence Interval
Bleeding/Abruption				
Mild Depression				
2nd Trimester a	0.754(0.341)	0.027	2.125	1.089-4.144
3rd Trimester a	-0.271(0.464)	0.559	0.763	0.307-1.893
Both Trimesters a	-0.499(1.078)	0.644	0.607	0.073-5.021
History of Depression b	0.663(0.227)	0.003	1.941	1.245-3.026
Summative Support				
2nd Trimester	-0.260(0.099)	0.009	0.771	0.635-0.937
Premature Rupture of Membranes				
Mild Depression				
2nd Trimester a	0.918(0.450)	0.042	2.504	1.036-6.054
3rd Trimester a	-1.052(1.029)	0.307	0.349	0.046-2.625
Both Trimesters a	0.606(1.077)	0.317	0.574	0.222-15.144



Unplanned Caesarean Section				
Mild Depression				
2nd Trimester a	-0.021(0.367)	0.954	0.979	0.477-2.008
3rd Trimester a	-1.210(0.542)	0.026	0.298	0.103-0.862
Both Trimesters a	-0.319(0.817)	0.697	0.727	0.147-3.604
Summative Stress				
3rd Trimester	0.127(0.058)	0.028	1.136	1.014-1.272
Age				
29-44 years c	0.632(0.214)	0.003	1.881	1.238-2.859
Operative Delivery				
Mild Depression				
2nd Trimester a	-0.241(0.496)	0.628	0.786	0.297-2.078
3rd Trimester a	0.626(0.404)	0.121	1.870	0.848-4.128
Both Trimester a	1.573(0.755)	0.037	4.820	1.098-21.161
Summative Support				
3rd Trimester	0.207(0.109)	0.057	1.230	0.994-1.523
Treatment for Mood Disorders				
2nd Trimester d	-1.116(0.543)	0.040	0.328	0.113-0.950
<sup>a</sup> Reference Category is No Mild Depression <sup>b</sup> Reference Category is No History of Depression <sup>c</sup> Reference Category is 15-28 years <sup>d</sup> Reference Category is No Treatment for Mood Disorders				

of therapy for a mood disorder at Time 2 were 67% less likely to have an operative delivery.

Three complications were significantly associated with anxiety. Swelling/edema and epidural use were associated with anxiety throughout pregnancy, while caesarean birth was significantly associated with anxiety at Time 1. Participants with chronic anxiety symptoms were 1.8 times more likely to experience swelling or edema during pregnancy. The association between swelling/edema and summative support was positive and married participants were 47% less likely to have swelling/edema during pregnancy. Women in the older category (29-44) were significantly more likely to have swelling/edema during pregnancy.

Epidural use was positively associated with anxiety symptoms, and we found a significant interaction between age and chronic anxiety. Referring to Table 4, as age increased in the participants who had chronic anxiety, their likelihood of using an epidural significantly decreased. Interestingly, women who drank alcohol at Time 1 were 2.3 times more likely to use an epidural.

Lastly, caesarean birth was significantly associated with anxiety symptoms at Time 1, with participants experiencing anxiety 48% less likely to have an unplanned caesarean birth. Summative stress at Time 2 had a significant, positive association with unplanned caesarean birth and older participants were significantly more likely to have a caesarean birth.

## Discussion

The prevalence of major depression symptoms is consistent with previous research, with 10 to 20% of a community sample

experiencing antenatal depression [25]. The prevalence of episodic major depression and mild depression symptoms were highest in the second trimester, which affirms previous research that depression decreases as pregnancy advances [26,27]. Previous literature has demonstrated that anxiety can vary during pregnancy [3,4], our study was no different with between 38.5% and 47.5% of participants experiencing anxiety symptoms.

Pregnancy complications were lower than those usually reported. For example, 16.1% of women experienced a urinary tract infection (UTI) compared to 30% in the general population of women [28,29] and approximately 13% of women experience preterm labour, with this number increasing in the last twenty years [30], compared to 3.4% of women in this study. The high sociodemographic levels found in this study population could explain this low prevalence of pregnancy complications. It may also be a factor in the levels of major depression symptoms, and the prevalence of mild depression symptoms, which were low.

We had hypothesized that chronic major depression symptoms would be more strongly associated with pregnancy and labour complications, compared to major depression symptoms that occurred only once during pregnancy. Some complications had a stronger association with episodic major depression symptoms (e.g., swelling/edema), while others (e.g., bleeding/abruption) were more strongly associated with chronic major depression symptoms.

Gestational diabetes was significantly associated with episodic depression symptoms at Time 2. Ragland et al. [9], reported that 42% of women who had been diagnosed with gestational diabetes also met the criteria for antenatal depression. The association between

**Table 4:** Final Models from Multivariate Logistic Regression for Complications Associated with Anxiety.

Variable	$\beta$ (S.E.)	p-value	Odds Ratio	95% Confidence Interval
Swelling/Edema				
Anxiety				
2nd Trimester a	0.318 (0.240)	0.185	1.374	0.859-2.199
3rd Trimester a	0.192 (0.293)	0.514	1.211	0.682-2.152
Both Trimesters a	0.597 (0.215)	0.005	1.816	1.192-2.766
Summative Support				
3rd Trimester	0.198 (0.076)	0.009	1.426	1.008-2.018
Marital Status b	-0.644 (0.333)	0.053	0.525	0.274-1.008
Age				
29-44 years c	0.355 (0.177)	0.045	1.426	1.008-2.018
Exercise (2nd Trimester)				
2-3x a week d	0.361 (0.252)	0.152	1.434	0.876-2.350
Occasionally/Never d	0.872 (0.240)	0.000	2.391	1.495-3.824
<b>Epidural Use</b>				
Variable	$\beta$ (S.E.)	p-value	Odds Ratio	95% Confidence Interval
Anxiety				
2nd Trimester a	1.283(0.781)	0.100	3.607	0.780-16.670
3rd Trimester a	1.630(1.089)	0.134	5.105	0.604-43.138
Both Trimesters a	1.644(0.713)	0.021	5.177	1.280-20.937
Drinking				
2nd Trimester b	0.867(0.423)	0.040	2.380	1.039-5.451
Age				
29-44 years c	0.105(0.262)	0.689	1.110	0.665-1.854
Anxiety*Age				
2nd Trimester*Age	-0.642(0.475)	0.176	0.526	0.207-1.335
3rd Trimester*Age	-0.690(0.644)	0.284	0.501	0.142-1.772
Both Trimesters*Age	-1.185(0.431)	0.006	0.306	0.131-0.712
<b>Caesarean Birth</b>				
Variable	$\beta$ (S.E.)	p-value	Odds Ratio	95% Confidence Interval
Anxiety				
2nd Trimester a	-0.651(0.306)	0.034	0.522	0.286-0.951
3rd Trimester a	-0.221(0.343)	0.519	0.801	0.409-1.570
Both Trimesters a	-0.157(0.251)	0.531	0.854	0.522-1.397
Summative Stress				
3rd Trimester	0.123(0.060)	0.041	1.131	1.005-1.272
Age				
29-44 b	0.620(0.213)	0.004	1.859	1.223-2.824

episodic major depression and gestational diabetes in our study was also strong, with participants experiencing depression symptoms at Time 1, 3.52 times more likely to have gestational diabetes as well. It is difficult to understand whether the increased likelihood of gestational diabetes is a result of depression or if those women diagnosed with gestational diabetes are more likely to experience depression.

However, Crowther et al. demonstrated that an intervention program to manage gestational diabetes contributed to a reduction in depression symptoms [31].

There was an unexpected association found in the multivariate logistic regression model for swelling/edema. In this model, episodic major depression at Time 1 was significantly associated with swelling/

edema, as was summative support at Time 3, which had a positive association. Research demonstrates that increased social support generally helps to decrease not only the prevalence of antenatal depression, but also of pregnancy complications [4,32]. It may be that women who experience adverse physical symptoms during pregnancy have more emotional support from family and friends due to their symptoms.

Overall, our study demonstrates that major depression symptoms are associated with obstetrical complications whether they occur episodically or chronically in pregnancy. Conceivably, some outcomes are more easily influenced by a psychopathology, such as depression symptoms. For example, gestational diabetes is related to the amount of exercise a woman undertakes during pregnancy and the diet she consumes [33,34]. Research demonstrates that women who are depressed may be less apt to take care of themselves during pregnancy [18]. However this is only one explanation, gestational diabetes is influenced by many other factors than exercise and diet and it may be that women who are diagnosed with gestational diabetes experience depression symptoms as a result of the diagnosis.

We anticipated chronic mild depression symptoms would have a stronger association with complications than episodic mild depression symptoms. Four outcomes reached statistical significance: antenatal bleeding/abruption, premature rupture of membranes (PROM), vacuum/forceps delivery, and caesarean birth. Some of these outcomes were significantly associated with chronic mild depression symptoms and others were associated with episodic mild depression symptoms, demonstrating that episodic mild depression can also have a significant influence on pregnancy and labour complications.

The association between chronic mild depression symptoms and vacuum and forceps was strong. This finding is consistent with the literature [5], which shows operative deliveries are associated with depression and confirms our hypothesis of chronic mild depression symptoms having a stronger association with vacuum/forceps delivery than episodic mild depression. However, this finding is also somewhat unique, as there is a lack of information regarding mild depression and its association with complications.

Many outcomes that were significantly associated with major or mild depression symptoms were associated with an episodic depressive score rather than chronic depression symptoms. This may mean that episodic depression occurring in the second trimester has a more detrimental impact on pregnancy and labour complications than depression symptoms occurring in the third trimester or chronically throughout pregnancy.

Others have also demonstrated that depression in the second trimester is associated with pregnancy and labour complications. For example, Dayan et al. [13], screened participants for depression in the second trimester and found that participants who screened positively for depression were significantly more likely to have a spontaneous preterm birth. Additionally, Kurki et al. [35], found that participants with depression symptoms in the second trimester were significantly more likely to have preeclampsia. However, some studies have demonstrated that depression and anxiety symptoms in the third trimester and continuously throughout pregnancy can influence pregnancy and labour complications, but this is not fully

understood. Therefore, further research is needed to understand which complications may be more influenced by depression occurring at different times during pregnancy.

Similar to mild and major depression symptoms, some complications had a stronger association with episodic anxiety, while others fit the hypothesis and were significantly associated with chronic anxiety. The finding that chronic anxiety was related to swelling/edema is consistent with the literature as anxiety is significantly related to hypertension and preeclampsia [35] and swelling/edema is a symptom of these issues [36]. It is not surprising that we found an association between complications of pregnancy and stress or mood problems.

Researchers report a bidirectional association between increased blood pressure and blood sugar level and mental health problems such as anxiety and depression that are caused by a number of shared underlying neurological and physiological mechanisms. These include inflammation and dysregulation of the hypothalamic-pituitary-adrenal axis may alter the hypothalamic pituitary adrenal axis, in which elevates plasma adrenocorticotrophic hormone and cortisol levels, which increases the release of placental corticotropin-releasing hormone, and can further increase of the release of adrenocorticotrophic hormone and cortisol [37,38].

There was an unexpected association between episodic anxiety symptoms at Time 1 and caesarean birth, with those experiencing episodic anxiety symptoms 48% less likely to have a caesarean birth. Past research has found that women who experience anxiety and depression during pregnancy are significantly more likely to have a caesarean birth [5]. A possible explanation for this contrary outcome is that women with higher sociodemographic factors, such as high income [39] and higher education [40] are more likely to give birth at an advanced age. Women who give birth at a higher maternal age are at a significantly increased risk for complications that result in a caesarean birth [41]. The positive association between stress and caesarean birth may provide a possible explanation for this association. It is possible that there is a desirability bias present here. Since stress and anxiety are interconnected concepts [42], perhaps participants were more comfortable responding to stressors than they were completing the screening tool for anxiety and depression symptoms.

Participants were significantly more likely to use an epidural if they were both in the younger age category and experienced chronic anxiety symptoms. This significant interaction fits with the literature because younger women are at a greater risk of experiencing anxiety symptoms during pregnancy [16] and therefore, may be more likely to also use an epidural, since epidural use is associated with anxiety [5] (Table 4). Women may also be having anxiety due to fear of childbirth; therefore, it makes sense that women experiencing anxiety throughout pregnancy are significantly more likely to request an epidural.

## Biases and Limitations

Since the women in this study have much higher sociodemographic status than the general population, this limits generalizability; however, many women fit this profile. This might be expected as



healthier, more highly educated, and higher income status people are more likely to participate in studies [43]. As well, it is reasonable to assume that a woman who is feeling depressed may be less engaged in participating in a lengthy research study.

It is possible that there was a bias in the complications reported. Data was self-reported and medical charts of the participants were not referenced to determine accuracy. The women completed the last questionnaire four to six weeks postpartum, and would have been adjusting to life with a new baby, so they may have forgotten some complications experienced earlier in pregnancy. Memory capacity can decrease throughout pregnancy and into the postpartum, particularly recall memory [44]. Furthermore, Pio de Almeida [27] found that participants suffering from postpartum depression have more memory problems compared to participants without postpartum depression, so some of the women with depression may have forgotten information.

Participants were not recruited until the second trimester; therefore, the impact that depression and anxiety in the first trimester is unknown. Additionally, participants were screened for depression with the EPDS and although it has high reliability, it is not a diagnostic tool [22]. Therefore, the EPDS score is a proxy for depression symptoms. We referred women with EPDS scores over 12 for more assessment and possible treatment. Lastly, it is important to note that we recognize that these were just two time points during pregnancy and women could have been depressed at different times.

## Conclusions and Implications

As research is confirming, pregnancy and labour complications are associated with depression and anxiety symptoms; therefore, it is imperative that healthcare professionals are cognizant and seek to identify depression and anxiety symptoms in their pregnant patients. Further, it is important to note that this study also demonstrates that mild depression, episodic depression, and anxiety symptoms can also have a significant impact on complications.

Further research on the impact of episodic and chronic depression and anxiety symptoms on pregnancy and labour complications is needed with more frequent measure of symptoms. This study identified that increased support also increased the likelihood of experiencing a pregnancy complication. This is opposite of what is generally found in the literature; therefore, it would be interesting to understand the relationship of various levels of support during pregnancy and determine if there is an optimal level of support and if too much support becomes stressful.

This study shows that depression and anxiety symptoms in the second trimester could have a more detrimental impact on the pregnancy compared to episodic depression and anxiety symptoms in the third trimester. Perhaps this means that some outcomes are more influenced by anxiety and depression symptoms than others or that there is a time during pregnancy that is more susceptible to negative influences such as depression. However, this topic is not well understood. Finally, it is important to note that even mild depression symptoms can influence pregnancy and labour outcomes, in particular operative births (use of forceps and/or vacuum), which may have greater adverse effects on the baby and mother.

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## Authors contributions

AB and NM conceived of the study, the design and coordinated the study. LS conceived the analysis plan, completed the analysis, and drafted the manuscript. All authors read, provided feedback, and approved the final manuscript.

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