Previous pregnancy outcomes and subsequent pregnancy anxiety in a Quebec prospective cohort

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Abstract

Introduction—Pregnancy anxiety is an important psychosocial risk factor that may be more strongly associated with adverse birth outcomes than other measures of stress. Better understanding of the upstream predictors and causes of pregnancy anxiety could help to identify high-risk women for adverse maternal and infant outcomes. The objective of the present study was to measure the associations between five past pregnancy outcomes (live preterm birth (PTB), live term birth, miscarriage at <20 weeks, stillbirth at ≥20 weeks, and elective abortion) and pregnancy anxiety at three trimesters in a subsequent pregnancy.

Methods—Analyses were conducted using data from the 3D Cohort Study, a Canadian birth cohort. Data on maternal demographic characteristics and pregnancy history for each known previous pregnancy were collected via interviewer-administered questionnaires at study entry. Pregnancy anxiety for the index study pregnancy was measured prospectively by self-administered questionnaire following three prenatal study visits.

Results—Of 2366 participants in the 3D Study, 1505 had at least one previous pregnancy. In linear regression analyses with adjustment for confounding variables, prior live term birth was associated with lower pregnancy anxiety in all three trimesters, whereas prior miscarriage was significantly associated with higher pregnancy anxiety in the first trimester. Prior stillbirth was associated with greater pregnancy anxiety in the third trimester. Prior elective abortion was

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significantly associated with higher pregnancy anxiety scores in the first and second trimesters, with an association of similar magnitude observed in the third trimester.

Discussion—Our findings suggest that the outcomes of previous pregnancies should be incorporated, along with demographic and psychosocial characteristics, into conceptual models framing pregnancy anxiety.

Keywords

Pregnancy; anxiety; perinatal mental health; adverse pregnancy outcomes; perinatal loss

Introduction

Epidemiologic studies have shown links between stress and anxiety during pregnancy and adverse pregnancy outcomes [1–3]. Pregnancy anxiety specifically captures concerns, fears and worries related to pregnancy [1,3–5] and has been identified in some research as a predictor of adverse birth outcomes [1,2,5–7]. Work by Dunkel-Schetter and others has found pregnancy anxiety to be a more consistent predictor of pregnancy duration than other forms of anxiety or psychosocial stress during pregnancy [1,5]. Stemming from this work, Dunkel-Schetter has developed a conceptual framework that integrates predictors, mediators and moderating variables to describe how pregnancy anxiety may lead to preterm birth (PTB) [1].

In light of findings on the possible downstream sequelae of pregnancy anxiety, it would be important to understand its upstream predictors. However, it is noteworthy that in Dunkel-Schetter's model, none of the predictors of pregnancy anxiety is specifically related to previous pregnancy experiences, which could plausibly change pregnancy expectations and increase future pregnancy anxiety [8,9]. Pregnancy anxiety has been associated with a prior history of miscarriage [10–12] or perinatal loss [9,13–15]. However, few studies have differentiated between different adverse pregnancy outcomes in the prediction of future pregnancy anxiety. Further, even in the absence of adverse past pregnancy outcomes, primiparity has also been associated with pregnancy anxiety [5,16–20].

Evidence suggests that perinatal loss may be associated with depressive symptoms during a subsequent pregnancy as well [14,21–23]. Pregnancy loss can be experienced as a stressful or traumatic event that is often followed by a period of grief and mourning [24] involving a complex pattern of psychological and physiological reactions [22]. Sequelae can include anxiety, depression, and other emotional symptoms [14,21–23] that can persist in some cases for 1 to 2 years [22]. Several studies investigating anxiety and depression during pregnancy have found both of these variables to be associated with previous perinatal loss [14,21–23], though one study found associations for pregnancy anxiety but not for trait anxiety or depressive symptoms [25].

Consequently, we propose in a first step to examine the contribution of obstetric history in primigravid and multigravid women to subsequent mental health measures in a Canadian cohort. In a second step, our specific objective is to measure in multigravid women the additional independent contributions of five past pregnancy outcomes – live preterm birth,

live term birth, miscarriage at <20 weeks, stillbirth at 20 weeks, and elective abortion – to anxiety and depression as measured in each of the three trimesters in a subsequent pregnancy. We hypothesized that previous live term births would be significantly associated with lower depression and anxiety scores and that previous live preterm births, stillbirths, miscarriages and elective abortions would be related to greater depression and anxiety symptoms. Further, we hypothesized that the associations of miscarriage with pregnancy anxiety would be stronger for pregnancy anxiety measured at the beginning of the index pregnancy, whereas the association between prior preterm birth and stillbirth with pregnancy anxiety would be stronger at the end of the index pregnancy.

Methods

Participants

The 3D Cohort Study comprises 2366 women recruited during the first trimester of pregnancy at one of nine clinical centers in the province of Quebec, Canada [26]. Women were between 18 and 45 years of age at the time of recruitment and fluent in English or French. Exclusion criteria included current intravenous drug use, severe illnesses or life threatening conditions, and multiple gestation pregnancies. All the participants signed informed consent forms and the study was approved by the IRB at Sainte-Justine University Hospital Research Center (Montreal) and those of all the collaborating centers.

Measures

Demographic characteristics examined include maternal age at study entry, number of previous pregnancies (gravidity prior to the index pregnancy), annual household income, education, race/ethnicity, marital status and smoking status. In addition, pregnancy intention (planned versus unplanned pregnancy) and use of ovulation-inducing drugs or other assisted reproductive technologies were assessed by self-report at baseline, and pregnancy complications were assessed by interviewer-administered questionnaire at each of three prenatal study visits.

Anxiety and depression scales—Mental health measures in the 3D Cohort Study were selected on an evidence basis after extensive consultation with experts in the fields of perinatal epidemiology, psychology and neuroscience from the Montreal Prematurity Study Group [27]. Pregnancy anxiety was measured using the scale developed by Dunkel-Schetter and colleagues [28,29], which has been used extensively by this group and others and has been shown to predict adverse birth outcomes including preterm birth [7]. Study participants reported how often they had felt *anxious*, *concerned*, *afraid* and *panicky* in the past week [29]. Responses were provided on a 5-point scale ranging from *never* to *almost always*. A 10-item anxiety disorders screening instrument developed by Séguin, Freeston and colleagues [30] was also administered. The scale was developed to screen for the following 10 conditions in parents in large scale longitudinal studies: simple phobia, social phobia, panic disorder, agoraphobia, generalized anxiety disorder (worry), generalized anxiety disorder (physical), obsessions, compulsions, post-traumatic stress disorder and hypochondria. Each item was rated on a 5-point Likert scale ranging from *never* to *constantly*, with the total score calculated as the number of items marked as *sometimes*,

often, or *constantly* (1 point for any of these responses, 0 points for *never* or *rarely*). Depressive symptoms were measured using the 10-item (first trimester) and 4-item (second and third trimesters) versions of the Center for Epidemiological Studies Depression Scale (CESD) [31]. In a previous validation study, principal components analysis was used to confirm similar factor structures in the English and French versions of the pregnancy anxiety scale and of the CESD [7].

Previous pregnancy outcomes—The number of previous pregnancies and outcomes of each previous pregnancy were reported at the first study visit. The following previous pregnancy outcomes were examined as exposure variables: live preterm births, live term births, stillbirths at 20 weeks, elective abortions and miscarriages at <20 weeks. We chose a cutoff of 20 weeks to delineate between miscarriage and stillbirth as this is the standard cutoff in Canada [32] and was the most commonly used cutoff in the literature to which we compared our results [19,22,25], though both earlier [21] and later [10,23,33,34] cutoffs also have been used. In contrast to previous studies of perinatal loss [8,9,14,15,35,36], neonatal deaths following past pregnancies were not measured in the 3D Study.

Procedure

Data on maternal demographic characteristics and pregnancy history for each known *previous pregnancy* (including those <20 weeks) were collected retrospectively via interviewer-administered questionnaires at study entry. Pregnancy anxiety for the (subsequent) *index pregnancy* and depressive symptoms were measured by self-administered questionnaire at each of the three prenatal visits (8–14 weeks, 20–24 weeks, 32–35 weeks). The anxiety disorders screening instrument was administered only once in the 3D Study, at the second-trimester assessment.

Statistical analysis

All the analyses were carried out using IBM-SPSS for Windows version 21 (IBM Corporation, Armonk, NY). Missing data were handled using the MULTIPLE IMPUTATION procedure in SPSS, with the fully conditional specification algorithm and five imputations. One participant who reported having been pregnant before the index pregnancy but who had no data on previous pregnancies was removed from analyses, leaving 2365 participants in the study sample. Eight previous pregnancies with implausible gestational ages were also removed. We began by describing demographic and clinical characteristics of the study sample. We compared anxiety and depression measures and response rates across different strata of the sample using SPSS UNIANOVA, which is robust to unbalanced designs.

Within the subsample of multigravid women, we computed Pearson bivariate correlations between previous pregnancy outcomes and subsequent depression and anxiety measures at each of the three trimesters. For measures showing significant bivariate correlations with the different previous pregnancy outcomes, associations were tested using linear regression models. Potential confounding variables examined included demographic and clinical characteristics and self-reported complications in the study pregnancy. Adjusted models included all of the five previous pregnancy outcomes in order to determine the unique effects

of each, with outcomes from each previous pregnancy considered simultaneously for each participant. Finally, we ran a sensitivity analysis predicting pregnancy anxiety while controlling for depression and anxiety disorders screening score.

Results

Study sample and previous pregnancies

Of 2365 participants in the study sample, 1824 completed the self-administered questionnaire at visit 1 (77%), 1709 at visit 2 (75% of those still pregnant) and 1581 at visit 3 (71%). Participants reporting white race/ethnicity, higher household incomes or education levels, and those married or living with a partner responded more frequently at all three trimesters, as did former smokers and women with intended pregnancies. Table 1 shows the demographic characteristics of the entire study sample (primigravid and multigravid participants) and mental health measures at each trimester across strata. Self-reported current pregnancy complications are detailed in Table 2. Data on "other reported complications" were detailed only at the third trimester in the 3D Study. The most frequently reported of these were gestational diabetes (32 participants, 1.4%), bacterial vaginosis (16 participants, 0.7%), and impaired glucose tolerance (11 participants, 0.5%).

The 1505 multigravid participants had a total of 2912 total previous pregnancies. Roughly half of these resulted in a live birth, one quarter in miscarriage and one fifth in elective abortion. Seventy percent of multi-gravid participants had at least one live birth (maximum number of live term births = 10, maximum number of live preterm births = 5), 37% had at least one previous miscarriage (maximum 9), 28% at least one elective abortion (maximum 5), and 3% at least one prior stillbirth (maximum 2).

Correlations between demographic variables, previous pregnancy outcomes and index pregnancy anxiety, anxiety and depression symptoms

Table 3 shows bivariate correlations between continuous demographic variables, previous pregnancy outcomes, and maternal mental health measures within the subsample of 1505 multigravid participants. The number of previous live term births was significantly correlated with lower pregnancy anxiety in all three trimesters. Prior stillbirth and elective abortion were both associated with higher pregnancy anxiety in all three trimesters. We observed significant positive correlations between both prior miscarriage and prior PTB with pregnancy anxiety in the first trimester of the index pregnancy. Despite moderate correlations accounting for about 9% of shared variance among the different mental health measures, none of the previous pregnancy outcomes displayed strong relationships with depressive symptoms or anxiety disorder screening score in the index pregnancy.

Associations between previous pregnancy outcomes and subsequent pregnancy anxiety at each trimester

Table 4 shows the results of multivariate linear regression analyses examining the associations of previous pregnancy outcomes among multigravid participants with index pregnancy anxiety in each trimester. Coefficients represent the change in standardized pregnancy anxiety score associated with each independent variable. The crude models show

the unadjusted parameters for each past pregnancy outcome, while the partially adjusted analyses show that prior live term birth, stillbirth and elective abortion were each independently associated with subsequent pregnancy anxiety in all the three trimesters.

Following from the results shown in Tables 1 and 3, household income, race/ethnicity, unintended pregnancy and self-reported complications were included as covariates in all fully adjusted linear regression analyses, and smoking was included in analyses predicting pregnancy anxiety in the first and second trimesters. Associations for a prior live term birth and elective abortion were opposite in direction but of similar magnitude before and after adjusting for covariates. The association between prior stillbirth and pregnancy anxiety maintained statistical significance in adjusted analyzes in the third trimester. The pattern of associations for live term births, stillbirths and elective abortions exhibited considerable homogeneity across the three trimesters in adjusted analyzes. Prior miscarriage was significantly associated with subsequent pregnancy anxiety in the first trimester only.

The fully adjusted models accounted for 9% of variance in pregnancy anxiety scores in the first and second trimesters, and 6% in the third trimester. In the sensitivity analysis where depression and anxiety disorders screening score were controlled for, the percent of variance explained by the models increased significantly to 33% in the first trimester, 24% in the second trimester and 26% in the third trimester. Point estimates of significant regression coefficients for previous pregnancy outcomes were non-significantly attenuated up to 21% while retaining statistical significance in the sensitivity analysis, with the exception of stillbirth predicting third-trimester pregnancy anxiety. After controlling for depression and anxiety disorders screening score, this coefficient was non-significantly attenuated by 32% from 0.40 (95% CI 0.05, 0.74, $p = .025$) to 0.27 (−0.01, 0.55, $p = .061$).

Discussion

The principal analyses of this study examined whether previous pregnancy outcomes predicted pregnancy anxiety in a subsequent pregnancy over and above several potential confounders. The associations for live term births and elective abortions were observed in all three trimesters of pregnancy, while the association for miscarriage was stronger and statistically significant only for first-trimester pregnancy anxiety and that for stillbirths was significant only in the third trimester. The findings were consistently in the directions we hypothesized and were largely robust to adjustment for demographic and socioeconomic variables. Our finding that prior preterm birth was associated in crude analyses with pregnancy anxiety only in the first trimester was unexpected, as we had hypothesized that this effect would be greater as the pregnancy progressed toward the third trimester, when a subsequent preterm birth was more likely to occur. Our findings for prior miscarriages and stillbirths were in line with our hypotheses regarding when in the pregnancy these exposures would exhibit the strongest effects. The effect size for prior stillbirth was moderate (40% of a standard deviation of the pregnancy anxiety scale), while those for other previous pregnancy outcomes were comparatively small (generally less than 15% of a standard deviation). Overall, effect sizes for previous pregnancy outcomes were of comparable magnitude to those for race/ethnicity and self-reported complications, and were smaller than the effect size for unintended pregnancy.

The relationship reported here between previous live term births and lower pregnancy anxiety corroborates results reported by Saisto and colleagues (standardized β= −0.15; 95% CI = −0.28, −0.02) [18]. While this association may be driven by the experience of previous pregnancy and successful childbirth, Saisto et al. point out that fears of pregnancy and childbirth may be related to more generalized anxiety, life dissatisfaction and difficulty coping with demanding life events for newly expectant mothers. It is also plausible that women in that study who had more previous live births would later be coping with greater family demands and stresses. Therefore, whatever anxiety these women experience may be more focused on such preexisting demands than on a new pregnancy. If this is so, however, such anxiety was not captured by the additional measures we examined, as prior live term births were not substantially associated with depression or symptoms of anxiety disorders. Of note, we did not find strong evidence linking prior PTB to pregnancy anxiety, and we found no evidence of such a link for pregnancy anxiety in the third trimester, when PTB most frequently recurs [37]. This raises the possibility that appropriate clinical management and communication with pregnant women who have a history of PTB may help alleviate concerns about recurrence. Alternatively, women may find that having a child born preterm is simply less anxiety-provoking than a spontaneous abortion or stillbirth, as sequelae beyond initial medical care for the infant may not be severe.

As expected, we found evidence for an association between prior miscarriage at <20 weeks and pregnancy anxiety in early pregnancy, with no association at mid- or late pregnancy in adjusted analyzes. This finding is consistent with several studies which have found elevated pregnancy anxiety scores among participants with a history of miscarriage [10–12]. Our findings for prior miscarriage contrast with those of two studies that found no association between history of miscarriage and pregnancy-specific distress or pregnancy anxiety [18,19], both of which used outcome measurement scales capturing a broader, and perhaps less sensitive, range of symptoms than our 4-item pregnancy anxiety scale.

We found an association between prior elective abortion and pregnancy anxiety that was strongest in the first trimester. This finding is consistent with previous studies linking a positive history of elective abortion with general anxiety [33,38] and psychosocial stress [39] in a subsequent pregnancy. The mediating factors linking elective abortion to pregnancy anxiety are not well understood. Psychological sequelae of elective abortion including possible shame and guilt have been described [40–42], but not in connection to pregnancy anxiety.

It is noteworthy that we did not observe substantial relationships between previous pregnancy outcomes and depressive symptoms or anxiety disorder screening score in the index pregnancy. It has been suggested that perinatal loss may be associated with general distress more so than with depressive symptomatology per se [14]. However, several studies have found both elevated depression and anxiety scores among pregnant women with previous adverse pregnancy outcomes [21–23]. Differences between results from previous studies and ours may stem from use of high-risk vs. general clinical samples, as well as use of different instruments to measure depression and anxiety.

Our results provide support for broadening the theoretical framework for the concept of pregnancy anxiety. Further exploration of the psychological mechanisms underlying the associations we found may in turn point the way toward clinical intervention. Findings from the sensitivity analysis show that the principal associations under investigation were not largely mediated by depression or anxiety symptoms. Women who have experienced perinatal loss or other adverse pregnancy outcomes in the past may become conditioned to fear a repetition of these outcomes in future pregnancies [8–11,13,15]. In addition to fears resulting from a conditioning response, pregnancy anxiety may stem from medical knowledge concerning the recurrence of some adverse pregnancy outcomes [43–45]. The results of our study could be used to inform the process of developing a predictive model to identify high-risk women for pregnancy anxiety screening. Our findings suggest that it may be valuable to consider screening at multiple time points, as anxiety levels declined only moderately from the first to the third trimester, and risk factors differed between early and late pregnancy. Screening several times across pregnancy also has the potential to identify women with chronic pregnancy anxiety, which may also be more severe [3].

Several limitations must be kept in mind when interpreting our results. Response rates to the self-administered questionnaires from which our outcome variables were taken ranged from 71% to 77%. Non-responders tended to be lower-SES, higher-risk participants and also tended to have higher pregnancy anxiety scores, suggesting that any non-response bias would lead to an attenuation of effects. In addition, the characteristics of the overall 3D Cohort from which our multigravid sample was drawn are likely to limit generalizability of our findings. We cannot directly compare the study sample to those who declined to participate, as no demographic information was available for non-participants. However, recruitment took place at urban clinical centers, and participants were on average older and had a higher education level than Canadian and Quebec births overall [26,46,47]. Rates of PTB and low birth weight were also slightly lower in the 3D Study than overall births in Canada or in the province of Quebec during the recruitment period [26,46,47]. In addition, the rates of self-reported complications including vomiting, vaginal bleeding, bacterial vaginosis and gestational diabetes were generally lower than those reported in other studies [48–50]. Finally, women who were illiterate or who used only a language besides English or French were excluded from the 3D Study. Thus, our findings may not be generalizable to more socially marginalized or otherwise vulnerable women. This is of particular concern, given the elevated rates of adverse pregnancy outcomes in such populations [51–54].

The characteristics of the 3D Study participants described above are reflected in the relatively low levels of pregnancy anxiety reported in our study. The overall mean pregnancy anxiety scores ranged from 3.1 to 3.7, while stratum-specific means ranged from 2.9 to 5.3. This is substantially lower than scores reported in another cohort using the same instrument, where levels ranged from 7.8 to 8.8 [7]. Our ability to study high levels of anxiety is thus limited, and it is plausible that stronger associations with our study outcomes would be observed in populations with greater stress levels or more variation in stress exposure.

Pregnancy anxiety is not a singular concept and can be measured using various instruments [3,55]. Most of the studies we reviewed [9,10,12,18,19,25] used different scales than that used in the 3D Study. In comparison to the 4-item scale we used that focuses exclusively on

concerns related to the pregnancy, other instruments may be less sensitive, as they tend to encompass a broader range of domains, including concerns about childbirth and hospitalization [18], as well as physical symptoms of pregnancy, concerns about paying for medical care, and changes in relationships [19]. Our results need to be compared with those of other studies with this caveat in mind. We also recognize that self-reported pregnancy history may be subject to recall bias and will underestimate the true incidence of miscarriage, as some pregnancies ending in miscarriage go unrecognized. Finally, while we separated previous preterm and term births, we did not consider early vs. late preterm births. It is plausible that very early PTB is more anxiety provoking than late preterm birth, given its severe consequences for infant and child development.

Alongside these limitations, our study has several key strengths. Most importantly, we had data on complete pregnancy history, which constitutes a substantial advance over previous studies that looked either at one adverse pregnancy outcome [10–12,21,56] or combined several outcomes to define a high-risk population [8,9,15,20,22–25]. While pregnancy history and current pregnancy complications as measured from chart abstractions are sometimes considered a gold standard, we believe the use of self-reported measures constitutes a strength in our study. Self-reported pregnancy history captures a wider range of exposures than chart abstractions or population-level health data sources, which generally do not include miscarriages or pregnancies occurring outside the registry catchment area. Our use of self-reported anxiety and depression measures as opposed to biomarkers allowed us to focus on the subjective components of these concepts as opposed to biological sequelae or correlates of adverse pregnancy experiences. Similarly, self-reported pregnancy complications are likely to be more relevant to pregnancy anxiety than complications as measured from the medical chart, which may be asymptomatic or of less concern to the patient. Finally, measurement of our study outcomes at all three trimesters of pregnancy enabled us to examine the time-specific associations with previous pregnancy outcomes in more detail than studies with only one [9,13–17,20,22,25] or two [10,33,38,56] measurements across pregnancy.

Our study findings point to several directions for future research. In line with our findings regarding previous live births and pregnancy anxiety, we suggest that future studies explore pregnancy anxiety in relation to already having additional children and other family stresses. Following up on our findings linking previous elective abortion to future pregnancy anxiety, we suggest that future studies explore factors mediating this association such as shame and guilt, as addressing these feelings has the potential to reduce both pregnancy anxiety and postpartum depression [57–59]. Finally, to further disentangle the relative effects of different aspects of pregnancy history and other predictors of pregnancy anxiety, further research using larger data sets is needed.

Conclusions

This study examined several previous pregnancy outcomes to add to the literature on the relationship between obstetric history and anxiety in future pregnancies. Our results showed independent links between several aspects of obstetric history and pregnancy anxiety, suggesting that the patient's entire pregnancy history needs to be considered in addressing

concerns about the current pregnancy, both in research frameworks and in clinical practice. Evidence-based intervention programs are likely to be more effective if they take into account the full range of a patient's obstetric experience, including prior pregnancy outcomes.

Acknowledgments

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Current knowledge on the subject

- Pregnancy anxiety has been identified as a psychological risk factor for adverse birth outcomes.

- Adverse pregnancy outcomes may increase women's anxiety related to subsequent pregnancy.

- Previous pregnancy outcomes have not been systematically incorporated into conceptual frameworks on pregnancy anxiety.

What this study adds

- In order to examine the timing of effects over pregnancy, we measured associations between previous pregnancy outcomes and pregnancy anxiety reported at three time points in a subsequent pregnancy.

- Prior live term birth, miscarriage, stillbirth and elective abortion were each independently associated with pregnancy anxiety in a later pregnancy, with risk factors differing depending on the timing of pregnancy anxiety measurement.

- Incorporation of previous pregnancy outcomes into research frameworks may strengthen conceptual models of pregnancy anxiety and lead to improved clinical screening.

Table 1

Sample characteristics and maternal mental health measures, entire 3D Cohort Study sample, *N* = 2365.

	N (%)		Pregnancy anxiety			Depression			Anxiety disorders screening scale Second trimester (*N* = 1700)
			First trimester (*N* = 1811)	Second trimester (*N* = 1700)	Third trimester (*N* = 1573)	First trimester (*N* = 1813)	Second trimester (*N* = 1696)	Third trimester (*N* = 1578)	
Overall	2365	(100%)	3.69 (3.29)	3.13 (2.98)	3.29 (2.94)	7.34 (4.74)	1.44 (2.00)	1.30 (1.87)	1.54 (1.84)
Maternal age									
<25	173	(7%)	4.13 (3.44)	3.02 (3.00)	3.25 (2.71)	7.81 (4.41)	1.85 (2.10)	1.46 (1.67)	1.94 (1.97)
25–29	751	(32%)	3.65 (3.30)	3.21 (3.01)	3.34 (2.88)	7.18 (4.82)	1.63 (2.17)	1.30 (1.81)	1.63 (1.87)
30–34	917	(39%)	3.50 (3.15)	3.03 (2.76)	3.27 (2.96)	7.38 (4.70)	1.26 (1.79)	1.22 (1.83)	1.40 (1.76)
35	519	(22%)	3.99 (3.47)	3.27 (3.32)	3.28 (3.07)	7.35 (4.76)	1.40 (2.06)	1.40 (2.05)	1.55 (1.90)
p			.058	.56	.98	.63	.002	.43	.02
Previous pregnancies									
0	860	(36%)	3.77 (3.09)	3.30 (2.86)	3.51 (2.86)	6.57 (4.55)	1.29 (1.85)	1.18 (1.71)	1.39 (1.69)
1	761	(32%)	3.43 (3.29)	2.93 (2.81)	3.19 (2.91)	7.69 (4.64)	1.40 (1.88)	1.25 (1.78)	1.55 (1.85)
2	380	(16%)	3.72 (3.53)	2.97 (2.96)	3.05 (2.87)	7.79 (4.75)	1.75 (2.30)	1.34 (1.83)	1.65 (1.85)
>2	364	(15%)	3.99 (3.51)	3.28 (3.63)	3.14 (3.26)	8.10 (5.14)	1.65 (2.28)	1.66 (2.37)	1.80 (2.16)
p			.098	.12	.11	<.001	.006	.008	.015
Annual household income (Canadian dollars)									
<30,000	256	(11%)	4.54 (3.93)	3.64 (3.40)	3.56 (3.33)	9.00 (5.40)	2.01 (2.45)	1.78 (2.19)	2.05 (2.36)
30,000–49,999	286	(13%)	3.98 (3.46)	3.40 (3.28)	3.32 (3.04)	8.31 (5.27)	2.11 (2.61)	1.65 (2.21)	1.84 (2.15)
50,000–99,999	1017	(45%)	3.67 (3.24)	3.10 (2.88)	3.34 (2.93)	7.28 (4.58)	1.44 (1.89)	1.32 (1.85)	1.53 (1.71)
100,000	688	(31%)	3.41 (3.03)	2.96 (2.83)	3.10 (2.73)	6.74 (4.47)	1.06 (1.66)	1.06 (1.65)	1.24 (1.63)
p			.001	.052	.32	<.001	<.001	<.001	<.001
Maternal education									
Less than college	254	(11%)	3.96 (3.58)	3.16 (2.94)	3.15 (2.93)	8.37 (5.36)	2.24 (2.53)	1.82 (2.25)	1.82 (2.09)
College or technical school	619	(27%)	3.90 (3.57)	3.22 (3.29)	3.45 (3.20)	7.63 (4.65)	1.59 (2.06)	1.40 (1.85)	1.79 (2.03)
University degree	911	(39%)	3.62 (3.12)	3.22 (2.94)	3.35 (2.84)	7.12 (4.65)	1.34 (1.92)	1.24 (1.86)	1.40 (1.68)
Master's or doctoral degree	532	(23%)	3.47 (3.10)	2.82 (2.67)	3.07 (2.83)	7.00 (4.65)	1.16 (1.79)	1.13 (1.73)	1.41 (1.79)
p			.16	.13	.28	.004	<.001	.001	.001
Maternal self-reported race/ethnicity									

	N (%)		Pregnancy anxiety			Depression			Anxiety disorders screening scale
			First trimester (N = 1811)	Second trimester (N = 1700)	Third trimester (N = 1573)	First trimester (N = 1813)	Second trimester (N = 1696)	Third trimester (N = 1578)	Second trimester (N = 1700)
White	1636	(69%)	3.53 (3.15)	2.92 (2.79)	3.14 (2.80)	7.30 (4.60)	1.42 (1.94)	1.26 (1.77)	1.46 (1.77)
Other	722	(31%)	4.16 (3.63)	3.76 (3.42)	3.71 (3.28)	7.43 (5.10)	1.51 (2.17)	1.40 (2.13)	1.77 (2.03)
p			<.001	<.001	.001	.58	.40	.19	.002
Marital status									
Married or living with a partner	2232	(95%)	3.62 (3.24)	3.12 (2.97)	3.30 (2.94)	7.26 (4.67)	1.41 (1.99)	1.28 (1.85)	1.53 (1.82)
Not married or living with a partner	127	(5%)	5.01 (3.96)	3.39 (3.37)	3.01 (2.98)	8.65 (5.67)	2.11 (2.15)	1.69 (2.14)	1.53 (2.24)
p			<.001	.46	.43	.008	.003	<.001	>0.99
Smoking									
Never	1331	(65%)	3.72 (3.29)	3.11 (2.93)	3.37 (3.01)	7.16 (4.78)	1.39 (1.93)	1.30 (1.91)	1.46 (1.71)
Former	408	(20%)	3.31 (3.20)	2.92 (2.82)	3.00 (2.89)	7.72 (4.82)	1.49 (2.07)	1.30 (1.83)	1.60 (1.94)
Current	303	(15%)	4.04 (3.34)	3.59 (3.15)	3.42 (2.88)	7.74 (4.65)	1.85 (2.35)	1.43 (1.81)	1.69 (1.94)
p			.033	.037	.15	.078	.013	.67	.17
Intended pregnancy									
Yes	1583	(91%)	3.50 (3.13)	3.05 (2.90)	3.20 (2.84)	7.24 (4.66)	1.42 (2.02)	1.25 (1.82)	1.53 (1.85)
No	150	(9%)	5.27 (3.96)	4.16 (3.58)	4.55 (3.79)	9.24 (6.10)	2.09 (2.67)	2.11 (2.64)	1.71 (1.89)
p			<.001	.001	<.001	<.001	.015	<.001	.42
Use of assisted reproductive technologies									
Yes	278	(12%)	3.81 (3.37)	2.91 (3.10)	3.13 (2.71)	7.21 (4.65)	1.21 (1.79)	1.17 (1.78)	1.56 (2.00)
No	2086	(88%)	3.67 (3.28)	3.16 (2.97)	3.31 (2.97)	7.35 (4.75)	1.47 (2.03)	1.32 (1.88)	1.53 (1.82)
p			.55	.25	.44	.66	.08	.30	.86
Self-reported complications first trimester									
Yes	578	(24%)	4.21 (3.50)	3.74 (3.39)	3.42 (2.86)	8.12 (4.87)	1.68 (2.20)	1.48 (2.00)	1.80 (1.97)
No	1787	(76%)	3.52 (3.21)	2.95 (2.82)	3.25 (2.96)	7.09 (4.67)	1.37 (1.93)	1.24 (1.82)	1.45 (1.79)
p			<.001	<.001	.32	<.001	.007	.031	.001
Self-reported complications second trimester									
Yes	267	(13%)	4.26 (3.76)	4.23 (3.69)	3.78 (3.26)	8.45 (5.33)	1.97 (2.62)	1.36 (1.85)	2.00 (2.24)
No	1863	(87%)	3.56 (3.20)	2.98 (2.84)	3.19 (2.85)	7.12 (4.61)	1.37 (1.89)	1.28 (1.87)	1.47 (1.77)
p			.004	<.001	.009	<.001	<.001	.62	<.001

| | N (%) | | Pregnancy anxiety | | | Depression | | | Anxiety disorders screening scale |
			First trimester (N = 1811)	Second trimester (N =1700)	Third trimester (N =1573)	First trimester (N = 1813)	Second trimester (N =1696)	Third trimester (N =1578)	Second trimester (N =1700)
Self-reported complications third trimester									
Yes	320	(16%)	3.64 (3.52)	3.20 (3.07)	3.71 (3.04)	7.93 (5.07)	1.60 (2.33)	1.63 (2.15)	1.76 (2.06)
No	1722	(84%)	3.67 (3.24)	3.12 (2.95)	3.22 (2.92)	7.16 (4.63)	1.41 (1.95)	1.24 (1.81)	1.49 (1.80)
p			.88	.67	.016	.014	.18	.002	.036

Scores reported for mental health measures are mean (std. dev.).

Table 2

Self-reported complications by trimester, entire 3D Cohort Study sample, maximum $N = 2365$.

	First trimester		Second trimester		Third trimester	
Any self-reported complications	578	(24%)	267	(12%)	320	(14%)
Repeated vomiting with weight loss	214	(9%)	*		*	
Vaginal bleeding	319	(13%)	90	(4%)	41	(2%)
Bacterial vaginosis treated	40	(2%)	43	(2%)		
Uterine contraction	*		*		55	(2%)
Preterm labor or threatened preterm birth	*		15	(1%)	78	(3%)
Other complications	106	(5%)	96	(4%)	178	(8%)

*
Data not collected in given trimester.

Table 3

Pearson correlations between demographic and obstetric risk factors and maternal mental health measures, 3D Cohort Study multigravid participants subsample, maximum $N = 1505$.

	N	Pregnancy anxiety			Depression			Anxiety disorders
		10	11	12	13	14	15	16
1. Maternal age (years)	1503	0.03	0.05	0.00	−0.02	−0.08**	0.04	−0.07*
2. Household income	1432	−0.13**	−0.09**	−0.09**	−0.18**	−0.20**	−0.16**	−0.15**
3. Maternal education (years)	1479	−0.07*	−0.05	−0.02	−0.07*	−0.12**	−0.01	−0.14**
4. Number of previous pregnancies	1505	0.06*	0.05	0.00	0.04	0.04	0.10**	0.05
5. Number of previous live preterm births	1505	0.06*	0.02	0.01	0.03	0.01	0.07*	0.04
6. Number of previous live term births	1505	−0.12**	−0.10**	−0.09**	0.00	0.02	0.06*	−0.05
7. Number of previous stillbirths	1505	0.08**	0.09**	0.09**	0.01	0.04	0.04	0.05
8. Number of previous elective abortions	1505	0.11**	0.11**	0.08*	0.05	0.04	0.02	0.05
9. Number of previous miscarriages	1505	0.09**	0.05	−0.01	0.02	0.00	0.02	0.05
10. Pregnancy anxiety first trimester	1114	–	0.60**	0.52**	0.50**	0.30**	0.28**	0.33**
11. Pregnancy anxiety second trimester	1026		–	0.61**	0.33**	0.38**	0.29**	0.32**
12. Pregnancy anxiety third trimester	963			–	0.35**	0.30**	0.42**	0.31**
13. Depression first trimester	1114				–	0.51**	0.41**	0.38**
14. Depression second trimester	1022					–	0.48**	0.38**
15. Depression third trimester	965						–	0.28**
16. Anxiety disorders screening scale second trimester	1025							–

*
$p < .05$.

**
$p < .01$.

Table 4

Results of multiple linear regression analyses between previous pregnancy outcomes and subsequent pregnancy anxiety at each trimester, 3D Cohort Study multigravid participants subsample, maximum N=1505.

	N^*	Crude models			Partially adjusted models[**]		Fully adjusted models[**]	
		β (95% CI)	p	R^2	β (95% CI)	p	β (95% CI)	p
First trimester ($N=1505$)								
Live preterm births	113	0.23 (0.03, 0.44)	0.028	0.007	0.19 (−0.01, 0.39)	.063	0.16 (−0.04, 0.36)	.10
Live term births	698	−0.14 (−0.23, −0.06)	0.003	0.015	−0.11 (−0.19, −0.03)	.011	−0.13 (−0.21, −0.05)	0.002
Stillbirths	30	0.38 (0.01, 0.74)	0.044	0.006	0.36 (0.01, 0.71)	.047	0.30 (−0.10, 0.70)	0.13
Elective abortions	311	0.16 (0.05, 0.28)	0.008	0.012	0.16 (0.05, 0.27)	.007	0.13 (0.03, 0.24)	0.013
Miscarriages	416	0.11 (0.04, 0.18)	0.003	0.009	0.12 (0.05, 0.19)	.002	0.11 (0.03, 0.18)	0.006
Income							−0.02 (−0.05, 0.02)	0.37
Non-white race/ethnicity							0.13 (−0.01, 0.27)	0.059
Current smoker							0.06 (−0.21, 0.32)	0.64
Former smoker							−0.23 (−0.39, −0.06)	0.008
Unintended pregnancy							0.51 (0.31, 0.71)	<0.001
Self-reported complications							0.21 (0.09, 0.33)	0.001
					$F(5,1499) = 13.85, p<.001, R^2 = 0.04$		$F(11,1493) = 15.09, p<.001, R^2 = 0.09$	
Second trimester ($N=1447$)								
Live preterm births	97	0.09 (−0.15, 0.32)	0.45	0.001	0.05 (−0.18, 0.27)	.66	0.00 (−0.21, 0.21)	0.99
Live term births	645	−0.13 (−0.20, −0.06)	0.001	0.013	−0.11 (−0.18, −0.04)	.004	−0.13 (−0.20, −0.05)	0.001
Stillbirths	27	0.37 (0.06, 0.68)	0.018	0.008	0.38 (0.07, 0.69)	.016	0.24 (−0.08, 0.57)	0.14
Elective abortions	272	0.14 (0.03, 0.25)	0.012	0.007	0.13 (0.02, 0.24)	.020	0.11 (0.00, 0.21)	0.047
Miscarriages	390	0.05 (−0.02, 0.11)	0.17	0.002	0.05 (−0.01, 0.12)	.11	0.04 (−0.02, 0.10)	0.19
Income							−0.01 (−0.05, 0.04)	0.78
Non-white race/ethnicity							0.17 (0.09, 0.26)	<0.001
Current smoker							0.13 (−0.07, 0.32)	0.20
Former smoker							−0.13 (−0.31, 0.06)	0.17
Unintended pregnancy							0.51 (0.32, 0.70)	<0.001
Self-reported complications							0.38 (0.19, 0.56)	<0.001
					$F(5,1441) = 7.60, p<.001, R^2 = 0.02$		$F(11,1435) = 13.52, p<.001, R^2 = 0.09$	

	N*	Crude models			Partially adjusted models **		Fully adjusted models **	
		β (95% CI)	p	R²	β (95% CI)	p	β (95% CI)	p
Third trimester (N = 1416)								
Live preterm births	100	0.05 (−0.13, 0.22)	0.60	<0.001	0.01 (−0.16, 0.18)	0.95	−0.04 (−0.22, 0.13)	0.64
Live term births	611	−0.11 (−0.19, −0.03)	0.007	0.008	−0.09 (−0.17, −0.01)	0.021	−0.13 (−0.20, −0.06)	<0.001
Stillbirths	27	0.43 (0.12, 0.74)	0.006	0.007	0.45 (0.14, 0.75)	0.004	0.40 (0.05, 0.74)	0.025
Elective abortions	259	0.13 (0.03, 0.22)	0.009	0.006	0.11 (0.01, 0.21)	0.026	0.09 (0.00, 0.18)	0.055
Miscarriages	362	−0.02 (−0.09, 0.05)	0.51	<0.001	−0.02 (−0.09, 0.05)	0.60	−0.02 (−0.09, 0.06)	0.64
Income							0.01 (−0.03, 0.05)	0.50
Non-white race/ethnicity							0.12 (0.01, 0.22)	0.033
Unintended pregnancy							0.59 (0.21, 0.96)	0.007
Self-reported complications							0.22 (0.03, 0.41)	0.025
					$F_{(5,1410)} = 5.85$, $p < .001$, $R^2 = 0.02$		$F_{(9,1406)} = 11.12$, $p < .001$, $R^2 = 0.06$	

*
N reported is number of participants with at least one of each previous pregnancy outcome. Analyses are based on continuous number of outcomes.

**
Partially adjusted models include adjustment for each previous pregnancy outcome; fully adjusted models include adjustment for other listed variables as well.