



## Demographic, Medical, and Psychosocial Predictors of Pregnancy Anxiety

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### Abstract

**Background:** Pregnancy anxiety is associated with risk of preterm birth and an array of other birth, infant, and childhood outcomes. However, previous research has not helped identify those pregnant women at greatest risk of experiencing this specific, contextually-based affective condition.

**Methods:** We examined associations between demographic, medical, and psychosocial factors and pregnancy anxiety at 24–26 weeks of gestation in a prospective, multicentre cohort study of 5271 pregnant women in Montreal, Canada.

**Results:** Multivariate analyses indicated that higher pregnancy anxiety was independently related to having an unintended pregnancy, first birth, higher medical risk, and higher perceived risk of complications. Among psychosocial variables, higher pregnancy anxiety was associated with lower perceived control of pregnancy, lower commitment to the pregnancy, more stressful life events, higher perceived stress, presence of job stress, lower self-esteem and more social support. Pregnancy anxiety was also higher in women who had experienced early income adversity and those who did not speak French as their primary language. Psychosocial variables explained a significant amount of the variance in pregnancy anxiety independently of demographic and medical variables.

**Conclusions:** Women with pregnancy-related risk factors, stress of various kinds, and other psychosocial factors experienced higher pregnancy anxiety in this large Canadian sample. Some of the unique predictors of pregnancy anxiety match those of earlier US studies, while others point in new directions. Screening for high pregnancy anxiety may be warranted, particularly among women giving birth for the first time and those with high-risk pregnancies.

**Keywords:** pregnancy anxiety, prenatal stress, psychosocial resources, medical risk.

### Background

*Pregnancy anxiety* is a negative emotional state involving worries about pregnancy such as the health and well-being of one's baby, impending childbirth, and issues surrounding motherhood.<sup>1</sup> Many studies have found pregnancy anxiety to be associated with preterm birth (PTB) and shorter length of gestation.<sup>2–7</sup> In addition, high maternal pregnancy anxiety has been linked to developmental deficits in offspring from infancy through adolescence including impaired mental and motor development,<sup>8,9</sup> poor attentional regulation,<sup>10</sup> greater likelihood of negative temperament,<sup>11,12</sup> poor executive function,<sup>13</sup> decreased grey

matter density,<sup>14</sup> and greater impulsivity.<sup>15</sup> In short, this construct appears to be a strong psychosocial predictor of adverse birth and child outcomes. Despite the myriad adverse outcomes associated with pregnancy anxiety, little is known about who is at greatest risk of experiencing pregnancy anxiety. Identifying predictors of pregnancy anxiety helps determine whom to target for prenatal interventions. Even if gestation is not lengthened by intervention, treating pregnancy anxiety may improve later developmental outcomes.

### Demographic and psychosocial characteristics

Many prior studies indicate that younger women have higher pregnancy anxiety<sup>5,16–18</sup> although a few studies report no associations with age.<sup>19</sup> Pregnancy anxiety is also inversely associated with income<sup>5,17,19</sup>, whereas education is positively correlated with

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pregnancy anxiety in some research,<sup>1</sup> negatively correlated in others,<sup>16,19</sup> and uncorrelated in one.<sup>18</sup> In general, pregnancy anxiety is lower among women who are married and who have more social support,<sup>5,16,17</sup> although participants who were dissatisfied in their marriages had higher pregnancy anxiety in one study.<sup>16</sup> Notably, women with higher pregnancy anxiety tend to have lower personal resources such as self-esteem, optimism, and perceived control over their pregnancies.<sup>5,17,20</sup>

### **Parity and medical risk factors**

Women who have never given birth have higher rates of pregnancy anxiety<sup>17</sup> and mothers with more complicated previous birth experiences (e.g. caesarean section or a vacuum-assisted vaginal delivery) exhibited higher anxiety during a subsequent pregnancy.<sup>21</sup> Also, medical risks have been associated with higher pregnancy anxiety at 18–20 weeks of gestation but not at 30–34 weeks of gestation.<sup>17</sup> Two studies over three times in pregnancy in the US and Canada differed in findings with one finding no associations with pregnancy intendedness<sup>16</sup> and the other finding those with intended pregnancies had lower pregnancy anxiety.<sup>17</sup>

### **Current study**

Although some studies have examined factors associated with pregnancy anxiety, few have examined several different predictors simultaneously or tested them in multiple regression models to understand independent effects. The aim of this study was to model multiple demographic, psychological, and medical factors simultaneously to predict pregnancy anxiety in a Canadian cohort of over 5000 pregnant women. We also included some variables not previously tested such as early income adversity, immigration, employment, and job stress, and we examined not only linear effects, but also curvilinear effects for the first time.

## **Methods**

### **Participants and procedure**

The methods for this study have been detailed elsewhere.<sup>22,23</sup> In brief, this study sample is composed of 5271 who had available data on pregnancy anxiety drawn from a study of 5337 pregnant women who

delivered their babies in one of four hospitals in Montreal, Canada, between October 1999 and April 2004. The majority of women were recruited at a routine ultrasound and others during visits for prenatal blood drawing or in prenatal care clinics at the study hospitals. Eligibility requirements were age  $\geq 18$  years at expected date of delivery, singleton gestation, and fluency in French or English. Exclusion criteria were severe chronic illness requiring ongoing treatment (excepting hypertension, asthma, or diabetes), placenta previa, history of incompetent cervix in previous pregnancy, impending delivery, or a major foetal anomaly. Eligible women who agreed to participate returned for a research visit between 24 and 26 weeks of gestation (based on ultrasound). During that visit, an interview was conducted to assess demographic, psychosocial, and clinical information.

## **Measures**

### **Pregnancy anxiety**

Pregnancy anxiety was assessed with a four-item measure developed for the Behaviour in Pregnancy Study (BIPS).<sup>6</sup> Participants rated how often they felt anxious, concerned, afraid, and panicky about being pregnant in the past month on a 5-point scale ranging from (1 = *never*) to (5 = *always*). Scores ranged from 4 to 20 (mean = 7.83, SD = 3.5) and were positively skewed, with most participants reporting low levels of pregnancy anxiety ( $\alpha = 0.81$ ). Scores from this brief measure predicted length of gestation better than general state anxiety or perceived stress in a previous study<sup>6</sup>, and published results on this cohort showed that this measure predicted earlier delivery and higher risk of preterm birth.<sup>22</sup> In addition, this measure has been associated with hypothesised mechanisms of the effect, namely higher levels of corticotrophin-releasing hormone, a hormone that plays a role in the timing of delivery<sup>24</sup> and higher cortisol.<sup>25</sup>

### **Demographics**

Demographic variables included age (continuous), marital status (cohabitating/married vs. neither), income (categorised as  $< \$15,000$ ,  $\$15,000$ – $< \$30,000$ ,  $\$30,000$ – $< \$50,000$ ,  $\$50,000$ – $< \$80,000$ ,  $\geq \$80,000$  and treated as continuous), immigrant status (immigrant vs. non-immigrant), primary language spoken at home (French vs. other), and employment status (three

categories: unemployed vs. employed with low job stress vs. employed with high job stress). The study did not collect data on race/ethnicity.

### Medical risk and pregnancy-related factors

These variables included parity (nulliparous vs. previous pregnancies), medical risk (low vs. high risk), body mass index (BMI; continuous), alcohol use (non-drinker vs.  $\geq 1$  drink per month), smoking status (non-smoker vs.  $\geq 1$  cigarette per day), pregnancy intendedness (did not intend or somewhat intended pregnancy vs. completely intended pregnancy), perceived risk of birth complications (continuous), perceived control of the pregnancy (continuous), and commitment to the pregnancy (continuous).

Participants with gestational or pre-existing diabetes, vaginal spotting or bleeding, or hospitalisation during the current pregnancy or prior pregnancy ending in stillbirth, preterm birth, or low birthweight were assigned to the *high medical risk* category. One item from a scale developed by Taylor *et al.*<sup>26</sup> was used to assess *perceived risk of birth complications*. Participants indicated their perception of risk of birth complications, which was collapsed into a 4-point scale (categorised as no risk, low risk, average risk, high risk). *Perceived control of pregnancy* was assessed using four items adapted from the internality subscale of the Parental Health Belief Scale<sup>27</sup> including 'There is nothing I can do to make sure my child will be healthy at birth', 'I can only do what the doctor told me to do to make sure my child will be healthy at birth'. Each answered from 1 to 5 (Agree strongly to Disagree strongly) ( $\alpha = 0.64$ ). *Pregnancy commitment* was assessed using a 5-item measure ( $\alpha = 0.68$ ).<sup>28</sup> Due to the abbreviated nature of these two latter measures, their internal consistency was somewhat lower than those of the (original) longer versions.

### Stress

Many variables were used to capture stress, including traditional measures (perceived stress, life events), but also residential crowding, domestic violence, and early income adversity.

*Residential crowding* was the number of people per room in residence (continuous). *Domestic violence* was assessed using the abuse assessment screen, which measures the frequency, severity, and perpetrator of violence.<sup>29</sup> Respondents were categorised as either

experiencing any violence or experiencing no violence. *Perceived stress* was assessed with the 4-item Perceived Stress Scale ( $\alpha = 0.79$ ).<sup>30</sup> For *stressful life events*, we used the Prenatal Life Events Scale, including 28 stressful events possibly experienced during pregnancy as well as how negative each event was.<sup>20,24</sup> The number of events was multiplied by the average event negativity (severity) to yield a continuous score. *Job stress* was assessed using an abbreviated version of a scale developed by Karasek *et al.*<sup>31</sup> Participants were classified as exposed to high job stress if they were working and experienced 'high demand' and 'low control' by this measure's scoring methods. Low job stress was any other combination of the demand and control subscales. *Early income adversity* was assessed with a single item: 'When you were between 12 and 15 years of age, did your family lack money?' Participants responded from 0 (*never*) to 3 (*always*); responses of 'never' were categorised as 'no', while responses of 1 or higher were categorised as 'yes'.

### Low or high psychosocial resources

Psychosocial resource variables measured were social support received, unmet support needs, self-esteem, and dispositional optimism.

*Social support* was operationalised as the total number of persons the mother felt would help if needed and in whom she could confide (continuous).<sup>32</sup> *Unmet social support needs* were measured with the Arizona Social Support Interview Schedule,<sup>33</sup> which assesses instrumental, emotional, informative, normative, and companionship support received. Participants with unmet needs in at least one area were categorised as having unmet support needs, while all others were categorised as having support needs met. *Self-esteem* was measured using an abbreviated four-item version of the Rosenberg Self-Esteem Scale ( $\alpha = 0.73$ ).<sup>34,35</sup> *Dispositional optimism* was assessed with four items selected from the Life Orientation Test,<sup>36</sup> a standard brief measure of six items (and four fillers) that is often used in health research to assess general optimism and pessimism ( $\alpha = 0.73$ ).

### Statistical analyses

Analyses were conducted using Stata 13. Missing data for predictor variables were imputed using a chained method and 20 imputed data sets followed by

deletion of imputed dependent variable values. In considering the mechanism of missing data, we determined that it is unlikely that probability of missingness depends on unobserved data. We determined that the data are likely missing at random and, therefore, assumptions for imputation are met. Percentage of missing data ranged from 0 to 7% with the exception of income, which was missing 13% of participants' responses. To select variables for inclusion in the multivariable regression model, crude associations between each potential predictor variable and pregnancy anxiety were assessed with Pearson and Point Biserial correlational tests. Following analysis of bivariate associations, we used the multiply imputed data set and multiple linear regression estimation with pregnancy anxiety as the dependent measure. Quadratic effects that were no longer significant in the multivariable regression model were removed. Residuals were normally distributed.

## Results

Descriptive statistics for all variables are displayed in Table 1. Women were on average 29 years of age, and nearly 90% were cohabiting and/or married to their partner. Modal income was \$50,000–80,000 Canadian dollars with a range from under \$15,000 (11.8%) to over \$80,000 (21.6%); also 22% were unemployed and 26% had early income adversity. More than a quarter of the sample was composed of immigrants, and 42% did not speak French as their primary language. Over a third (35%) were high medical risk, 41% had given birth previously, and 62% intended the pregnancy. Nineteen percent drank alcohol in the past month and 16% had one cigarette/day. Overall, there was variability in stress and resources in the sample, with an average of three stressful life events in the pregnancy thus far, and 12% experiencing unmet support needs.

Correlations among the 23 predictors were examined prior to primary analyses and are displayed in Table S1 (available online). Most correlation coefficients were  $< 0.30$  and none higher than 0.49 (between social support and optimism). Immigrants were more likely to be non-French speaking ( $r = 0.40$ ); income was associated with age, cohabitation, and unemployment ( $r$ 's = 0.37, 0.35,  $-0.31$ , respectively), and perceived stress was associated with lower commitment to pregnancy ( $r = -0.34$ ), more life events ( $r = 0.39$ ), more unmet support needs ( $r = 0.30$ ), and lower

**Table 1.** Description of the study sample

	Mean (SD) or %	Range	N
<b>Demographics</b>			
Maternal age	29.4 (5.4)	18–49	5268
Cohabiting/married (% yes)	89.6		5248
<b>Income</b>			
<15,000 CAD	11.8		4613
15,000–<30,000 CAD	15.7		
30,000–<50,000 CAD	23.2		
50,000–<80,000 CAD	27.7		
≥80,000 CAD	21.6		
Immigrated to Canada (% yes)	27.6		5268
Primary language other than French (% yes)	41.7		5262
<b>Employment</b>			
Unemployed (% yes)	21.7		5190
Low stress job (% yes)	58.0		
High stress job (% yes)	20.3		
<b>Medical- and pregnancy-related factors</b>			
Previous pregnancy (% yes)	41.3		5262
High medical risk (% yes)	35.4		5266
Body mass index	23.7 (5.1)	13.7–53.6	5031
>1 alcoholic drink/month (% yes)	19.2		5269
≥1 cigarette/day (% yes)	15.9		5224
Intended pregnancy (% yes)	62.3		5270
<b>Perceived risk of birth complications</b>			
No risk (% yes)	20.8		5208
Low risk (% yes)	47.1		
Average risk (% yes)	22.6		
High risk (% yes)	9.6		
Perceived control of pregnancy	8.9 (3.0)	4–20	5082
Commitment to pregnancy	20.3 (3.2)	2–24	4929
<b>Stress</b>			
Residential crowding	0.6 (0.3)	0–4	5228
Domestic violence (% yes)	6.9		5271
Perceived Stress Scale	4.1 (3.1)	0–16	5267
Stressful life events	3.0 (3.4)	0–29.3	4946
Early income adversity (% yes)	25.9		5239
<b>Low or high resources</b>			
Unmet support needs (% yes)	11.6		5261
Self-esteem	12.8 (1.2)	4–16	5235
Social support	4.0 (1.3)	0–6	5243
Optimism	11.1 (2.6)	1–17	5256

self-esteem ( $r = -0.46$ ). Having an intended pregnancy was associated with higher commitment as well ( $r = -0.36$ ).

As shown in Table 2, all predictors had significant crude associations with pregnancy anxiety in the expected directions, with the exception of BMI and alcohol use. Pregnancy anxiety was lower in married and French-speaking women, those born in Canada,

**Table 2.** Crude and adjusted associations between studied predictors and pregnancy anxiety

	Bivariate regressions $\beta$ (95% confidence interval)	Multiple regression (reduced) $\beta$ (95% confidence interval)
Demographics		
Maternal age		
Linear	-0.37 (-0.53, -0.21)	0.00 (-0.02, 0.02)
Quadratic	0.01 (0.00, 0.01)	
Cohabiting/married	-1.42 (-1.73, -1.11)	-0.03 (-0.34, 0.28)
Income	-0.41 (-0.49, -0.33)	0.01 (-0.21, 0.24)
Immigrant	0.73 (0.52, 0.94)	0.02 (-0.21, 0.24)
Non-French speaking	0.83 (0.64, 1.03)	0.51 (0.32, 0.70)
Unemployed (ref = low stress job)	0.70 (0.46, 0.94)	0.04 (-0.20, 0.28)
High stress job (ref = low stress job)	0.90 (0.65, 1.15)	0.31 (0.08, 0.53)
Medical- and pregnancy-related factors		
Previous pregnancy	-0.47 (-0.66, -0.28)	-0.81 (-1.00, -0.62)
High medical risk	0.70 (0.50, 0.90)	0.31 (0.13, 0.49)
Body mass index	0.00 (-0.01, 0.03)	
>1 alcoholic drink/month	-0.29 (-0.54, -0.05)	
$\geq 1$ cigarette/day	0.58 (0.31, 0.84)	0.03 (-0.22, 0.28)
Intended pregnancy	-1.44 (-1.64, -1.25)	-0.54 (-0.73, -0.34)
Perceived risk of birth complications	0.73 (0.62, 0.83)	0.43 (0.33, 0.53)
Perceived control of pregnancy		
Linear	-0.53 (-0.71, -0.36)	-0.10 (-0.13, -0.07)
Quadratic	0.02 (0.01, 0.02)	
Commitment to pregnancy	-0.36 (-0.39, -0.33)	-0.18 (-0.21, -0.15)
Stress		
Residential crowding	1.04 (0.67, 1.41)	-0.16 (-0.56, 0.22)
Domestic violence	1.40 (1.03, 1.77)	0.12 (-0.23, 0.46)
Perceived Stress Scale	0.44 (0.41, 0.47)	0.25 (0.22, 0.29)
Stressful life events	0.21 (0.18, 0.24)	0.03 (0.00, 0.06)
Early income adversity	1.04 (0.82, 1.25)	0.23 (0.02, 0.42)
Low or high resources		
Unmet support needs	1.83 (1.54, 2.12)	0.25 (-0.04, 0.53)
Self-esteem	-0.54 (-0.58, -0.49)	-0.18 (-0.23, -0.13)
Social support	-0.34 (-0.41, -0.27)	0.08 (0.01, 0.15)
Optimism		
Linear	-0.58 (-0.79, -0.38)	-0.33 (-0.51, -0.14)
Quadratic	0.02 (0.01, 0.03)	0.02 (0.01, 0.02)
Model adjusted $R^2$		0.24

with higher family incomes, low stress jobs, and who were not having a first baby. Pregnancy anxiety was higher among smokers and women of high medical risk, and who perceived they were of high risk of birth complications, and who had unintended pregnancies. Pregnancy anxiety was also higher among women with higher stress, specifically those exposed to residential crowding, domestic violence, higher perceived stress, more stressful life events, and early income adversity. Pregnancy anxiety was lower in women with better psychosocial resources, namely more social support, fewer unmet needs, higher self-esteem, and higher commitment to the pregnancy.

In addition to these effects, we found significant quadratic relationships with maternal age, optimism, and perceived control of pregnancy (see Figure 1). As shown in Figure 1, pregnancy anxiety was associated in a curvilinear manner with older age, higher optimism, and increasing perceived control of the pregnancy.

We then ran two multiple regression models. First, we included only demographics, nulliparity, and medical risk. All of these variables were highly significant in prediction of pregnancy anxiety ( $P < 0.001$ ) with the exception of age (neither quadratic nor linear), and being unemployed (adjusted  $R$  squared = 0.06). We next examined all predictors of

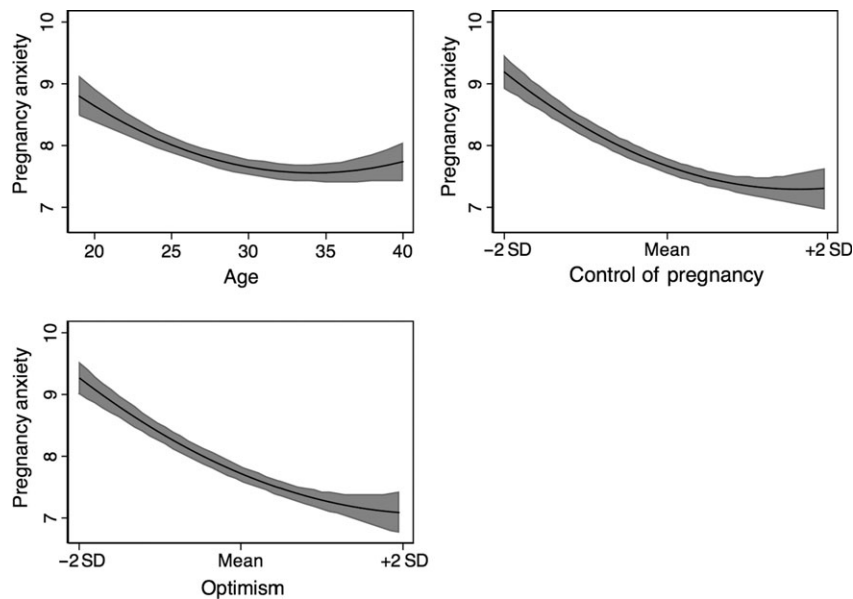


Figure 1. Quadratic crude associations (with 95% confidence interval) for age, optimism, and perceived control of pregnancy.

pregnancy anxiety in a multiple regression model, leaving out those non-significant at the bivariate level (BMI, alcohol use). Also, the quadratic effects of age and perceived control of pregnancy were no longer significant in this analysis, thus only linear terms were retained in the final model (see Table 2, right column). The full final model with all predictors had an adjusted  $R^2$  of 0.24. Higher pregnancy anxiety was associated independently with each of the following variables: primary language other than French, having a first birth, unintended pregnancy, higher medical risk, higher perceived risk of birth complications, lower perceived control, lower commitment to the pregnancy, higher perceived stress, more stressful life events, high job stress, early income adversity, lower self-esteem, and more social support. In addition, as shown in Figure 2, pregnancy anxiety was associated in a curvilinear manner with optimism, such that moderate levels of optimism were associated with the lowest pregnancy anxiety whereas very low or very high levels of optimism were associated with higher pregnancy anxiety.

### Comment

In this study, we examined potential predictors of pregnancy anxiety using a well-validated, brief measure of pregnancy anxiety administered to a large cohort of pregnant women in Canada. Our results replicate prior findings for some predictors and

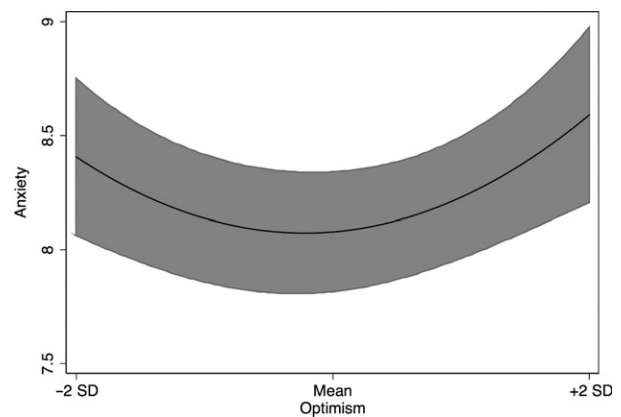


Figure 2. Quadratic association (with 95% confidence interval) between optimism and pregnancy anxiety.

provide new evidence for several factors not previously studied. In prior studies, demographic factors, namely maternal age, income, and marital status were associated with pregnancy anxiety.<sup>5,16–19</sup> Here, we also found strong associations with these and other known risk factors. However, when psychosocial variables were in the model, these effects were no longer significant with the exception of speaking a primary language at home other than French. Thus, the associations of pregnancy anxiety with variables such as maternal age, income, and marital status may be explained by resulting psychosocial resources and stressors as mediators, rather than by these demographic factors directly. We suggest that

demographics are antecedents or endogenous factors that would be expected to work through more proximal and current psychosocial factors, as they did here.

Speaking a language other than French at home was the only demographic characteristic still associated with higher pregnancy anxiety with psychosocial variables in the model. A possible explanation is that women who do not speak the predominant language in the province (Quebec) may have more difficulty communicating with healthcare providers or face stigma stemming from their inability to speak the local language leading to higher pregnancy anxiety. Although this interpretation cannot be tested using the present data, it suggests that any women who do not speak the predominant language used in healthcare settings (such as Spanish speakers in the United States) may be more likely to experience pregnancy anxiety.

Consistent with expectations and prior research, significant medical and pregnancy-related predictors of pregnancy anxiety were first birth, high medical risk, low perceived control, and unintended pregnancy. Women who have given birth previously are typically lower in pregnancy-related anxiety, probably because having already experienced pregnancy, and childbirth, they know what to expect.<sup>16</sup> A first pregnancy is understandably associated with a woman experiencing higher anxiety regarding all facets of the construct of pregnancy anxiety – regarding this baby, this pregnancy, and this birth, as well as mothering after birth. We found that pregnancy anxiety was also higher among women who had medical risk conditions. Women at high risk due to complications in current or past pregnancies, or because of general health problems, were higher on average in pregnancy anxiety, even when adjusting for support and other resources. Little prior work has explored how a woman's perception of her own medical risk conditions contributes to pregnancy anxiety, above and beyond objective assessments of medical risk obtained from chart abstractions. Here, we find that perceiving that one has higher risk (or less control) over the pregnancy were both independently associated with higher pregnancy anxiety. Having an intended pregnancy in contrast was associated with lower pregnancy anxiety, consistent with one prior study<sup>17</sup> but contrary to another.<sup>16</sup>

Stress in various forms was associated with higher pregnancy anxiety. Women who were exposed to higher stress in their jobs, who had more stressful life events, who experienced early life adversity from low

income, or who had higher general perceived stress (chronic stress) had higher levels of pregnancy anxiety. Thus, exposure to and perceptions of stress during pregnancy, and even earlier in the lifespan, may contribute to higher levels of anxiety during pregnancy. The associations between pregnancy anxiety and the various stress measures were statistically significant but of moderate magnitude ranging from 1% to 15% shared variance, underscoring that pregnancy anxiety is distinct from stress or distress.<sup>17,37</sup> Regarding causal direction, it is unlikely that pregnancy anxiety produced life stress, and more likely that life stress increased anxiety of pregnancy, although with cross-sectional analyses, it is impossible to infer causality.

Higher self-esteem was also independently associated with lower pregnancy anxiety, consistent with previous studies showing inverse relationships between pregnancy anxiety and personal resources such as mastery and self-esteem.<sup>5,17,20</sup> Although the crude association was in the expected direction, that social support was not significant in multivariate analyses is inconsistent with prior studies.<sup>5,17</sup> This suggests that other factors often confounded with social support, such as marital status or self-esteem, are more powerful here. We also found non-linear effects of dispositional optimism. Those with the lowest and highest levels of dispositional optimism had higher pregnancy anxiety whereas women with moderate levels were lower in pregnancy anxiety. These findings are consistent with prior work in a variety of health-relevant contexts such as multiple sclerosis, Parkinson's disease, and HIV where moderate dispositional optimism was most adaptive.<sup>38</sup>

Our study has a number of strengths, including its prospective cohort design, large sample size, use of validated measures, and the socioeconomically diverse population from four large maternity hospitals in Montreal. To our knowledge, this is among the largest studies to examine predictors of pregnancy anxiety with a sample of over 5000 women. The four-item pregnancy anxiety index has strong face validity and demonstrated predictive validity; scores have been shown to predict length of gestation better than general state anxiety or perceived stress<sup>6</sup> and have been associated with an increased risk of preterm birth.<sup>22</sup> In addition, this measure has been associated with higher levels of CRH, a hormone that may play a role in the timing of delivery,<sup>24</sup> and higher salivary cortisol,<sup>25</sup> which is evidence that the HPA axis

mediates the effect of pregnancy anxiety on length of gestation. Although there are other published measures of pregnancy anxiety, including one of ours,<sup>5</sup> the four-item adjective measure used here has proven to be particularly practical and powerful. We therefore suggest it may have value in a broader range of applications as a possible screener and way of targeting interventions. For example, women at high medical risk and those giving birth for the first time might be screened for pregnancy anxiety with this measure during prenatal care appointments.

Our analytic strategy, that is the use of multiple imputations and multiple regressions, allowed us to study a large number of potential predictors to test for independent associations with pregnancy anxiety. Nonetheless, an important limitation of our study is the fact that pregnancy anxiety and the predictors were measured only once during the second trimester of pregnancy. Finally, this study did not ascertain race/ethnicity, which has been shown to be related to pregnancy anxiety in past studies, and should be assessed in studies with high diversity on these dimensions.<sup>19,24</sup>

## Conclusions

In conclusion, pregnancy anxiety has emerged as an important independent risk factor for adverse birth outcomes.<sup>2-7</sup> It is therefore important for researchers and clinicians to develop a clearer understanding of who experiences it. Understanding the psychosocial profiles of women who experience high levels of pregnancy anxiety is a first step towards determining why this type of distress is robustly associated with subsequent adverse birth and developmental outcomes. Little evidence has been published about which subgroups of the population have higher psychosocial risk factors, and that evidence is contradictory. Our results offer some insights that replicate and extend past research and point to some groups of women who might benefit most from screening and intervention efforts. Enhanced versions of traditional interventions such as childbirth education and cognitive behavioural therapeutic methods as well as newer stress reduction interventions such as mindfulness training may be useful, although such interventions have not yet been offered to those with high pregnancy anxiety.<sup>39</sup> Further research should help in testing the benefits and potential harms of such screening and intervention.

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## Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. Correlations among model predictors.