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Pregnancy-Related COVID Worry, Depressive Symptom Severity, and Mediation Through Sleep Disturbance in a low-income, primarily Latinx population in California's Central Valley

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Abstract

Purpose.—This study (1) assessed the psychometric properties of a pregnancy-related COVID worry scale, (2) explored variations in pregnancy-related COVID worry over the course of the pandemic, and (3) examined associations between pregnancy-related COVID worry and depressive symptom severity, and evaluated sleep disturbance as a mediator.

Methods.—Data were drawn from an ongoing randomized trial comparing the effectiveness of two enhanced forms of prenatal care. The current analysis includes baseline pre-randomization data collected from participants who enrolled November 2020-November 2021 (n=201). Participants were pregnant individuals with low income and primarily Latinx.

Results.—Our 7-item scale was valid and reliable for assessing pregnancy-related COVID worry. Pregnancy-related COVID worry did not vary significantly by any participant characteristic or pandemic stage. Pregnancy-related COVID worry was significantly associated with depressive symptom severity in multivariate analysis (p=.002). For each unit increase on the 10-point pregnancy-related COVID worry scale, the odds of mild-to-severe depression increased by 16% (odds ratio=1.16, 95% confidence interval 1.02-1.32, p=.02), holding all other variables constant.

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Sleep disturbance mediated the pregnancy-related COVID worry-depressive symptom relationship (48% of the total effect mediated).

Conclusions.—Worry about how COVID may impact their baby, birth, and postpartum experiences was associated with higher depressive symptom severity, partly through its effect on sleep. These findings suggest that interventions related to improving sleep quality among perinatal populations may reduce depressive symptoms.

Keywords

COVID-19; pregnant; worry; sleep disturbance; depressive symptom severity

Introduction

There is no question that mental health has suffered during the COVID-19 pandemic. The prevalence of moderate-to-severe depressive symptoms in a nationally representative sample early in the pandemic (March-April 2020) was over three-fold higher than in a nationally representative sample before the pandemic (2017-2018; 27.8% vs. 8.5%, respectively), and respondents with lower income, fewer savings, and more stressors had higher odds of moderate-to-severe depression.[1] The same is true for pregnant people; for example, 37% of pregnant Canadians reported elevated depressive symptoms early in the pandemic (April 2020) relative to pre-pandemic estimates of approximately 10%.[2]

Identifying potentially modifiable psychological risk factors for depression during the pandemic is an important initial step to reducing risk. Among pregnant people, generalized worry, as evidenced by endorsement of statements such as, “once I start worrying, I can’t stop,” has been associated with increased risk of postpartum depression (adjusted odds ratio, aOR 3.91, 95% CI 1.44, 10.65).[3] Worry about COVID specifically is associated with elevated depression among pregnant and postpartum individuals. In a sample of over 1,000 pregnant and postpartum individuals in the United States, nearly 1 in 5 reported feeling very-to-extremely worried about COVID-19 health risks, and worry was associated with over three-fold higher odds of clinically significant depressive symptoms.[4]

The present study seeks to fill three important gaps in the literature by examining associations between worry and depressive symptoms among pregnant people during the pandemic. First, little is known about worry about COVID’s impact on pregnancy and birth, which is an important gap as pregnancy-specific anxiety may be particularly pernicious for birth outcomes.[5] An obvious impediment is the dearth of validated tools for the assessment of pregnancy-related COVID worry. Thus, we sought to: 1) assess the psychometric properties of a pregnancy-related COVID worry scale we developed, 2) explore variations in pregnancy-related COVID worry over the pandemic, and 3) examine concurrent associations between pregnancy-related COVID worry and depressive symptom severity.

Second, little is known about potential mediators of the worry-depression association in pregnant populations. Identifying mediators may explain why or how worry may lead to increased depressive symptoms and identify targets for intervention. Insomnia mediates

this association among non-pregnant people;[6] we examine sleep disturbance as a possible mediator of the worry-depression association in a pregnant population.

Finally, the majority of previous research was conducted in predominantly White samples. Among studies with a sufficient sample to analyze findings by race/ethnicity, pregnant people of color are more likely to report feeling concerned about getting COVID. [7] Black and Latinx pregnant persons are also more likely to report significant consequences of the pandemic on their employment, finances, food security and prenatal care, and substantial distress .[8,9] To address these gaps in the literature, we examined pregnancy-related COVID worry and depressive symptoms in a sample of approximately 200 pregnant, primarily Latinx individuals with low income in California's Central Valley.

Methods

Overview

The current paper includes a subset of participants from our ongoing randomized controlled trial entitled "Engaging Mothers & Babies – Reimagining Antenatal Care for Everyone" (EMBRACE), which is a comparative effectiveness study of two forms of enhanced prenatal care. The goal of EMBRACE is to determine differences in preterm birth rates, mental health outcomes, and clinical care experiences among low-income pregnant and birthing people in Fresno, California. Participant recruitment for EMBRACE began in September 2019 and was suspended on March 16, 2020, due to shelter-in-place and physical distancing guidelines implemented in response to COVID-19. We resumed recruitment in November 2020. For the current analysis, we focused on baseline pre-randomization data collected November 2020-November 2021. The study was approved by the University of California, San Francisco and California State University, Fresno Institutional Review Boards.

Participants and Procedures

We describe the recruitment and study procedures pertinent to the current paper, which includes data from the baseline pre-randomization timepoint only. Participants were recruited from several clinical sites in Fresno. Research staff identified potentially eligible participants by reviewing appointment records and approaching them via in-person or remote screening, depending on social distancing restrictions and clinic preferences. For in-person screening, study staff approached potentially eligible individuals in the waiting rooms of participating clinical sites. Remote screening occurred over the telephone. Inclusion criteria were: 1) <24 weeks' gestation (with pregnancy confirmed by ultrasound if <8 weeks), 2) eligible for Medicaid (i.e., ≤213% of the federal poverty level) and 3) able to speak English or Spanish. Exclusion criteria were: 1) not planning to continue prenatal care with the participating provider, 2) not able to legally consent to study participation, or 3) not available to attend group prenatal sessions at the scheduled times.

Eligible and interested individuals signed the informed consent form, completed an interviewer-administered baseline questionnaire, and received $30 remuneration.

Measures

All the variables included in this analysis were assessed via interviewer-administered questionnaires.

Sociodemographic Factors.—Maternal age was calculated by subtracting the participant's birthdate from the baseline interview date. Race/ethnicity was coded by asking participants to indicate the category with which they most identified (Latina, Latinx, or Hispanic; African American or Black; Native American, American Indian, Alaskan Native, or Indigenous person; Asian; White; Pacific Islander or Native Hawaiian; bi- or multi-racial/ethnic; and other). Due to small cell sizes, Native American, American Indian, Alaskan Native, or Indigenous person; Asian; and Pacific Islander or Native Hawaiian were collapsed into the "other" category. Participants were asked to choose their monthly household income before taxes from a list of categories (less than $1,000; $1,000 to 2,000; $2,001 to 3,000; Over $3,000), as well as their employment status (yes, no), and highest educational attainment (8th grade or less; some high school; high school graduate, GED, or equivalent; some college, junior college, or vocational school; college graduate; professional or graduate degree). Due to small cell sizes, college graduate and professional or graduate degree were collapsed into the college graduate category.

Clinical Factors.—These included gestational age (calculated based on expected due date), parity, current or past hypertension (hypertension, high blood pressure, or pre-eclampsia), diabetes (Type I, Type II, or gestational), history of premature birth (<37 weeks gestation), history of low birthweight (<5.5 lbs or 2,500 g), bleeding or threatened miscarriage in current pregnancy, and history of ever testing positive for COVID.

Psychological Factors.—Participants indicated whether they had ever been diagnosed with or treated for depression, anxiety, or other mental health concern.

Perceived stress was measured using the 10-item Perceived Stress Scale (PSS), which assesses the extent to which situations in the last month were considered stressful.[10] Scores range from 0 to 40, with higher scores indicating more stress. Internal consistency was acceptable (Cronbach's a=.83).

Depressive symptom severity was measured using the Patient Health Questionnaire (PHQ-9).[11] Consistent with DSM-5 criteria for depression, nine items assess symptoms of anhedonia, depressed mood, sleep disturbance, fatigue, appetite disturbance, guilt, concentration difficulties, psychomotor agitation or retardation, and suicidal ideation over the past two weeks. Total scores range from 0-27; scores ranging from 1-4 indicate minimal severity, 5-9 indicate mild severity, 10-14 indicate moderate severity, 15-19 indicate moderately severe severity, 20-27 indicate severe severity. The PHQ-9 has been validated in pregnant, predominantly low-income individuals[12] and is frequently used in obstetric care settings. Internal consistency was acceptable (Cronbach's a=.76).

Anxiety was measured using the Generalized Anxiety Disorder questionnaire (GAD-7).[13] This 7-item measure assesses symptoms of anxiety and worry in the previous two weeks.

Total scores from 5-9 suggest mild anxiety, 10-14 suggest moderate anxiety, 15-21 suggest severe anxiety. Internal consistency was acceptable (Cronbach's a=.86).

Sleep disturbance was assessed using the short form version of the Patient-Reported Outcomes Measurement Information System (PROMIS) sleep disturbance item bank.[14] Summary scores were converted to T scores, standardized with 50 as the mean for the US general population, and one standard deviation was 10. T scores less than 55 suggest none to slight sleep disturbance, 55-59 suggest mild sleep disturbance, 60-69 indicate moderate sleep disturbance, and 70 and above indicate severe sleep disturbance. Internal consistency was acceptable (Cronbach's a=.92).

Pregnancy-related COVID worry was measured with a 7-item scale that assessed worries about being pregnant and giving birth during the pandemic. We adapted the Cambridge Worry Scale[15] to specifically address pregnancy-related COVID worry. We pretested it with three pregnant people who were not enrolled in EMBRACE and four people who enrolled in EMBRACE prior to the pandemic. To reduce participant burden by making response option scales similar to other scales in the interview-administered questionnaires, we expanded the original 6-point response options used in the Cambridge Worry Scale to make each a 10-point response option scale, with 1=not a worry and 10=a major worry. Scores on this scale range from 1 to 10 and are derived by calculating the mean response to all items rated by the participant. Additional details about the psychometric analysis and items are described in the results section and the final version of the 7-item COVID-19 Worry Scale is presented in Table 2.

Pandemic Stage.—To examine whether pregnancy-related COVID worry varied over the course of the pandemic, we created a variable indicating whether study measures were completed prior to vaccine availability (4/19/2021), during mass roll out of vaccines (4/19/2021-5/31/21), or during the emergence of the delta and omicron variants (6/1/2021 and after).

Analytic Plan

We used descriptive analyses to examine frequency and percentage of categorical variables and means and standard deviations of continuous variables.

Psychometric Analyses—Initially, the pregnancy-related COVID worry scale had 10 items. First, we examined the distributions of the items. We recoded missing or "not applicable" (N/A) responses in two ways. First, we performed a simple imputation where we recoded N/A to the 5 to obtain a uniform scale for the psychometric analysis without loss of data. Second, we converted the N/A categories to missing and dropped them from the psychometric analysis. We constructed a correlation matrix to examine correlations among the items, and conducted exploratory factor analysis using principal factoring to assess construct validity, that is, how well the items represented the underlying conceptual structure.[16,17] We used the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy to assess if the variables were suitable for factor analysis. KMO Values above 0.5 are considered satisfactory for factor analysis.[18] We then examined the eigenvalues (the amount of information captured by a factor) and scree plots (plots of eigenvalues) using Kaiser's rule

of only retaining factors with eigenvalues exceeding unity and the “break” in the scree plot to decide on how many factors to retain.[17,19,20] Finally, to determine which items to retain, we examined the item loadings using a cut off of 0.5 in order to obtain a parsimonious scale.[21]

Internal consistency reliability was assessed using Cronbach’s alpha; values ≥0.7 are generally considered acceptable evidence of reliability.[19] We then assessed criterion-related validity to evaluate whether the measure is related to other measures or outcomes in theoretically predictable ways.[16,17] We hypothesized that pregnancy-related COVID worry would be positively associated with anxiety (GAD-7) and perceived stress (PSS). We tested this hypothesis using the Pearson correlation coefficient and ordinary least squares regression.

Finally, we explored associations between participant characteristics, vaccination status, and pandemic stage with pregnancy-related COVID worry as the outcome. We used Pearson correlation tests for continuous predictor variables (i.e, age; parity; gestational age; perceived stress; anxiety symptom severity; sleep disturbance), independent-samples t-tests for dichotomous predictor variables (i.e., currently employed; current or past hypertension, high blood pressure, or pre-eclampsia; diabetes; history of premature birth; history of low birthweight; bleeding or threatened miscarriage in current pregnancy; ever tested positive for COVID; history of anxiety; history of depression; other mental health history), and univariate ANOVAs for categorical predictors with more than two levels (i.e., race/ethnicity; monthly income; education; pandemic stage).

Pregnancy-related COVID Worry Associations with Depressive Symptom Severity—We investigated bivariate associations between each participant characteristic and depressive symptom severity as the outcome using Pearson correlation tests for continuous predictor variables (i.e, age; parity; gestational age; perceived stress; anxiety symptom severity; sleep disturbance; pregnancy-related COVID worry), independent-samples t-tests for dichotomous predictor variables (i.e., currently employed; current or past hypertension, high blood pressure, or pre-eclampsia; diabetes; history of premature birth; history of low birthweight; bleeding or threatened miscarriage in current pregnancy; ever tested positive for COVID; history of anxiety; history of depression; other mental health history), and univariate ANOVAs for categorical predictors with more than two levels (i.e., race/ethnicity; monthly income; education; pandemic stage). The final linear regression model testing our hypothesis that pregnancy-related COVID worry would have a significant, positive association with concurrent depressive symptom severity included as covariates the participant characteristics previously shown to be associated with depressive symptom severity (i.e., age, race/ethnicity, parity, income) or shown to have a statistically significant relationship with depressive symptom severity in bivariate analyses in the current sample.

To ease clinical interpretation, we used logistic regression to evaluate whether pregnancy-related COVID worry was associated with significantly higher odds of mild-to-severe depressive symptom severity. Although 10 is the conventional PHQ-9 cutoff for identifying possible depression (i.e., moderate-to-severe depressive symptoms), we used a cutoff of 5 (i.e., mild-to-severe depressive symptoms) due to our sample size and because

research shows that even sub-threshold depressive symptoms are associated with functional impairment among pregnant individuals.[22]

Sleep Disturbance as a Mediator of the Pregnancy-Related COVID worry – Depressive Symptom Severity Association—We used the Hayes SPSS Process tool to conduct a simple mediation analysis to examine whether pregnancy-related COVID worry is associated with higher depressive symptom severity because pregnancy-related COVID worry is associated with more sleep disturbance, which in turn is associated with higher depressive symptom severity.[23] Sleep disturbance was regressed on pregnancy-related COVID worry (*a*), and depressive symptom severity was regressed on sleep disturbance (*b*) and pregnancy-related COVID worry (*c'*). The indirect effect (*ab*) indicates how depressive symptom severity is influenced by pregnancy-related COVID worry through sleep disturbance. We calculated the percent of the total effect accounted for by the indirect effect (i.e., percent mediated; *ab*/*c)* and calculated confidence intervals using 5,000 bootstrap samples.

We used STATA version 17 to perform the psychometric analyses, and SPSS version 28 to perform all other analyses.

Results

Participants

Descriptive statistics for participant characteristics are presented in Table 1. In short, our sample comprised 201 individuals who were between the first and second trimesters of pregnancy. Participants were in their mid-20s on average, and the largest proportion of was Latinx (73%) and not currently employed (64%). Nearly 20% of participants reported a history of anxiety or depression, and 17% were experiencing moderate-to-severe depressive symptom severity.

Psychometric Analysis

Examining the distribution of the initial 10 items on the pregnancy-related COVID worry scale identified the following items with missing or “not applicable” responses: relationship with partner, 4 N/A, 1 missing; someone you live with will get COVID, 1 N/A; baby will get COVID, 2 missing; giving birth during pandemic, 1 N/A; not able to work, 13 N/A; support during birth, 1 N/A. Recoding the not applicable option to 5 and to missing yielded similar results, thus only the results of the latter are presented. As displayed in Table 2, participants reported feeling the most worried about whether the person they want to be with them will be there for the birth because of COVID-19 (M=6.46, SD=3.69).

The correlation matrix showed that all pairwise correlations were > .3 (range.3 to.74), except for some correlations between the first two items (relationship with partner and relationship with family and friends) and the rest of the items (Table 2). The KMO measure of sampling adequacy for all items are >0.7, with an overall KMO of 0.84, indicating adequate sample adequacy for factor analysis. The initial exploratory factor analysis yielded 1 factor with eigenvalues greater than one (4.2), accounting for 85% of the cumulative variance. All items, except the first two items, had loadings greater than 0.5 on this factor. We dropped these

two items because they had lower loadings, lower correlations with other items (Table 2), and differed conceptually from the other items that focused on pregnancy- and birth-related worries. In addition, we dropped item 9, which assessed worry about not being able to work, which differed conceptually from the remaining items. Factor analysis of the remaining 7 items yielded 1 factor with eigenvalues >1 (3.6), accounting for 95% of the cumulative variance (Figure 1), and with all items having loadings of >0.5 on this factor, and uniqueness of <0.8 (Table 3). The 7-item scale had a Cronbach's alpha of .87 indicating good internal consistency.

The correlation coefficient between pregnancy-related COVID worry and perceived stress was 0.38 ($p<.001$), and each unit increase in COVID worry was associated with about one unit increase in perceived stress scores (B=1.16, $p<.001$, CI=0.77 to 1.55). The correlation coefficient between pregnancy-related COVID worry and anxiety symptom severity was .27 ($p<.001$), and each unit increase in COVID worry was associated with about a half-unit increase in anxiety scores (B=0.48, $p<.001$, CI=0.24 to 0.72), indicating good criterion validity.

Pregnancy-related COVID worry was not significantly associated with any sociodemographic or clinical characteristics, did not differ significantly between participants who received a COVID vaccine (M=5.48, SD=2.34) and those who did not (M=5.10, SD=2.70; t=−0.62, p=.53), and it did not vary significantly by pandemic stage ($F(2,198)=2.15$, p=.12). Mean (SD) pregnancy-related COVID worry scores were 5.50 (2.45) during the pre-vaccine stage, 4.40 (2.32) when vaccines became widely available, and 5.37 (2.62) during the Delta and Omicron variants.

Pregnancy-related COVID Worry Associations with Depressive Symptom Severity

As displayed in Table 4, among the sociodemographic and clinical participant characteristics, only a history of testing positive for COVID had a statistically significant association with depressive symptom severity (t=−2.78, p=.006); this variable was therefore also included as a potential confounder in the final linear regression model. Several psychological characteristics were positively associated with depressive symptom severity, including self-reported history of anxiety (t=−2.70, p=.007), perceived stress (r=.60, $p<.001$), anxiety symptom severity (r=.64, $p<.001$), and sleep disturbance (r=.52, $p<.001$).

As displayed in Table 5 (left panel), pregnancy-related COVID worry had a positive, statistically significant association with depressive symptom severity (B=0.52, SE=0.12, $p<.001$) in bivariate analysis. Both pregnancy-related COVID worry (p=.002) and history of testing positive for COVID (p=.002) were significant predictors of depressive symptom severity in multivariate analysis. To facilitate clinical interpretation of these findings, we additionally conducted a logistic regression with mild-to-severe depression (i.e., PHQ-9 total score ≥ 5) as the outcome (Table 6). For each unit increase on the 10-point pregnancy-related COVID worry scale, the odds of mild-to-severe depression increased by 16% (OR=1.16, 95% CI 1.02-1.32, p=.02), holding all other variables constant. That is, scoring one standard deviation (2.52) above the mean for pregnancy-related COVID worry was associated with 40% higher odds of mild-to-severe depression. Again, history of testing positive for COVID was a large and significant predictor of mild-to-severe depression (OR 4.40, p=.003).

Sleep Disturbance as a Mediator of the Pregnancy-Related COVID worry–Depressive Symptom Severity Association

From a simple mediation analysis using ordinary least squares path analysis, pregnancy-related COVID worry indirectly influenced depressive symptom severity through its effect on sleep disturbance. Pregnancy-related COVID worry had a positive association with sleep disturbance (a=1.42, p<.001), and sleep disturbance had a positive association with depressive symptom severity (b=0.18, p<.001). A bootstrap confidence interval for the indirect effect (ab=0.26) based on 5,000 bootstrap samples was above zero (95% CI 0.14-0.41). Sleep disturbance accounted for 48% of the total effect (0.26/0.55). There was also evidence that pregnancy-related COVID worry was associated with depressive symptom severity independent of its effect on sleep disturbance (c'=0.29, p=.01).

Discussion

Among a sample of low-income, primarily Latinx, Black, and biracial pregnant individuals, worrying about how COVID might affect their baby or birth and postpartum experience was concurrently associated with depressive symptom severity. Further, worrying about COVID was associated with more disturbed sleep, which in turn was associated with increased depression. To some extent, worrying about COVID may be normative, adaptive, and somewhat difficult to control. However, the current findings suggest that improving sleep disturbance may buffer the impact of worry on depressive symptoms. Indeed, three randomized controlled trials document the efficacy of cognitive behavior therapy for treating prenatal insomnia,[24-26] and suggest that improving insomnia during pregnancy reduces, and possibly prevents, postpartum depression.[24] Cognitive behavior therapy skills that may be particularly pertinent include scheduling worry and problem-solving time during the day to reduce the tendency to worry at night, and scheduling wind-down time before bed to transition from a busy day to a restful night. More research is needed on whether other treatment modalities may improve prenatal sleep disturbance and reduce depression (e.g., making the bedroom more conducive to sleep, using supportive pillows, etc.).

We showed that our 7-item scale is a valid and reliable scale for assessing pregnancy-related COVID worry. Compared to the three and four factor structures obtained in the validation of the Cambridge worry scale in a pregnant population in the UK, we obtained a single factor structure.[15] This is not surprising given the changes we made, including reducing the total number of items and worry domains from socio-medical, own health, socio-economic and relational to just focus on COVID worry. COVID worry is correlated with anxiety, consistent with the original scale. Additionally, the internal consistency of our unidimensional scale is slightly higher than the Cronbach alpha of .79 obtained in the validation of the original Cambridge Worry Scale.

A notable finding was that a history of testing positive for COVID was associated with significantly higher depressive symptom severity; depressive symptom severity scores were over two points higher among those with a history of testing positive compared to those without (M=7.55, SD=4.92 vs M=5.22, SD=4.24), corresponding with a moderate effect size (Cohen’s d=0.56). These findings are consistent with evidence among non-pregnant individuals globally. An observational cohort of over 200,000 individuals from six nations

found that COVID-19 diagnosis was associated with significantly higher odds of moderate-to-severe depressive symptom severity (aOR 1.18, 95% CI 1.03-1.36) and poor sleep quality (aOR 1.13, 95% CI 1.03-1.24).[27] Mechanisms of the COVID history–increased depression association are currently unknown, but could include worry about long-term effects of COVID, social withdrawal, functional limitation, or inflammatory processes. Taken together, these findings suggest that pregnant individuals who report a history of testing positive for COVID should be closely monitored for depression, or better, referred for depression prophylaxis.[28]

Moderate-to-severe depressive symptom severity was prevalent in this sample (17%), but lower than previous reports among non-pregnant (28%[1]) and pregnant populations (37%[2]) during the pandemic. However, previous investigations were conducted earlier in the pandemic and with predominantly non-Hispanic White populations. The prevalence of elevated depressive symptoms in the current sample was similar to pregnant Latinx patients in an integrated managed health care organization in June 2020-April 2021 (13%). One unexpected finding was that pregnancy-related COVID worry was not particularly elevated in this sample (M=5.28, where the maximum score is 10), and did not vary significantly by pandemic stage. This was particularly surprising given well-publicized findings that Latinx individuals are at significantly greater risk for COVID infection and hospitalization relative to non-Latinx, White individuals.[29]

There are some important limitations and unique features of this dataset to consider when interpreting study findings. First, the cross-sectional study design precludes our ability to draw causal conclusions, or infer whether worry about COVID preceded and increased risk for depression. The reverse is also possible: that those who are more depressed worried more about COVID. Longitudinal research is needed to evaluate the temporal order of the COVID worry – depression relationship. Second, although the specificity of our sample addresses an important gap in the literature, it does potentially limit generalizability to all pregnant people. Third, although adapting an existing worry scale to measure pregnancy-related COVID worry specifically addressed an important need during the emergence of the pandemic, it limits comparison with other samples. Further, because of the short time frame we had to introduce this scale, we did not have the opportunity to conduct expert reviews and cognitive interviews to assess content validity, relevance, and comprehensibility. Thus, the tool may not have adequately captured all the issues the population was most worried about.

In conclusion, our findings show that although pregnancy-related COVID worry was not particularly elevated in a sample of low-income pregnant people, most of whom were Latinx, Black, or biracial, those who worried more also had higher depressive symptoms, and this was partly due to increased sleep disturbance. There are two important clinical implications that we wish to highlight. First, current findings suggest that pregnant individuals with a history of testing positive for COVID are at particularly increased risk of mild-to-severe depressive symptoms and should be closely monitored for symptom exacerbation or referred for depression prophylaxis. Second, findings underscore the importance of assessing and intervening upon sleep disturbance, particularly considering

growing evidence of its contributions to depression risk among pregnant and postpartum people.

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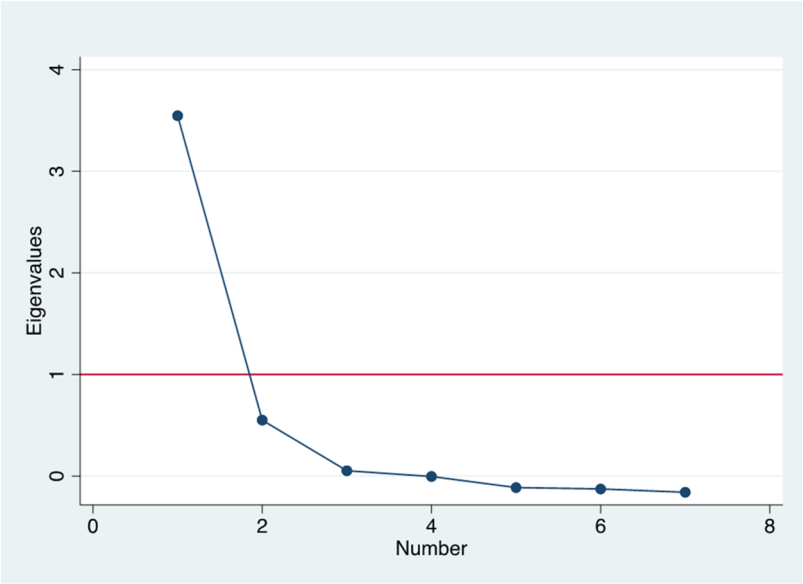

Figure 1:
Scree plot from factor analysis

Table 1.

Participant sociodemographic, clinical, and psychological characteristics

Characteristic	Mean or Frequency	Standard deviation or %	n
Sociodemographic characteristics			
Age (years)	27.35	5.81	198
Race/Ethnicity			201
Latina, Latinx, or Hispanic	147	73.1%	
African American or Black	12	6.0%	
White	20	10.0%	
Bi- or multi-racial/ethnic	10	5%	
Other *	12	6%	
Monthly Income (Household, before taxes)			201
Less than $1,000	41	20.4%	
$1,000-2,000	56	27.9%	
$2,001-$3,000	52	25.9%	
Over $3,000	43	21.4%	
Currently employed	73	36.3%	201
Highest level of education			201
Less than high school, high school graduate, GED or equivalent	102	50.7%	
Some college, junior college, or vocational school	72	35.8%	
College graduate	26	12.9%	
Clinical characteristics			
Current or past hypertension, high blood pressure, or pre-eclampsia	26	12.9%	201
Type I, II, or Gestational Diabetes	25	12.4%	200
Parity	1.60	1.42	200
History of premature birth	26	12.9%	200
History of low birthweight	14	7.0%	200
Bleeding or threatened miscarriage in current pregnancy	35	17.4%	200
Gestational age (weeks)	13.74	4.21	201
Ever tested positive for COVID	29	14.4%	201
Ever received COVID vaccination	25	22.1%	113
Psychological characteristics			
History of anxiety	37	18.4%	201
History of depression	40	19.9%	201
Other mental health history	6	3.0%	201
Perceived stress	13.17	7.65	195
Depressive symptom severity	5.58	4.42	199
Moderate-to-severe depression	34	17.1%	
Anxiety symptom severity	3.95	4.47	200
Moderate-to-severe anxiety	22	11%	
Sleep disturbance T score	50.54	11.37	195

Characteristic	Mean or Frequency	Standard deviation or %	n
Moderate-to-severe sleep disturbance	40	20.5%	
Pregnancy-related COVID worry score	5.28	2.52	201
Pandemic stage when enrolled			201
Pre vaccines	82	40.8%	
Vaccines widely available	29	14.4%	
Delta and Omicron variants	90	44.8%	

* Native American, American Indian, Alaskan Native, or Indigenous Person n = 1 (0.5%); Pacific Islander or Native Hawaiian n=2 (1%), Asian n=6 (3%), Other n=3 (1.5%)

Table 2.

Descriptive data and correlation matrix for initial 10 items of the Pregnancy-Related COVID Worry Scale

					Correlation matrix									
	In final scale?	**N**	**Mean**	**Standard Deviation**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. How COVID-19 has affected your relationship with your partner (if applicable).	No	196	2.13	2.30	1.00									
2. How COVID-19 has affected your relationship with your family and friends.	No	201	3.38	2.93	**.51**	1.00								
3. The possibility that you will get COVID-19.	Yes	201	4.61	3.28	.27	.26	1.00							
4. The possibility that someone you live with will get COVID-19.	Yes	200	4.65	3.27	.27	**.35**	**.77**	1.00						
5. The possibility that your baby will get COVID-19.	Yes	199	5.58	3.57	.13	.21	**.65**	**.65**	1.00					
6. Going to the hospital during the COVID-19 outbreak.	Yes	201	5.45	3.36	.27	**.37**	**.47**	**.44**	**.36**	1.00				
7. Giving birth during the COVID-19 outbreak.	Yes	200	5.92	3.26	.28	**.33**	**.52**	**.51**	**.51**	**.74**	1.00			
8. Coping with a new baby during the COVID-19 outbreak.	Yes	201	4.26	3.18	.20	**.38**	**.38**	**.36**	**.45**	**.50**	**.55**	1.00		
9. Not being able to work (if applicable) because of COVID-19.	No	188	4.80	3.57	.27	.27	**.36**	**.30**	**.39**	**.41**	**.45**	**.40**	1.00	
10. Whether the person you want to be with you will be there for the birth because of COVID-19.	Yes	199	6.46	3.69	.15	.14	**.39**	**.37**	**.36**	**.43**	**.50**	.29	**.37**	1.00

Table 3:

Results of exploratory factor analysis of the 7-item Pregnancy-Related COVID Worry Scale

Variable	Factor1	Uniqueness
The possibility that you will get COVID-19.	0.79	0.27
The possibility that someone you live with will get COVID-19	0.77	0.29
The possibility that your baby will get COVID-19	0.73	0.41
Going to the hospital during the COVID-19 outbreak	0.72	0.33
Giving birth during the COVID-19 outbreak.	0.81	0.24
Coping with a new baby during the COVID-19 outbreak.	0.58	0.61
Whether the person you want to be with you will be there for the birth because of COVID-19.	0.52	0.70

Table 4.

Bivariate associations between sociodemographic, clinical, and psychological characteristics and depressive symptom severity.

	B	Standard Error	p-value
Sociodemographic			
Age (years)	−0.08	0.05	.16
Race/Ethnicity			
Latina, Latinx, or Hispanic		reference	
African American or Black	1.71	1.32	.20
White	1.76	1.05	.09
Bi- or multi-racial/ethnic	1.61	1.44	.26
Other	−1.21	1.32	.36
Monthly Income (Household, before taxes)			
Less than $1,000	−0.99	0.94	.30
$1,000-2,000	−1.65	0.88	.06
$2,001-$3,000	−1.41	0.89	.12
Over $3,000		reference	
Currently employed	−0.18	0.65	.78
Highest level of education			
Less than high school, high school graduate, GED or equivalent	0.85	0.98	.38
Some college, junior college, or vocational school	1.08	1.02	.29
College graduate		reference	
Clinical			
Current or past hypertension, high blood pressure, or pre-eclampsia	0.80	0.93	.39
Type I, II, or Gestational Diabetes	−1.09	0.95	.25
Parity	−0.39	0.22	.08
History of premature birth	−0.25	0.93	.78
History of low birthweight	−0.20	1.23	.87
Bleeding or threatened miscarriage in current pregnancy	0.55	0.83	.50
Gestational age at baseline (weeks)	−0.02	0.08	.76
Ever tested positive for COVID	2.43	0.87	.006
Baseline psychological characteristics			
History of anxiety	2.15	0.79	.007
History of depression	1.09	0.78	.16
Other mental health history	3.18	1.82	.08
Perceived stress	0.34	0.03	<.001
Anxiety symptom severity	0.63	0.05	<.001
Sleep disturbance T score	0.20	0.02	<.001
Pregnancy-related COVID worry	0.52	0.12	<.001
Pandemic stage			
Pre vaccines	0.27	0.96	.78
Vaccines widely available		reference	

	B	Standard Error	p-value
Delta and Omicron variants	−0.11	0.95	.91

Table 5.

Bivariate (left panel) and multivariate (right panel) models evaluating potential predictors of depressive symptom severity.

	Univariate				Multivariate			
	B	**SE**	**95% CI**	**p**	**B**	**SE**	**95% CI**	**p**
Age	−0.08	0.05	−0.18, 0.03	.16	−0.02	0.06	−0.15, 0.11	.77
Race/Ethnicity				.18				.21
Latina, Latinx, or Hispanic			reference				reference	
African American or Black	1.71	1.32	−0.89, 4.32	.20	1.57	1.26	−0.91, 4.06	.21
White	1.76	1.05	−0.31, 3.83	.09	1.65	0.98	−0.29, 3.58	.09
Bi- or Multi-racial	1.61	1.44	−1.22, 4.45	.26	0.48	1.50	−2.48, 3.44	.75
Other	−1.21	1.32	−3.81, 1.40	.36	−1.41	1.25	−3.87, 1.06	.26
Parity	−0.39	0.22	−0.83, 0.04	.08	−0.18	0.25	−0.67, 0.31	.48
Monthly household income				.27				.15
Less than $1000	−0.99	0.94	−2.85, 0.87	.30	−0.98	0.93	−2.82, 0.85	.29
$1000 to $2000	−1.65	0.88	−3.38, 0.08	.06	−1.76	0.86	−3.46, −0.07	.04
$2001 to $3000	−1.41	0.89	−3.17, 0.35	.12	−1.74	0.87	−3.45, −0.02	.05
Over $3000			reference				reference	
Ever tested positive for COVID	2.43	0.87	0.71, 4.16	.006	2.63	0.85	0.96, 4.31	.002
Pregnancy-related COVID worry	0.52	0.12	0.29, 0.76	<.001	0.39	0.12	0.15, 0.63	.002

Table 6.

Bivariate (left panel) and multivariate (right panel) models evaluating potential predictors of mild-to-severe depressive symptom severity.

	Univariate			Multivariate		
	OR	**95% CI**	**p**	**OR**	**95% CI**	**p**
Age	.98	0.93-1.03	.44	1.00	0.93-1.07	.96
Race/Ethnicity			.14			.15
Latina, Latinx, or Hispanic		reference			reference	
African American or Black	3.49	0.91-13.43	.07	3.55	0.82-15.39	.09
White	2.16	0.82-5.73	.12	2.11	0.75-5.96	.16
Bi- or Multi-racial	1.75	0.47-6.45	.40	1.17	0.25-5.54	.84
Other	0.58	0.17-2.02	.39	0.41	0.11-1.58	.19
Parity	0.91	0.75-1.11	.37	0.98	0.76-1.28	.91
Monthly household income			.15			.08
Less than $1000	0.71	0.30-1.71	.45	0.71	0.27-1.87	.48
$1000 to $2000	0.40	0.18-0.91	.03	0.32	0.13-0.81	.02
$2001 to $3000	0.53	0.23-1.21	.13	0.44	0.18-1.11	.08
Over $3000		reference			reference	
Ever tested positive for COVID	3.10	1.30, 7.38	.01	4.40	1.65-11.70	.003
Pregnancy-related COVID worry	1.21	1.08-1.36	.001	1.16	1.02-1.32	.02