Prenatal distress during the COVID-19 pandemic: clinical and research implications

Cindy H. Liu1,2,3, Sunah Hyun1,3, Carmina Erdel1,3, Leena Mittal2,3

Received: 17 December 2020 / Accepted: 13 October 2021 / Published online: 30 October 2021
© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2021

Abstract
Purpose The objective of this study was to identify risk and protective factors related to general prenatal distress and COVID-19-specific prenatal distress to inform intervention targets among women pregnant during the COVID-19 pandemic.
Methods The study relied on data obtained from U.S. pregnant women (N=701) who participated in the Perinatal Experiences and COVID-19 Effects (PEACE) Study from May 21 to October 3, 2020. The present cross-sectional study examined the potential risk and protective factors associated with different features of prenatal distress among U.S. pregnant women during the COVID-19 pandemic.
Results Approximately two-thirds of expectant mothers indicated being more stressed about going to the hospital because of COVID-19. Generalized anxiety and PTSD were associated with higher levels of general and COVID-19-specific prenatal distress. Depression symptoms were associated with higher general prenatal distress. Higher levels of distress tolerance were associated with lower levels of general prenatal distress (B = −0.192, p < .001) and COVID-19-specific prenatal distress (B = −0.089, p < .05). Higher levels of instrumental social support were marginally associated with lower COVID-19-specific prenatal distress (B = −0.140, p < 0.1).
Conclusion Findings draw attention to prenatal distress experiences during the COVID-19 pandemic, including new types of distress arising from the pandemic itself. Women might benefit from the introduction of interventions such as mindfulness-based or relaxation therapy. Coverage of responsibilities and financial assistance is particularly needed during the COVID-19 pandemic. Limitations include a majority White and high socioeconomic sample. These findings provide specificity regarding potential targets for addressing prenatal distress.

Keywords Pregnancy · Pandemic · Mental health · Stress · Depression · Anxiety

Introduction
Ensuring the physical safety of mothers during pregnancy, labor, and delivery has been a major priority given the potential direct risks of SARS-CoV-2. Yet, the mental health and well-being of mothers, infants, and their families throughout the perinatal period have been overlooked. Concerns have primarily consisted of mitigating infection risks during pregnancy, and the viral transmission to the infant [1–3] although there are now increased calls for addressing the perinatal mental health issues as a result of the pandemic [4–6].

As women have continued to conceive during the pandemic, it is necessary to understand how their experience of pregnancy has been affected throughout the period, as demonstrated by calls to support women having a “pandemic pregnancy” [7–9]. While pregnancy and the anticipation of having a new baby may be regarded as a positive experience, many women find pregnancy itself to be emotionally and physically challenging. Pregnancy-specific stress or what we refer to here as general prenatal distress encompasses stress specific to maternal fears and worries related to pregnancy [10]. These include anxieties about the changes in one’s roles, responsibilities, and relationships that occur alongside with having a baby [11], concerns such as...
physical symptoms or complaints that occur with changes in the body, as well as worries about the developing fetus and the health of the baby [12–14]. While pregnancy-specific distress may co-occur with general life stress, there is evidence that pregnancy-specific distress may independently predict birth outcomes [11], even more so than general stress experiences or stress unrelated to pregnancy itself [10, 15].

The COVID-19 pandemic represents a new source of stress with unique implications for parents and those preparing for childbirth [16], which we refer to as COVID-19-specific prenatal distress. There is evidence to indicate that this stress has led to additional stress during pregnancy. Women have expressed concerns related to visiting their physicians and the transmission of the virus to their children while holding or feeding the baby [17]. Stress regarding birth preparations and COVID-19 infection risk are linked to elevated anxiety during pregnancy [18].

Identifying the potential risk and protective factors implicated in the experience of general prenatal distress and COVID-19-specific prenatal distress are keys to developing strategies that support those who have been pregnant during the pandemic. Emotional social support [18], along with interpersonal characteristics such as relationship satisfaction or better rapport with one’s mother during pregnancy is associated with lower pregnancy-specific distress [19]. However, instrumental support, or tangible assistance such as financial support or having someone assist with household chores [20], may be particularly critical during the pandemic, as quarantine measures limited access to resources, such as prenatal care or caregiver support. Psychological resilience refers to one’s ability to thrive in the face of adversity or to bounce back from challenges or setbacks [19, 20], and distress tolerance refers to one’s ability to manage and tolerate emotional distress. Both may be individual characteristics that protect one from experiencing stress, although it is unknown what role they play in reducing general prenatal distress or COVID-19-specific prenatal distress.

To better prioritize intervention targets for reducing stress among women pregnant during a pandemic, this study sought to identify risk and protective factors associated with general prenatal distress and COVID-19-specific prenatal distress. The current study used data from the PEACE Study (Perinatal Experiences and COVID-19 Effects; www.peacestudy2020.com), an online assessment launched in May 2020 to gather information about the mental health and well-being of U.S. pregnant and postpartum women amidst the COVID-19 pandemic [21]. Our present analysis focused on women who were at least in their second trimester of pregnancy. Since certain factors may be more protective against certain types of stress, we examined associations between protective factors (resilience, distress tolerance, and emotional and instrumental social support) and two outcomes: general prenatal distress and COVID-19-specific prenatal distress, while controlling for sociodemographic factors, pre-existing mental health conditions [22], and current mental health symptoms.

**Methods**

**Participants**

Using the preliminary PEACE 2020 data collected from Wave 1 data collection (N = 701) from May 21, 2020 to October 3, 2020, the present cross-sectional study examined the potential risk and protective factors associated with prenatal distress among U.S. pregnant women during the pandemic. Pregnant women over the age of 18 in their second or third trimester of pregnancy were eligible to participate in the study. Participants were recruited using various methods including email, social media, word of mouth (i.e., listservs and Facebook groups). Eligible participants were given informed consent followed by a 30- to 40-min online REDCAP survey. The survey included standard measures that assess COVID-19-related experiences, family-social risk, resilience, perceived relationship with the fetus, and health outcomes. To ensure data quality, several attention checks and human verification were embedded throughout the survey. Furthermore, study staff visually inspected data to detect any response irregularities. All the study procedures were approved by the Institutional Review Board at Mass General Brigham.

**Measures**

**Depression symptoms**

Current depression symptoms were assessed through the Center for Epidemiologic Studies - Depression (CES-D) self-report measure [23]. This 20-item measure determines the frequency of symptoms associated with depression, such as restless sleep, poor appetite, and feeling lonely over the past week. Participants responded using the four response options: rarely or none of the time (less than 1 day); some or a little of the time (1–2 days); occasionally or a moderate amount of the time (3–4 days); and most or all of the time (5–7 days). Higher sum scores represent greater depression symptoms [24].

**Anxiety symptoms**

To assess participants’ current anxiety symptoms, the Generalized Anxiety Disorder Scale (GAD-7) was used [25]. The 7-item self-report measure determines participants’ frequency of anxiety symptoms during the past 2 weeks using the response options ranging from 0 (not at all) to
3 (nearly every day). Higher sum scores indicate elevated anxiety symptoms [26].

**PTSD symptoms**

Participants’ current PTSD symptoms were assessed through the PTSD Checklist—Civilian Version (PCL-C) [27]. This standardized self-report rating scale comprises of 17 items that measure how much participants have been bothered by problems and experiences in response to stressful life events over the past month. Responses range from 1 (not at all) to 5 (extremely). Higher sum scores indicate greater PTSD symptoms.

**Instrumental support**

Using a 4-item subscale of the Two-Way Social Support Scale [28], participants’ instrumental support was assessed. Items assessed the likelihood of receiving the following assistance, including “If stranded somewhere there is someone who would get me,” “I have someone to help me if I am physically unwell,” “There is someone who would give me financial assistance,” and “There is someone who can help me fulfill my responsibilities when I am unable.” A response scale of 0 (not at all) to 5 (always) was used, with the total sum score used for analyses. Higher scores indicate higher instrumental support.

**Emotional support**

The Multidimensional Scale of Perceived Social Support (MSPSS) is a self-report measure that assesses participants’ perception of social support from partner, friends, and family [29]. The 12 questions on this measure includes items such as “I get the emotional help and support I need from my family,” “I can count on my friends when things go wrong,” and “There is a special person in my life who cares about my feelings.” Responses were rated using scale options of 1 (very strongly disagree) to 7 (very strongly agree). Sum scores were used for analysis, with higher scores reflecting greater emotional support.

**Resilience**

Participants’ psychological resilience was measured using the 10-item Connor–Davidson Resilience Scale (CD-RISC-10) [20]. The measure includes questions regarding one’s ability to cope with adverse experiences such as “I am able to adapt when changes occur,” or “I think of myself as a strong person when dealing with life’s challenges and difficulties.” Using a 5-point Likert scale ranging from 0 (not true at all) to 4 (truly nearly all the time), participants indicated how they felt in the past month. Sum scores were calculated for analysis, with higher scores reflecting greater resilience.

**Distress tolerance**

The Distress Tolerance Scale (DTS) assessed participants’ ability to withstand and cope with emotional distress [30]. Examples of items include “Feeling distressed or upset is unbearable to me,” “My feelings of distress are so intense that they completely take over.” Using the 15-item measure, participants rated their ability to tolerate distress on a scale of 1 (strongly agree) to 5 (strongly disagree). Higher scores indicate greater levels of distress tolerance.

**General prenatal distress**

Pregnant women’s specific worries and concerns were assessed using the Prenatal Distress Questionnaire (PDQ) [12]. A total of 12 questions captured participants’ concerns regarding medical problems, physical symptoms, parenting, relationships, body changes, labor and delivery, and the baby’s health. Using a 5-point Likert scale ranging from 0 (“never”) to 4 (“always), participants reported parental distress regarding concerns about giving birth and the baby, concerns over body weight/image, and concerns over emotions and relationships. The Cronbach’s alpha for the overall scale was 0.78 indicating good reliability. The mean score was used for analyses.

**COVID-19-specific prenatal distress**

Feelings of worry specific to pregnant women during the COVID-19 pandemic were determined using the subscales of a newly developed 8-item measure. Items included an assessment of worry/stress regarding concerns such as “I don’t have a way to get to the hospital if I/my baby becomes sick and I need to see a doctor” or “not receiving adequate prenatal care due to COVID-19 (see Table 3 for the full list of items). Participants indicated how they felt on a 5-point scale, with 1 indicating (not worried/stressed at all) and 5 indicating (very worried/stressed.) Cronbach’s alpha for measure items was 0.81, indicating good reliability. The mean score was used for analyses.

**Duration of pandemic**

The number of days from the date when COVID-19 was declared as a pandemic (March 13, 2020) to each participant’s survey start date was calculated. Given possible changes in the experience of the pandemic over time, this variable was included as a covariate.
**Data analytic plan**

Using hierarchical multiple regression models, we examined the unique effects of risk and protective factors on pregnant women’s general prenatal distress and COVID-19-specific prenatal distress. The regression models included covariates and predictor variables that were entered through the following steps: sociodemographic characteristics (Block 1), pre-existing mental health diagnoses (depression, generalized anxiety, PTSD; Block 2), current mental health symptoms (depression, generalized anxiety, PTSD; Block 3), and protective factors (instrumental support, emotional support, resilience, distress tolerance; Block 4).

**Results**

Table 1 displays key characteristics of our study sample. Women were on average 32.5 years of age, with the large majority college educated (90.5%), White (92.9%) and cohabitating with their partners (98.3%). More than 40% reported a household income of more than $150,000. This was the first pregnancy for about 47% of our sample. On average, the women were at 28 weeks of gestation at the time of the survey administration. The survey was completed between 69 and 201 days since the start of the pandemic in the U.S., which was designated as March 13, 2020.

Table 2 describes the mental health and psychosocial experiences based on the responses on survey measures. Within our sample, 18.1% had a pre-existing diagnosis of depression, 27.0% had a pre-existing diagnosis of generalized anxiety, and 4.1% had a pre-existing diagnosis of PTSD. The mean CES-D score was 14.45, the mean GAD-7 was 6.38, and the mean PCL-C score was 29.34. The mean level of instrumental support as assessed by the IS was 18.15, the mean of emotional support as assessed by the MSPSS was 71.07. The mean level of psychological resilience as assessed by the CD-RISC was 27.30, and the mean level of distress tolerance as assessed by the DTS was 3.58. The mean score for general prenatal stress, as assessed by the 12-item PDQ was 1.66. The mean score for COVID-19-specific prenatal distress was 2.54.

Table 3 displays the rates at which respondents indicated being “worried/stressed” or “very worried/very stressed” for various COVID-19-specific prenatal distress. Notably, 67.2% of respondents indicated being worried/stressed about going to the hospital because of COVID-19. The next item that showed the highest rate of worry/stress pertained to accessing the hospital if the respondent or her baby became sick (45.1%), followed by worries about COVID-19 stress interfering with maternal bonding (33.3%), fears about transmitting the virus to the baby (29.7%), and contracting COVID-19 during labor and delivery (24.1%). Among respondents, 16.8% indicated being worried/stressed about their birth partner or support person not being able to be with them during labor and delivery, and 16.6% being worried/stressed about becoming very sick and not having a trusted member or friend to care for their baby. A small minority of participants indicated being worried/stressed about not receiving adequate prenatal care due to COVID-19.

Table 4 demonstrates the extent to which our sociodemographic characteristics, pre-existing mental health diagnoses, current mental health symptoms, and risk and protective factors accounted for reported general prenatal distress as assessed by the PDQ and COVID-19-specific prenatal distress as measured by our 8-item measure. Race as a covariate was excluded from models likely due to multicollinearity. We first report factors associated with general prenatal distress. Those who had a college education ($B = 0.110$, $p < 0.05$), and who attained a masters ($B = 0.163$, $p < 0.1$),

| Predictors | Means ± SD or % |
|------------|-----------------|
| Maternal age (years) | 32.51 ± 3.9 |
| Maternal education | |
| Less than college | 9.5% |
| College | 31.8% |
| Masters | 39.9% |
| Doctorate | 18.8% |
| Household income (USD/year) | |
| < $74,999 | 14.5% |
| $75,000 – 149,999 | 44.5% |
| $150,000 – 224,999 | 25.4% |
| > $225,000 | 15.6% |
| Maternal race | |
| White | 92.9% |
| Black or African American | 1.0% |
| Hispanic or Latino | 3.1% |
| Asian and Pacific Islander | 3.0% |
| Other | 0% |
| First pregnancy | |
| No | 53.2% |
| Yes | 46.8% |
| Pregnancy trimester | |
| 2nd | 40.2% |
| 3rd | 59.8% |
| Gestational weeks | 28.25 ± 7.60 |
| Cohabiting | |
| No | 1.7% |
| Yes | 98.3% |
| Pandemic duration (days) | 119.87 (range 69.0–201.0) |

$N = 701$
or doctorate \( (B = 0.148, p < 0.1) \), were marginally or more likely to report general prenatal distress compared to those with less than a college education. Cohabiting with a partner was marginally associated with lower general prenatal stress \( (B = -0.061, p < 0.1) \), whereas the report of this pregnancy being the first was significantly associated with higher levels of general prenatal distress \( (B = 0.156, p < 0.001) \). Those who took the survey later in the pandemic had higher levels of general prenatal distress \( (B = 0.066, p < 0.05) \). Pre-existing mental health diagnoses showed no association with general prenatal distress. When accounting for sociodemographic variables, pandemic duration, and pre-existing mental health, higher levels of depression symptoms, generalized anxiety, and PTSD were associated with higher levels of general prenatal distress (depression: \( B = 0.259, p < 0.001 \), generalized anxiety: \( B = 0.114, p < 0.05 \), and PTSD: \( B = 0.117, p < 0.05 \)). When controlling for these mental health symptoms, distress tolerance was found to significantly predict general prenatal distress, with higher levels of distress tolerance being associated with lower levels of general prenatal distress \( (B = -0.192, p < 0.001) \). All the predictors accounted for 42.0% of the model variance.

Next, we examined factors associated with COVID-19-specific prenatal distress. No sociodemographic or pre-existing depression and generalized anxiety mental health diagnoses were associated with COVID-19-specific prenatal distress. A pre-existing PTSD diagnosis was marginally associated with COVID-19-specific prenatal distress. Current generalized anxiety and PTSD symptoms were associated with COVID-19-specific prenatal distress (generalized anxiety: \( B = 0.193, p < 0.01 \); PTSD: \( B = 0.155, p < 0.1 \)), although the association with PTSD symptoms was marginal. After controlling for sociodemographic variables, pre-existing mental health conditions and current mental health symptoms, instrumental support and distress tolerance were found to be marginally and significantly associated with COVID-19-specific prenatal distress respectively, with higher levels of instrumental support and distress tolerance associated with lower levels of COVID-19-specific prenatal distress \( (B = -0.140, p < 0.1, \text{ distress tolerance: } B = -0.089, p < 0.05) \). All the predictors accounted for 26.8% of the model variance.

### Discussion

Our objective was to understand expectant mothers’ experiences related to general prenatal distress and distress specific to the COVID-19 pandemic, based on data obtained from...
May to October 2020 during the COVID-19 pandemic. The baseline scores for general prenatal distress and COVID-19-specific prenatal distress indicate that women in general did not report high levels of general prenatal distress during our study period comparable to other work on general prenatal distress [31]. Rather, higher rates of COVID-19-related concerns were observed at an item level with more than two-thirds of women reported experiencing more stress about going to the hospital because of the COVID-19 pandemic and almost half worried about access to health care during the pandemic. Almost one-third of women were worried about transmitting the virus to the baby and that their stress would affect their ability to bond with their baby.

We also sought to understand the factors related to general prenatal distress and COVID-19-related prenatal distress. Contrary to expectations, no significant associations were observed between resilience with either general prenatal distress or COVID-19-specific prenatal distress after controlling for psychiatric symptoms; rather, it was distress tolerance that appeared to protect against general prenatal distress and COVID-19-specific prenatal distress. The lack of association with resilience is intriguing given that prior work has shown high psychological resilience to be associated with lower prenatal distress [32]. The positive appraisals of a situation, which may be similar to psychological resilience given its connotation of benefit or growth from adversity, has also been negatively associated with

### Table 4

| Blocks of variables entered in three steps | General prenatal distress (PDQ total) | COVID-19-specific prenatal distress |
|-------------------------------------------|--------------------------------------|--------------------------------------|
|                                            | $B$ | $R^2$ | $\Delta R^2$ | $B$ | $R^2$ | $\Delta R^2$ |
| (1) Covariates                            |     |       |           |     |       |           |
| Maternal age                              | −0.023 | 0.031 | 0.031* | 0.019 | 0.019 |
| Maternal education (ref = less than college) |     |       |           |     |       |           |
| College                                  | 0.110* | 0.023 |
| Masters                                  | 0.163† | 0.093 |
| Doctorate                                | 0.148† | 0.024 |
| Household income (ref = <$74,999)         |     |       |           |     |       |           |
| $75,000—149,999                          | −0.013 | 0.005 |
| $150,000—224,999                         | −0.006 | 0.026 |
| >$225,000                                | 0.049 | 0.001 |
| Cohabitating with partner (ref = no)      | −0.061† | 0.023 |
| First pregnancy (ref = no)               | 0.156*** | 0.015 |
| Gestational weeks                        | −0.018 | 0.046 |
| Pandemic duration                        | 0.066* | 0.051 |
| (2) Pre-existing mental health diagnosis  |     |       |           |     |       |           |
| Depression                               | 0.021 | −0.011 |
| Generalized anxiety                      | −0.032 | −0.008 |
| PTSD                                     | 0.001 | −0.067† |
| (3) Current mental health symptoms        |     |       |           |     |       |           |
| Depression                               | 0.259*** | 0.061 |
| Generalized anxiety                      | 0.114* | 0.193** |
| PTSD                                     | 0.117* | 0.155† |
| (4) Protective factors                   |     |       |           |     |       |           |
| Instrumental support                     | −0.051 | 0.268 | 0.243 | 0.195** |
| Emotional support                        | −0.021 | −0.140† |
| Resilience                               | −0.064 | 0.039 |
| Distress tolerance                       | −0.192*** | −0.051 |

Model does not include maternal race due to multicollinearity

$N = 701$

* $p < 0.1$

† $p < 0.05$

‡ $p < 0.01$

*** $p < 0.001$
pregnancy-specific distress [9, 33]. It may be that resilience and any consideration of growth from adversity might have been less relevant when the women took the survey [34, 35] given the uncertain nature of the pandemic at that point in time. While fewer studies have directly examined distress tolerance in relation to pregnancy stress, the observed associations between distress tolerance and both prenatal distress outcomes are sensible. A core component of distress tolerance is the tolerance of aversive, physiological responses to distress, in contrast to a psychological resilience, which involves cognitive processes such as the reframing of one’s capacity to handle a challenge. Accordingly, general prenatal distress has been linked to greater physiological arousal [10, 32, 33, 36]. While avoidant coping is not necessarily a conceptual converse to distress tolerance, prior work shows that it appears to be associated with higher levels of reported prenatal distress [12, 36–38] supporting the observed association between increased distress tolerance and reduced prenatal distress.

Instrumental support but not emotional support was marginally associated (p < 0.1) with COVID-19-specific prenatal distress. The distinction of social support types may be relevant when understanding the needs of pregnant women during the pandemic. Emotional social support provides one with a sense of self-worth [39], as well as belonging and connectedness with others [35], and is imperative for the physical, mental, and emotional well-being [40, 41]. Instrumental support may be more relevant during a pandemic the need for access and resources although additional research is needed to determine its role for pregnant women.

It is important to note the limitations of this work. First, although we were able to collect data nationwide, the study utilized a convenience sampling approach. This is likely to have led to an over-representation of White women and those who are higher in socioeconomic status (higher incomes and educational levels). Caution must be taken in the generalizability of our findings to all pregnant women in the U.S., particularly given the disparities faced by racial/ethnic minorities and those of lower socioeconomic status throughout the pandemic [5, 42]. Disparities regarding how stress and mental health are discussed between providers and patients within prenatal care settings have existed prior to the pandemic [43]. It is possible that non-White and lower SES women are more likely to report greater levels of distress [36, 44]. In light of this, data from the pandemic which focuses on the stress experiences among non-White and lower SES pregnant women are urgently needed. Second, the cross-sectional design does not allow us to draw causal inferences between our predictors and outcome variables, nor does it allow us to understand how these findings extend into the postpartum period. Pre-existing data has shown prenatal stress to be strongly associated with postpartum mental health [45]; therefore, further work to examine subsequent outcomes are warranted. Third, the results are solely based on the self-report, including the self-screening for mental health symptoms, which is subjective and not diagnostic. Thus, our data, as with other survey studies, may be subject to problems related to recall bias. Fourth, the incorporation of data related to neonatal characteristics would enhance our understanding of the different factors that might contribute to prenatal distress, and an important future direction for research given the implications of the pandemic on families of high-risk infants (e.g., those requiring care in the NICU) [46, 47].

In spite of these limitations, our work draws attention to understanding the prenatal distress experiences during the COVID-19 pandemic, highlighting the nuances of distress from current conditions. Our findings suggest that under the conditions of the pandemic, women who experience prenatal distress might benefit from the introduction of interventions that address distress tolerance such as mindfulness-based or relaxation therapy [42] and supports that help to cover responsibilities or provide financial assistance. Providers are encouraged to speak to patients about their mood [43], to inquire with their patients whether they have such support, and to consult with social work or other specialists to determine if there are ways to meet the tangible needs of pregnant women. These findings provide specificity regarding potential targets for addressing prenatal distress that takes place during the COVID-19 pandemic and as such, should compel us to assess such risks and protective factors. Being aware of the contributing factors to prenatal distress is needed so that practitioners can refer patients to appropriate interventions to reduce distress.

Acknowledgements Authorship: support for this manuscript was provided through the Mary A. Tynan Faculty Fellowship, Weinberg and Barton families, the Family Health and Resiliency Fund, and a National Institutes of Health K23 MH 107714-01 A1 award (to C.H.L.) and T32 MH016259 (to S.H.). We are grateful for the assistance of Ga Tin Finneas Wong in the preparation of this manuscript and Emily Zhang in the collection of this data. This work has not been presented in any meetings nor has it been posted on a preprint server.

Author contributions CHL: protocol/project development. LM: protocol/project development and manuscript writing. CE: protocol/project development and manuscript editing. SH: data collection or management. CHL: data collection, manuscript writing. LM: protocol/project development and manuscript editing. CE: protocol/project development and manuscript editing.

Funding This study was funded by the Mary A. Tynan Faculty Fellowship and a NIH K23 MH 107714–01 A1 award (to C.H.L.) and NIH T32 MH016259 (to S.H.), the Weinberg and Barton families, and the Family Health and Resiliency Fund.

Data availability Data are not available due to lack of permission from research participants.

Code availability SPSS software codes were used.
Informed consent

Informed consent was obtained from all the individual participants included in the study.

References

1. Zeng H, Xu C, Fan J et al (2020) Antibodies in infants born to mothers with COVID-19 pneumonia. JAMA 323:1848–1849. https://doi.org/10.1001/jama.2020.4861
2. Schwartz DA (2020) An analysis of 38 pregnant women with COVID-19, their newborn infants, and maternal-fetal transmission of SARS-CoV-2: maternal coronavirus infections and pregnancy outcomes. Arch Pathol Lab Med 144:799–805. https://doi.org/10.5858/arpm.2020-0901-SA
3. Shahbazi Sighaldeh S, Ebrahimi Kalan M (2020) Care of newborns born to mothers with COVID-19 infection: a review of existing evidence. J Matern Fetal Neonatal Med. https://doi.org/10.1080/14767058.2020.1777969
4. Osborne LM, Kimmel MC, Surkan PJ (2021) The crisis of perinatal mental health in the age of COVID-19. Matern Child Health J 25:349–352. https://doi.org/10.1007/s11886-020-03114-y
5. Masters GA, Asipenko E, Bergman AL et al (2021) Impact of the COVID-19 pandemic on mental health, access to care, and health disparities in the perinatal period. J Psychiatr Res 137:126–130
6. Matvienko-Sikar K, Meedya S, Ravaldi C (2020) Perinatal mental health during the COVID-19 pandemic. Women Birth 33:309–310. https://doi.org/10.1016/j.wombi.2020.04.006
7. Ceulemans M, Hompes T, Foulon V (2020) Mental health status of pregnant and breastfeeding women during the COVID-19 pandemic: a call for action. Int J Gynecol Obest. https://doi.org/10.1002/ijgo.13295
8. Thapa SB, Mainali A, Schwank SE, Acharya G (2020) Perinatal mental health in the time of the COVID-19 pandemic. Acta Obstet Gynecol Scand 99:817–818. https://doi.org/10.1111/aogs.13894
9. Caparros-Gonzalez RA, Alderdice F (2020) The COVID-19 pandemic and perinatal mental health. J Reprod Infant Psychol 38:223–225
10. Huizink AC, Mulder EJH, Robles de Medina PG et al (2004) Is pregnancy anxiety a distinctive syndrome? Early Human Dev 79:81–91. https://doi.org/10.1016/j.earhdemdev.2004.04.014
11. Alderdice F, Lynn F (2011) Factor structure of the prenatal distress questionnaire. Midwifery 27:553–559. https://doi.org/10.1016/j.midw.2010.05.003
12. Yali AM, Lobel M (1999) Coping and distress in pregnancy: an investigation of medically high risk women. J Psychosom Obstet Gynecol 20:39–52
13. Gurung RA, Dunkel-Schetter C, Collins N et al (2005) Psychosocial predictors of prenatal anxiety. J Soc Clin Psychol 24:497–519
14. Furber CM, Garrod D, Maloney E et al (2009) A qualitative study of mild to moderate psychological distress during pregnancy. Int J Nurs Stud 46:669–677
15. Lobel M, Cannella DL, Graham JE et al (2008) Pregnancy-specific stress, prenatal health behaviors, and birth outcomes. Health Psychol 27:604
16. Liu CH, Doan SN (2020) Psychosocial stress contagion in children and families during the COVID-19 pandemic. Clin Pediatr (Phila) 59:853–855. https://doi.org/10.1177/0009922820927044
17. Fakari FR, Simbar M (2020) Coronavirus pandemic and worries during pregnancy; a letter to editor. Arch Acad Emerg Med 8:e21
18. Preis H, Mahaffey B, Heiselman C, Lobel M (2020) Pandemic-related pregnancy stress and anxiety among women pregnant during the coronavirus disease 2019 pandemic. Am J Obstet Gynecol MFM 2:100155. https://doi.org/10.1016/j.ajogmf.2020.100155
19. Campbell-Sills L, Stein MB (2007) Psychometric analysis and refinement of the Connor-Davidson resilience scale (CD-RISC): validation of a 10-item measure of resilience. J Traum Stress 20:1019–1028. https://doi.org/10.1002/jts.20271
20. Connor KM, Davidson JRT (2003) Development of a new resilience scale: the Connor-Davidson resilience scale (CD-RISC). Depress Anxiety 18:76–82. https://doi.org/10.1002/da.10113
21. Liu CH, Erdei C, Mittal L (2020) Risk factors for depression, anxiety, and PTSD symptoms in perinatal women during the COVID-19 pandemic. Psychiatry Res 295:113552. https://doi.org/10.1016/j.psychres.2020.113552
22. Liu CH, Stevens C, Conrad R, Hahn HC (2020) Evidence for elevated psychiatric distress, poor sleep, and quality of life concerns during the COVID-19 pandemic among U.S. young adults with suspected and reported psychiatric diagnoses. Psychiatry Res 292:113345. https://doi.org/10.1016/j.psychres.2020.113345
23. Radloff LS (1977) The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1:385–401. https://doi.org/10.1177/014662167700100306
24. Lewinsohn PM, Seeley JR, Roberts RE, Allen NB (1997) Center for epidemiologic studies depression scale (CES-D) as a screening instrument for depression among community-residing older adults. Psychol Aging 12:277–287. https://doi.org/10.1037/0882-7974.12.2.277
25. Spitzer RL, Kroenke K, Williams JB, Lübbe B (2006) A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med 166:1092–1097. https://doi.org/10.1001/archinte.166.10.1092
26. Plummer F, Manea L, Trepel D, McMillan D (2016) Screening for anxiety disorders with the GAD-7 and GAD-2: a systematic review and diagnostic metaanalysis, Gen Hosp Psych 39:24–31. https://doi.org/10.1016/j.genhosppsych.2015.11.005
27. Weathers FW, Litz BT, Herman DS et al (1993) The PTSD Checklist (PCL): reliability, validity, and diagnostic utility. In: Annual convention of the international society for traumatic stress studies, vol 462. San Antonio, TX
28. Shakespeare-Finch J, Obst PL (2011) The development of the 2-way social support scale: a measure of giving and receiving emotional and instrumental support. J Pers Assess 93:483–490. https://doi.org/10.1080/00223891.2011.594124
29. Zimet GD, Dahlem NW, Zimet SG, Farley GK (1988) The multidimensional scale of perceived social support. J Pers Assess 52:30–41. https://doi.org/10.1207/s15327752ijps5201_2
30. Simons JS, Gaheer RM (2005) The distress tolerance scale: validation and development of a self-report measure. Motiv Emot 29:83–102. https://doi.org/10.1007/s11031-005-7955-3
31. Pluess M, Bolten M, Pirke K-M, Hellhammer D (2010) Maternal trait anxiety, emotional distress, and salivary cortisol in pregnancy. Biol Psychol 83:169–175. https://doi.org/10.1016/j.biopsycho.2009.12.005
32. DiPietro JA, Ghera MM, Costigan K, Hawkins M (2004) Measuring the ups and downs of pregnancy stress. J Psychosom Obstet Gynecol 25:189–201
33. DiPietro JA, Hilton SC, Hawkins M et al (2002) Maternal stress and affect influence fetal neurobehavioral development. Dev Psychol 38:659
34. Hyun S, Wong GTF, Levy-Carrick NC et al (2021) Psychosocial correlates of posttraumatic growth among US young adults during the COVID-19 pandemic. Psychiatry Res 302:114035
35. Liu CH, Zhang E, Wong GTF, Hyun S (2020) Factors associated with depression, anxiety, and PTSD symptomatology during the COVID-19 pandemic: clinical implications for US young adult mental health. Psychiatry Res 290:113172. https://doi.org/10.1016/j.psychres.2020.113172
36. Ibrahim SM, Lobel M (2020) Conceptualization, measurement, and effects of pregnancy-specific stress: review of research using the original and revised prenatal distress questionnaire. J Behav Med 43:16–33
37. Hamilton JG, Lobel M (2008) Types, patterns, and predictors of coping with stress during pregnancy: examination of the revised prenatal coping inventory in a diverse sample. J Psychosom Obstet Gynecol 29:97–104. https://doi.org/10.1080/01674820701690624
38. Koletzko SH, La Marca-Ghaemmaghami P, Brandstätter V (2015) Mixed expectations: effects of goal ambivalence during pregnancy on maternal well-being, stress, and coping. Appl Psychol Health Well-Being 7:249–274
39. Hill EM (2016) Quality of life and mental health among women with ovarian cancer: examining the role of emotional and instrumental social support seeking. Psychol Health Med 21:551–561
40. De Sousa MT, Chur-Hansen A, Due C (2020) First-time mothers’ perceptions of social support: recommendations for best practice. Health Psychology Open 7:2055102919898611. https://doi.org/10.1177/2055102919898611
41. Razurel C, Kaiser B, Sellenet C, Epiney M (2013) Relation between perceived stress, social support, and coping strategies and maternal well-being: a review of the literature. Women Health 53:74–99
42. Barbosa-Leiker C, Smith CL, Crespi EJ et al (2021) Stressors, coping, and resources needed during the COVID-19 pandemic in a sample of perinatal women. BMC Pregnancy Childbirth 21:171. https://doi.org/10.1186/s12884-021-03665-0
43. Liu CH, Tronick E (2012) Do patient characteristics, prenatal care setting, and method of payment matter when it comes to provider-patient conversations on perinatal mood? Matern Child Health J 16:1102–1112. https://doi.org/10.1007/s10995-011-0835-4
44. Yilmaz EB (2019) Socio-demographic and pregnancy-related characteristics associated with prenatal distress: a Turkish study. Cent Eur J Nurs Midwifery 10:1069
45. Liu CH, Tronick E (2013) Re-conceptualising prenatal life stressors in predicting post-partum depression: cumulative-, specific-, and domain-specific approaches to calculating risk. Paediatr Perinat Epidemiol 27:481–490
46. Erdei C, Liu CH (2020) The downstream effects of COVID-19: a call for supporting family well-being in the NICU. J Perinatol 40:1283–1285. https://doi.org/10.1038/s41372-020-0745-7
47. Liu CH, Mittal L, Erdei C (2021) COVID-19-related health worries compound the psychiatric distress experienced by families of high-risk infants. J Perinatol 41(5):1191–1195

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.