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## Research Paper

## Mental health of pregnant and postpartum women in response to the COVID-19 pandemic

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## ARTICLE INFO

## Keywords:

Covid-19 pandemic  
Stress  
Longitudinal  
Pregnancy  
Depression  
anxiety

## ABSTRACT

**Background:** The COVID-19 pandemic has been uniquely challenging for pregnant and postpartum women. Uncontrollable stress amplifies risk for maternal depression and anxiety, which are linked to adverse mother and child outcomes. This study examined change in internalizing symptoms from before to during the COVID-19 pandemic among pregnant and postpartum women longitudinally, and investigated moderation by loneliness and other contextual risk factors.

**Methods:** 135 women ( $M_{age} = 31.81$ ; 26% Latina, 55% non-Hispanic White, 11% Black; 39% low-income) enrolled in an existing prospective study completed self-report questionnaires including the EPDS and STAI-short form during early pregnancy, prior to COVID-19, and during COVID-19.

**Results:** Depressive symptoms were higher during COVID-19 compared to pre-COVID-19 and just as high as during early pregnancy. Anxiety symptoms were higher during COVID-19 compared to both pre-COVID-19 and early pregnancy. Higher loneliness was associated with increased depressive symptoms during COVID-19. Greater COVID-19 specific adversity was linked to greater increases in internalizing symptoms during COVID-19. Lower income-to-needs-ratio most strongly predicted symptoms during early pregnancy.

**Limitations:** The present study is longitudinal, but the correlational nature of the data precludes causal conclusions regarding the effect of the pandemic on mental health.

**Conclusion:** Longitudinal analyses suggest the COVID-19 pandemic resulted in increased internalizing symptoms among diverse pregnant and postpartum women. Interpersonal and contextual factors exacerbate risk and the impact of the pandemic on women's mental health. Identifying mothers at-risk for depression and anxiety may increase treatment utilization, mitigate fetal and infant exposure to maternal depression and anxiety, and help prevent adverse child outcomes.

## 1. Introduction

The global health crisis resulting from novel coronavirus 2019 (COVID-19) and ensuing governmental and societal action to reduce the spread of the virus have had profound economic and social consequences. The COVID-19 pandemic represents a severely stressful event with widespread disruptions, including loss of income and housing, social/physical distancing, and fearfulness about infection, that may contribute to changes in mental health symptoms. Cross-sectional evidence suggests that the pandemic is associated with symptoms of depression and anxiety in non-pregnant adults (Ettman et al., 2020;

McGinty et al., 2020). This mental health impact may be particularly pronounced among pregnant and postpartum women as vulnerable populations for whom depressive and anxiety symptoms can have intergenerational consequences (Bush et al., 2020; Centers for Disease Control and Prevention (CDC), 2020; Davis and Narayan, 2020; Glynn et al., 2018; Mahrer et al., 2014; Salisbury et al., 2016), including poorer child behavioral, cognitive, and socioemotional developmental outcomes (Buss et al., 2011; Davis and Sandman, 2012; Kingston and Tough, 2014) and later development of psychopathology among offspring (Davis et al., 2020; Weissman et al., 2006).

The COVID-19 pandemic is an uncontrollable stressor that has devastated day-to-day life. However, it also serves as a natural experiment,

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providing an opportunity to assess the impact of stress exposure on mental health. Longitudinal evidence on mental health responses to the pandemic is sparse to date, and it is unknown whether the pandemic is associated with increases from previous levels of depressive and anxiety symptoms in pregnant and postpartum women. The current study used a prospective design in which symptoms of depression and anxiety were longitudinally assessed in pregnant and postpartum women twice before and once during the pandemic to evaluate whether maternal mental health symptoms changed in response to the COVID-19 pandemic. The current study further evaluated risks moderating effects on symptom change.

Exposure to uncontrollable stressors, such as natural disasters or global pandemics, exacerbates maternal mental health difficulties (Ehrlich et al., 2010; Glynn et al., 2001; Harville et al., 2009; Khatri et al., 2019; Kildea et al., 2018; Xiong et al., 2010). However, most studies of pregnant and postpartum women to date are cross-sectional, assessing symptom levels only after a disaster, so it is unknown how maternal mental health may change in response to such events. One longitudinal study examined change in psychological distress from before to after Hurricane Katrina in a low-income population of mothers and found that higher income was protective against increases in psychological distress in response to the hurricane (Paxson et al., 2012). Another study investigating the 2008 Iowa Flood in a predominantly white, upper-middle class sample of women in the perinatal period found that poor social support was associated with increases in depressive symptoms in response to the flood (Brock et al., 2015). Most existing research on the COVID-19 pandemic is cross-sectional and with socio-demographically low-risk perinatal populations. Even in low-risk samples, pregnant women assessed during the pandemic showed higher depressive and anxiety symptoms compared to a separate cohort of pregnant women assessed prior to the pandemic (Berthelot et al., 2020).

Although the COVID-19 pandemic is a universal stressor experienced across the globe, it is likely that the mental health impact of this event will differ based on interpersonal and contextual factors (Brock et al., 2015). Interpersonal support and social connection are protective against development of depression and anxiety (Milgrom et al., 2019; Santini et al., 2015), and, during pregnancy and in the postpartum period, they are robust predictors of maternal mental health (Dunkel-Schetter et al., 1996; Rini et al., 2006; Stapleton et al., 2012). Stay-at-home orders and social distancing interventions impacting social connectedness have been shown to impact mental health in adults (Palgi et al., 2020) and may have consequences for mental health among pregnant and postpartum women.

There has been widespread concern that the pandemic will increase disparities in mental health (e.g., Anderson et al., 2020), and it is known that women who experience sociodemographic risk factors may be particularly susceptible to psychopathology (D'Anna-Hernandez et al., 2015; Grote et al., 2010; Ponting et al., 2020; Shakeel et al., 2015). Contextual factors like socioeconomic status (SES) likely increase susceptibility to the negative impacts of COVID-19 specific stressors (CDC, 2020). Further, research has already indicated that there are SES-related disparities in COVID-19 outcomes such as higher incidence of COVID-19 infections in lower-SES areas (Das et al., 2020). More severe experiences of disaster-specific adversity (e.g., losing a loved one, job loss) can also amplify mental health symptoms (Paxson et al., 2012).

#### Current Study

Longitudinal research investigating the mental health implications of the COVID-19 pandemic from before to during the pandemic among pregnant and postpartum women is needed in order to assess the impact of the pandemic on mental health and to identify risk and protective factors. Elucidating the risks and needs of this vulnerable population may have intergenerational benefits by reducing fetal and infant exposure to maternal mental health problems. The current study applied a longitudinal design to assess changes in symptoms of depression and anxiety before and during the COVID-19 pandemic among a racially and ethnically diverse sample of pregnant and postpartum women. Partici-

pants were assessed at three timepoints: early pregnancy and before the pandemic (early pregnancy), the most proximal study visit before the COVID-19 pandemic (pre-COVID-19), and during the pandemic (COVID-19). We hypothesized that depressive and anxiety symptoms would increase during the COVID-19 pandemic compared to pre-pandemic levels, especially from the pre-COVID-19 timepoint. Additionally, we examined loneliness, an interpersonal factor related to social connectedness, and contextual factors including income-to-needs ratio and COVID-19 specific adversity as moderators of the change over time in depressive and anxiety symptoms. We hypothesized that (1) greater loneliness, (2) greater socioeconomic risk, and (3) greater COVID-19 specific adversity would be associated with greater increases in depressive and anxiety symptoms from before to during the pandemic.

## 2. Methods

### 2.1. Study design and sample

**Study Design.** A COVID-19 response survey was distributed to women participating in a longitudinal investigation of mental health during pregnancy and postpartum (the Care Project; see Davis et al., 2018). The COVID-19 response survey was distributed on 04/13/2020, and participants who completed the survey by 05/22/2020 were included in present analyses. To assess the impact of the pandemic on changes in mental health, these survey responses were compared to two assessments of mental health symptoms completed prior to the pandemic. The study timeline is provided in Supplementary Material. All procedures were approved by University of Denver's Institutional Review Board and all women provided informed consent.

The COVID-19 survey was completed in the context of local and national events and pandemic-related policies. Both Colorado's governor and the US president declared the COVID-19 pandemic a state of emergency on 03/10/2020. In Colorado, a stay-at-home order from 03/26/2020 to 04/26/2020 required all individuals except essential workers to stay at home. Colorado transitioned to a safer-at-home order on 04/27/2020, allowing for the reopening of non-essential businesses with screening, social distancing and sanitation requirements, and encouraging vulnerable populations to stay home. During the time of this survey, Colorado schools were closed, non-essential travel was banned, and social distance regulations were implemented.

**Sample.** Participants included 135 pregnant women from the Care Project in the Denver, CO metro area (see Davis et al., 2018). This sample constitutes an enriched group of participants who were oversampled at recruitment for elevated levels of depressive symptoms. Women who were 25 weeks gestational age (GA) or less, 18–45 years old, English speaking, and carrying a singleton intrauterine pregnancy were initially recruited. Exclusion criteria included illicit drug or methadone use, major health conditions, psychosis, and mania. The Care Project involves a randomized controlled trial of interpersonal psychotherapy for distressed pregnant women; participants randomized to the active treatment group of this RCT were excluded from the current analyses.

At the time of completion of the COVID-19 survey, participants were 20–43 years old ( $M = 31.81$ ,  $SD = 5.57$ ). Median household income before the pandemic was \$60,000, and 39% of participants were living at or near federal classification of poverty (less than 200% of the federal poverty line). Table 1 provides demographic and COVID-19 relevant characteristics of this diverse sample.

### 2.2. Measures

**Depressive Symptoms** were measured at all three assessment periods using the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987). The EPDS is a 10-item screening measure validated for use in the perinatal period (Bunevicius et al., 2009); total scores range from 0 to 30. Cronbach's  $\alpha$  ranged from 0.89 to 0.90.

**Table 1**  
Demographic Characteristics.

	Frequency (valid %) or Mean (SD)
Race and Ethnicity	
Non-Hispanic White	74 (54.8%)
Latina	35 (25.9%)
African American/Black	15 (11.1%)
Asian	6 (4.4%)
American Indian/Alaskan Native	9 (6.7%)
Native Hawaiian or Other Pacific Islander	1 (0.7%)
More than one Race	5 (3.7%)
Marital/Cohabitation Status	
Married and/or cohabitating with partner	105 (77.8%)
Not living with partner/spouse	30 (22.2%)
Education	
Some HS, HS Diploma, GED	24 (17.8%)
Tech/Voc. School, Associate's, Some College	45 (33.3%)
Bachelor's Degree or higher	66 (48.9%)
Income	
Annual Income (median)	\$60,000
Income-to-Needs Ratio	4.09 (3.63)
At or below 200% of the poverty line	53 (39.3%)

*Anxiety Symptoms* were measured at each timepoint using a 6-item version of the State Trait Anxiety Inventory (STAI-SF; Marteau and Bekker, 1992); total scores range from 6 to 24. Cronbach's  $\alpha$  ranged from 0.88 to 1.00.

*Loneliness* was measured in the COVID-19 assessment using an 8-item version of the UCLA Loneliness Scale (RULS-8; Roberts et al., 1993); total scores range from 6 to 24. Cronbach's  $\alpha$  was 0.84.

*Income-to-Needs Ratio (INR)*. INR was calculated by dividing the total reported household income by the poverty threshold corresponding to the number of persons living in the household at the time of assessment, as specified by the U.S. Census Bureau (2020). Women were categorized into low INR (below 200% INR,  $n = 53$ ) and higher INR (above 200% INR,  $n = 82$ ; Berzin and De Marco, 2010; Snell-Rood et al., 2017).

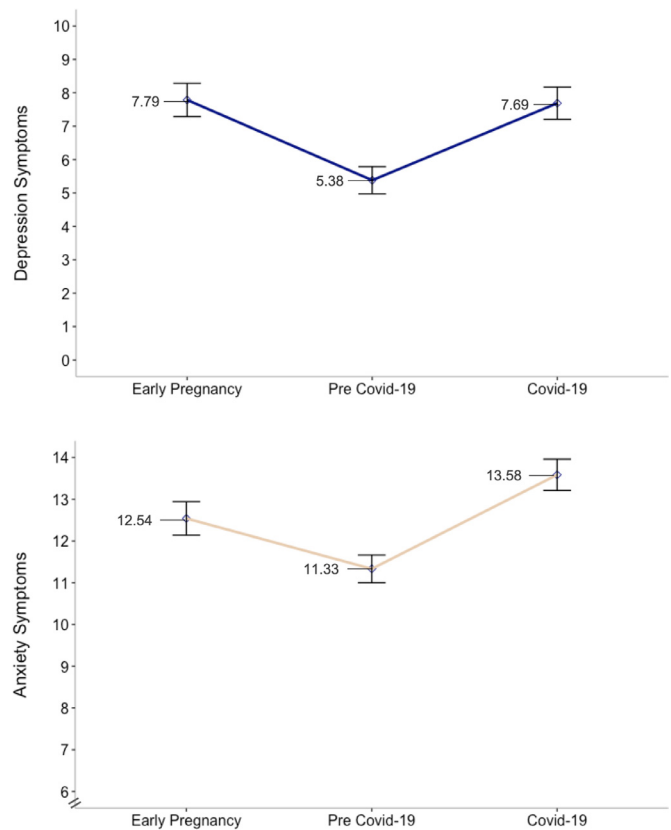
*COVID-19 Specific Adversity*. A COVID-19 specific adversity score was computed by summing items assessing objective exposure to COVID-19 from the NIH Coronavirus Health Impact Survey – Adult Self-Report Baseline Short Form (National Institutes of Health, 2020). Items assessed stressors such as job loss, inability to work from home, and exposure to COVID-19 for self and family; they were scored as 0 (no) or 1 (yes) and summed with a range of 0 to 13. Visual inspection of the data evidenced a sharp break between adversity scores of 2 versus 3. As such we categorized individuals with total COVID-19 specific adversity between 0 and 2 in the lower adversity group ( $n = 94$ ), and those with total scores of 3 or higher were included in the higher adversity group ( $n = 41$ ).

### 2.3. Data analysis plan

The data analytic plan and hypotheses for the present study were pre-registered with Open Science Framework (<https://osf.io/brw72/>). To examine whether there were changes over time in symptoms of depression and anxiety from early pregnancy to pre-COVID-19 and during COVID-19, we conducted repeated measures analyses of variance (ANOVAs) with Greenhouse-Geisser corrections as needed. Little's (1986) MCAR test was nonsignificant ( $\chi^2(41) = 47.68, p = .22$ ), suggesting that data were missing completely at random. Missing data were imputed using EM procedures.

## 3. Results

Table 2 provides descriptive statistics and bivariate correlations among all study variables. The following percent of women were above the cutoff of 10 or higher on the EPDS, based on screening guidelines by the American College of Obstetricians and Gynecologists (2008) and the developers of the EPDS (Cox et al., 1987): 35% during pregnancy, 15.5% prior to the COVID-19 pandemic, 33.3% during the pandemic.



**Fig. 1.** Symptoms of depression and anxiety before and during the COVID-19 pandemic

Note: Total depression symptoms scores (as measured by the EPDS) range from 0–30. Total anxiety symptoms scores (as measured by the STAI-SF) ranged from 6–24.

### 3.1. Change in symptoms of depression and anxiety in response to the COVID-19 pandemic

Symptoms of depression ( $F(1.68, 225.16) = 23.73, p < .001, \text{partial } \eta^2 = 0.15$ ) and anxiety ( $F(1.74, 233.45) = 21.51, p < .001, \text{partial } \eta^2 = 0.14$ ) changed across three assessment timepoints (Fig. 1). Symptoms of depression were higher during the pandemic as compared to pre-pandemic levels ( $F(1, 134) = 44.68, p < .001, \text{partial } \eta^2 = 0.25$ ), but were not significantly higher than symptoms during early pregnancy ( $F(1, 134) = 0.04, p = .84, \text{partial } \eta^2 = 0.00$ ). Anxiety symptoms were higher during the pandemic as compared to both pre-COVID-19 ( $F(1, 134) = 52.50, p < .001, \text{partial } \eta^2 = 0.28$ ) and early pregnancy ( $F(1, 134) = 6.67, p = .01, \text{partial } \eta^2 = 0.05$ ). Covariates including ethnicity, race, age, and cohabitation status were not associated with change in depressive or anxiety symptoms over time.

### 3.2. Loneliness and change in symptoms of depression and anxiety

Loneliness moderated the change over time in depressive symptoms ( $F(1.68, 222.63) = 4.32, p = .02, \text{partial } \eta^2 = 0.03$ ), but not anxiety symptoms ( $F(1.74, 231.44) = 0.82, p = .43, \text{partial } \eta^2 = 0.006$ ). Fig. 2 shows that women exhibiting more loneliness reported greater increases in depressive symptoms during the COVID-19 pandemic relative to pre-COVID-19 and early pregnancy ( $F(1, 133) = 4.08, p = .04, \text{partial } \eta^2 = 0.03$ ). The two pre-pandemic assessments (early pregnancy and pre-COVID-19) did not differ ( $F(1, 133) = 0.07, p = .79, \text{partial } \eta^2 = 0.00$ ). Higher loneliness was associated with elevated depressive and anxiety symptoms at all three timepoints (see Table 2).

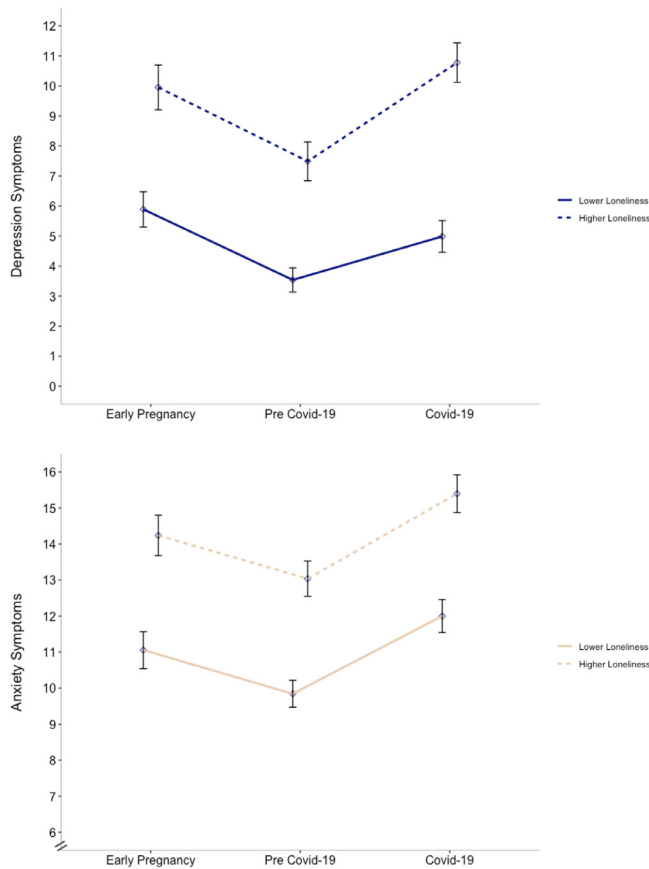
**Table 2**  
Descriptive Statistics and Correlations.

	M (SD)	1	2	3	4	5	6	7	8
1. Pregnancy EPDS	7.79 (5.8)	.							
2. Pregnancy STAI	12.54 (4.67)	.76***	.						
3. Pre-COVID-19 EPDS	5.38 (4.73)	.71***	.65***	.					
4. Pre-COVID-19 STAI	11.33 (3.86)	.54***	.67***	.75***	.				
5. COVID-19 EPDS	7.69 (5.62)	.54***	.50***	.71***	.58***	.			
6. COVID-19 STAI	13.58 (4.36)	.38***	.46***	.56***	.62***	.79***	.		
7. Loneliness	15.55 (5.44)	.40***	.43***	.48***	.50***	.58***	.53***	.	
8. COVID-19 specific adversity	0.30 (0.46)	.07	.04	.13	.10	.27***	.24**	.02	.
9. INR	0.61 (0.49)	−0.31**	−0.20*	−0.15	−0.08	−0.02	.11	−0.17	.04

\*\*  $p < .01$

\*\*\*  $p < .001$ .

EPDS = Depressive Symptoms; STAI = Anxiety Symptoms.

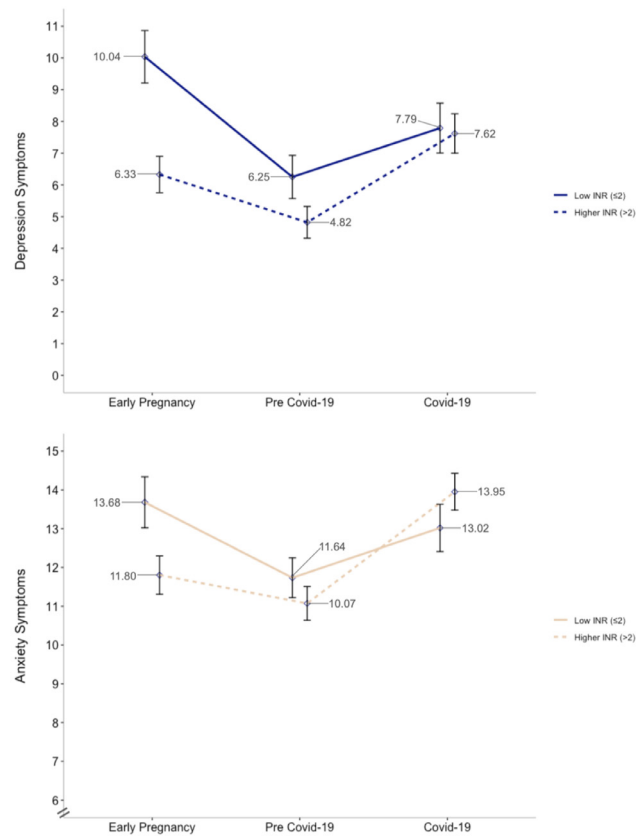


**Fig. 2.** Loneliness and change in symptoms of depression and anxiety before and during the COVID-19 pandemic

Note: Data were analyzed continuously but were graphed using a median split for visualization purposes. For within timepoint analyses, see Table 2.

**3.3. INR and change in symptoms of depression and anxiety**

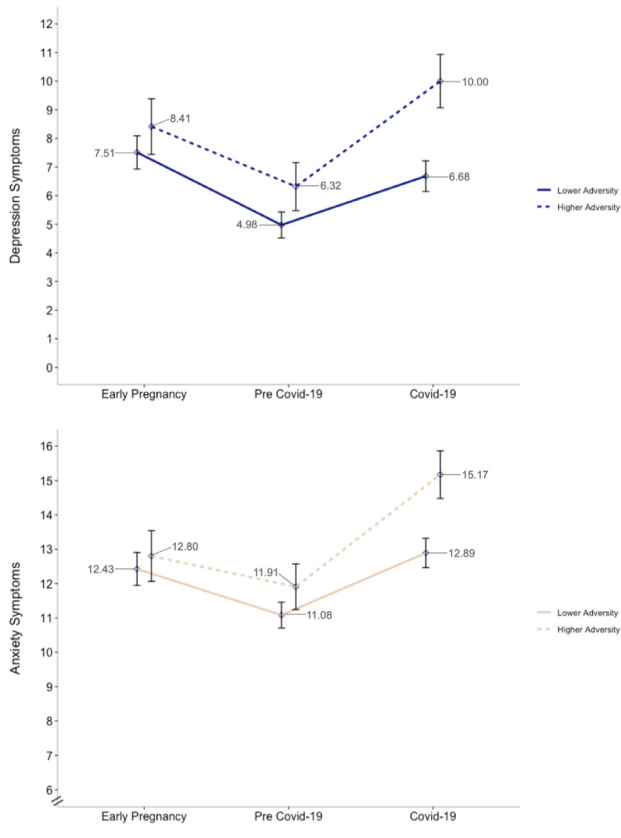
As shown in Fig. 3, INR moderated the change in both depressive symptoms ( $F(1.70, 219.63) = 5.73, p = .006, \text{partial } \eta^2 = 0.04$ ) and anxiety symptoms ( $F(1.78, 229.08) = 4.56, p = .02, \text{partial } \eta^2 = 0.03$ ) over time. Women in the low INR group reported higher depressive and anxiety symptoms during early pregnancy [depression:  $F(1, 52) = 9.29, p = .004, \text{partial } \eta^2 = 0.15$ ; anxiety: ( $F(1, 52) = 11.54, p = .001, \text{partial } \eta^2 = 0.18$ ) and during the COVID-19 pandemic [depression:  $F(1, 52) = 10.31, p = .002, \text{partial } \eta^2 = 0.17$ ]; anxiety: ( $F(1, 52) = 11.54, p = .001, \text{partial } \eta^2 = 0.18$ ] relative to the pre-pandemic assessment. For the higher INR group, symptoms of depression and anxiety were



**Fig. 3.** Symptoms of depression and anxiety before and during COVID-19 for low and higher INR groups

Note: Examination of within time point group differences revealed that the low INR group reported elevated scores compared to the higher INR group during pregnancy for both symptoms of depression [ $t(133) = 3.81, p < .001$ ] and anxiety [ $t(133) = 2.31, p = .02$ ], but the two groups did not significantly differ at pre-COVID-19 [depression:  $t(133) = 1.73, p = .09$ ; anxiety:  $t(133) = 0.97, p = .33$ ] or during COVID-19 [depression:  $t(133) = 0.17, p = .86$ ; anxiety:  $t(133) = -1.22, p = .23$ ].

higher during COVID-19 compared to early pregnancy [depression:  $F(1, 81) = 5.17, p = .03, \text{partial } \eta^2 = 0.06$ ; anxiety:  $F(1, 81) = 17.89, p < .001, \text{partial } \eta^2 = 0.18$ ] and to pre-COVID-19 [depression:  $F(1, 81) = 35.50, p < .001, \text{partial } \eta^2 = 0.31$ ; anxiety:  $F(1, 81) = 43.24, p < .001, \text{partial } \eta^2 = 0.35$ ]. The low INR group reported elevated scores compared to higher INR during early pregnancy, but the groups did not significantly differ prior to or during the COVID-19 pandemic (see Fig. 3).



**Fig. 4.** Symptoms of depression and anxiety before and during the COVID-19 pandemic for lower and higher groups for COVID-19 specific adversity  
**Note:** Examination of within time point group differences showed differences for depressive symptoms during the pandemic ( $t(133) = -3.27, p = .001$ ) such that the higher adversity group reported elevated symptoms of depression. There were no group differences in symptoms of depression or anxiety pre-COVID-19 [ $t(133) = -1.52, p = .13$ ;  $t(133) = -1.15, p = .25$ , respectively] or during early pregnancy [ $t(133) = -0.83, p = .41$ ;  $t(133) = -0.43, p = .67$ , respectively].

### 3.4. COVID-19 specific adversity and change in symptoms of depression and anxiety

As illustrated in Fig. 4, COVID-19 specific adversity moderated change in depressive symptoms ( $F(1.69, 225.02) = 4.62, p = .02, \text{partial } \eta^2 = 0.03$ ) and anxiety symptoms ( $F(1.76, 233.58) = 3.60, p = .04, \text{partial } \eta^2 = 0.03$ ) over time. Overall results showed that during the pandemic higher depressive and anxiety symptoms were reported among women who experienced higher levels of COVID-19 specific adversity. For the higher adversity group, symptoms of depression and anxiety were higher during the pandemic compared to pre-pandemic [depression:  $F(1, 40) = 23.29, p < .001, \text{partial } \eta^2 = 0.37$ ; anxiety:  $F(1, 40) = 25.68, p < .001, \text{partial } \eta^2 = 0.39$ ]. Anxiety symptoms were higher during the pandemic compared to early pregnancy ( $F(1, 40) = 11.51, p = .002, \text{partial } \eta^2 = 0.22$ ). The change in depressive symptoms from pregnancy to the pandemic did not reach standard significance ( $F(1, 40) = 3.53, p = .07, \text{partial } \eta^2 = 0.08$ ). For the lower adversity group, symptoms of depression and anxiety were higher during the pandemic compared to pre-pandemic [depression:  $F(1, 93) = 23.41, p < .001, \text{partial } \eta^2 = 0.20$ ; anxiety:  $F(1, 93) = 28.46, p < .001, \text{partial } \eta^2 = 0.23$ ], but not early pregnancy [depression:  $F(1, 93) = 2.22, p = .14, \text{partial } \eta^2 = 0.02$ ; anxiety:  $F(1, 93) = 0.93, p = .34, \text{partial } \eta^2 = 0.01$ ]. Depressive symptoms were higher among the high adversity group relative to the lower adversity group during the pandemic, but not beforehand (see Fig. 4).

## 4. Discussion

The COVID-19 pandemic has had an immense impact on society with health and economic implications. The effect on mental health remains poorly understood, and this is especially critical for pregnant and postpartum women whose mental health not only affects their own well-being but can have intergenerational consequences. The current longitudinal study of women from racially and ethnically diverse backgrounds during the prenatal and postpartum periods showed that symptoms of depression and anxiety were higher after the start of the COVID-19 pandemic compared to pre-pandemic levels. This increase in symptoms was compounded in women reporting more loneliness and COVID-19 specific adversity. Interestingly, INR did not predict a greater increase in symptoms in response to COVID-19; women with lower INR had the highest depressive symptoms during early pregnancy. As experiencing mental health symptoms during pregnancy and postpartum periods can have serious effects for both mother and child, these results highlight the necessity for identifying women at increased risk for mental health difficulties in response to the pandemic.

Cross-sectional COVID-19 pandemic studies (Ettman et al., 2020; McGinty et al., 2020) suggest that, similar to prior natural disaster research (Ehrlich et al., 2010; Glynn et al., 2001; Harville et al., 2009; Khatri et al., 2019; Kildea et al., 2018; Xiong et al., 2010), adult mental health symptoms are elevated during the pandemic. The present investigation leverages a prospective design to determine the change in symptoms in response to this stressor. Among the present sample of pregnant and postpartum women, depressive symptoms increased from before to during the COVID-19 pandemic and were as high as symptom levels reported during early pregnancy, with 35% of women reporting clinically significant levels of symptoms during the pandemic relative to 15.5% prior to the pandemic. Women in the present study were oversampled for elevated depressive symptoms during early gestation. Depressive symptoms commonly decline after an initial assessment in repeated measures longitudinal work, consistent with regression to the mean and attenuation effects (Long et al., 2020). Of concern, though, depressive symptoms returned to high levels during the pandemic. Symptoms of anxiety were higher during the COVID-19 pandemic than pre-COVID-19 and early pregnancy. These data suggest that the COVID-19 pandemic alters symptom trajectories, contributing to a resurgence of depressive symptoms comparable to levels experienced during early pregnancy and an increase of anxious symptoms to a level higher than previously experienced in the present sample.

Experiencing the COVID-19 pandemic differentially impacted pregnant and postpartum women's mental health depending on interpersonal and contextual factors. Consistent with previous literature (Brage et al., 1993), we show that women who reported more loneliness also have higher depressive symptoms at all time points. Loneliness also was associated with a greater increase in depressive symptoms, although not anxiety symptoms, from before to during the pandemic. This exacerbating effect of loneliness on depressive symptoms in the midst of the COVID-19 pandemic highlights the importance of providing support to pregnant and postpartum women to reduce feelings of isolation and loneliness in order to mitigate mental health consequences.

Perhaps surprisingly, INR did not predict changes in mental health symptoms in response to the pandemic. These results suggest that uncontrollable stress and uncertainty surrounding the pandemic (e.g., job and housing loss; health of the new baby) conferred risk for depression and anxiety among pregnant and postpartum women regardless of INR (but see Paxson et al., 2012). Notably this finding is consistent with other recent research demonstrating that, in the early months of the pandemic, low-SES pregnant women reported decreased symptoms of depression (Silverman et al., 2020). Lower-SES women who are more accustomed to unpredictable environments may be more resilient in the face of new uncontrollable stressors. Alternatively, the early governmental and societal action to reduce the spread of the virus, such as stay-at-home orders

and temporary relief from stimulus checks, may have temporarily reduced other stressors commonly faced by low-SES communities, such as difficulty obtaining or affording child care and long work hours. Women with low INR did report higher depressive symptoms during pregnancy before the pandemic, with symptoms approaching the clinical cutoff of the EPDS (Cox et al., 1987). Economic stressors may be particularly potent during pregnancy when women are planning for the birth of their child, consistent with literature linking low socioeconomic security to symptoms of depression and anxiety during pregnancy (Lancaster et al., 2010).

Women who experienced more COVID-19 specific adversity reported higher levels of both depressive and anxiety symptoms during the pandemic relative to women who experienced lower levels of COVID-19 specific adversity. Depressive symptoms approached the clinical cutoff on the EPDS during the COVID-19 pandemic for the high adversity group (Cox et al., 1987). These findings are consistent with existing literature suggesting that disaster-specific adversity predicts mental health symptom increases in response to exposure (Brock et al., 2015; Paxson et al., 2012). Further research is needed to elucidate intersectional consequences of low SES and exposure to COVID-19 specific adversity, as low-income individuals are more likely to work in jobs with higher risk for virus exposure, to live in crowded environments, and to lack access to paid sick leave (CDC, 2020).

The current study should be evaluated in light of strengths and limitations. First, this study employed a prospective longitudinal design illuminating change in depressive and anxious symptoms from during pregnancy to before the pandemic to during the COVID-19 pandemic. Even with a longitudinal design, the correlational nature of the data precludes making causal conclusions regarding the effect of the pandemic on mental health. Another strength is the racial, ethnic, and socioeconomic diversity of the sample, allowing for an analysis of the intersectionality of multiple risk factors upon depressive and anxiety symptoms in response to the COVID-19 pandemic.

## 5. Conclusion

The CDC has designated pregnant and postpartum women as vulnerable to the COVID-19 pandemic (CDC, 2020). Using a longitudinal design in which symptoms of depression and anxiety were assessed twice prior to COVID-19 and again early in the pandemic, we evaluated how much, when, and for whom symptoms changed in response to experiencing this public health crisis. During this uncontrollable, stressful pandemic, pregnant and postpartum women report significant increases in mental health symptoms from pre-pandemic levels, and there was a resurgence of depression symptoms to levels observed early pregnancy. Identifying safe ways to provide social support during this pandemic may be essential to the mental health of pregnant and postpartum women, suggesting a potential target for intervention. Further, reducing the toll of COVID-19 specific adversity experienced by some, but not all, pregnant and postpartum women is vital for mitigating the mental health impacts of this pandemic. This knowledge can assist in identifying mothers at-risk for depression and anxiety and may increase mental health care utilization targeted at reducing loneliness, mitigate fetal and infant exposure to maternal depression and anxiety, and ultimately could help prevent future adverse child outcomes.

## Author statement

Author Contributions: All authors conceptualized and designed the study. SP and EH prepared data for analysis. SP and EH conducted analyses. SP, EH, BH, and ED wrote the manuscript. All authors reviewed and approved the submitted manuscript.

## Declaration of Competing Interest

We have no conflicts of interest or competing interests to disclose.

## Funding

This work was funded by NIMH R01 MH109662.

## Acknowledgements

The authors wish to thank the families who participated in this project. The assistance of the Care Project research team, who made this work possible, is gratefully acknowledged.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jadr.2021.100123.

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