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ORIGINAL ARTICLE

Clinician-reported childbirth outcomes, patient-reported childbirth trauma, and risk for postpartum depression

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Abstract

Childbirth trauma is common and increases risk for postpartum depression (PPD). However, we lack brief measures to reliably identify individuals who experience childbirth trauma and who may be at greater prospective risk for PPD. To address this gap, we used data from a racially diverse prospective cohort (n=1082). We collected survey data during pregnancy and at 12 weeks postpartum, as well as clinician-reported data from medical records. A new three-item measure of patient-reported childbirth trauma was a robust and independent risk factor for PPD, above and beyond other known risk factors for PPD, including prenatal anxiety and depression. Cesarean birth, greater blood loss, and preterm birth were each associated with greater patient-reported childbirth trauma. Finally, there were prospective indirect pathways whereby cesarean birth and higher blood loss were related to higher patient-reported childbirth trauma, in turn predicting greater risk for PPD. Early universal postpartum screening for childbirth trauma, targeted attention to individuals with childbirth complications, and continued screening for depression and anxiety can identify individuals at risk for PPD. Such efforts can inform targeted interventions to improve maternal mental health, which plays a vital role in infant development.

Keywords Childbirth · Birth trauma · Depression · Postpartum · Prevention

Childbirth can be very challenging, with 1 in 3 individuals experiencing traumatic births (Rodríguez-Almagro et al. 2019), characterized by extreme physical, emotional, or psychological distress (Greenfield et al. 2016). Traumatic childbirth increases risk for postpartum depression (PPD), psychosis, and anxiety (Munk-Olsen et al. 2006; Rodríguez-Almagro et al. 2019), which themselves can precede mental health problems and need for long-term treatment (Thompson and Fox 2010). Traumatic childbirth also has adverse implications for infant development (Gagliardi et al. 2012;

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Handelzalts et al. 2021). However, evaluating an event as traumatic comes from an individual's perception of that event (Carlson and Dalenberg 2000). Importantly, patients describe experiencing trauma even when their childbirth outcomes are described as "routine" by clinicians (Beck 2004). Thus, research is needed to differentiate clinician-reported medical complications of childbirth from patient perceptions of trauma, both of which could independently or, in concert, increase risk for adverse outcomes in caregivers and children.

Patient-reported childbirth trauma is important for understanding risk for negative postpartum mental health outcomes, including PPD, with evidence that trauma exposure is implicated in the emergence of depressive symptoms (Dekel et al. 2020; Seng 2002). Posttraumatic stress disorder (PTSD) following childbirth has also been linked to PPD, particularly among individuals who have significant childhood trauma histories or fear of childbirth (Handelzalts et al. 2021; Nakić Radoš et al. 2020; Oh et al. 2016). In terms of clinician-reported factors related to PPD, the literature remains equivocal. For example, while some studies have reported reduced risk for PPD among recipients of analgesia during labor (Ding et al. 2014; Hiltunen et al. 2004), a recent meta-analytic review suggests no link (Almeida et al. 2020). Likewise, meta-analytic studies both support (Carter et al. 2006) and refute (Olieman et al. 2017) the existence of an association between cesarean birth and PPD. Other childbirth factors that could be traumatizing and contribute to patient-reported trauma and risk for PPD include perineal injury (Dunn et al. 2014), method of placenta removal (Elsharkawy 2018), preterm birth (PTB; Paula Eduardo et al. 2019), blood loss (Liu et al. 2021), and postpartum anemia (Kang et al. 2020).

Prior qualitative work has characterized a range of traumatic birth experiences, including negative emotional (e.g., grief, fear, anxiety) and clinical (e.g., emergency cesarean birth, placental abruption) experiences (Abdollahpour and Motaghi 2019; Taghizadeh et al. 2013). To date, however, few studies have used brief screening measures to assess patient-reported childbirth trauma and how those experiences tally with clinician-reported medical complications of childbirth. In one exception, four validated DSM-orientated questions were used to assess childbirth trauma among 400 individuals in Iran who were assessed within 48 h of childbirth. Questions focused on the extent to which childbirth threatened loss of life, physical harm, or feelings of panic, worry, and helplessness (Abdollahpour et al. 2019; Abdollahpour et al. 2017; Gamble et al. 2005). Emergency cesarean and postpartum hemorrhage were associated with the highest likelihood of patient-reported traumatic childbirth (Abdollahpour et al. 2017).

However, no studies have assessed childbirth trauma in relation to risk for PPD using both clinician-reported and patient-reported data and among racially diverse individuals. This gap is critical in the context of strikingly higher maternal and infant morbidity and mortality rates among Black individuals (Martin and Montagne 2017; Slomski 2019). Moreover, only a handful of studies have investigated whether childbirth factors, including labor analgesic (Munro et al. 2021), predict risk for PPD beyond 4–8 weeks postpartum. Studies are needed with follow-up periods that extend beyond this range to establish the longer-term effects of childbirth trauma on risk for PPD and capture risk for depressive symptoms onset later in the initial postpartum year (Goodman 2004). In sum, more effective and reliable methods are needed to assess both clinician- and patient-reported childbirth trauma and *prospectively* identify individuals at risk for PPD from racially diverse community samples.

Using a prospective longitudinal cohort, we sought to identify clinician-reported factors that contributed to patient reports of childbirth trauma and risk for PPD at 12 weeks postpartum. Our first aim was to test the hypothesis that patient-reported childbirth trauma represents an independent risk factor for PPD, above and beyond other risk factors for PPD, including prenatal anxiety and depression. Our second aim was to establish clinician-reported childbirth factors associated with patient-reported childbirth trauma, focusing on mode of childbirth, lack of labor analgesia, blood loss, placental removal method, degree of vaginal tearing, preterm birth, and 5-min Apgar score. In our third aim, we tested prospective pathways between clinician-reported childbirth factors and risk for PPD via patient-reported childbirth trauma (i.e., indirect associations).

Methods

Design and procedures

We used a medical record search to identify 3,548 pregnant individuals ≥18 years receiving medical and prenatal care through [blind for review] between April 17, 2020, and May 1, 2020. Individuals were contacted through email to participate in an online survey administered through REDCap (time 1). Labor and birth outcome data were obtained from hospital records (time 2). Postpartum data were obtained through an online REDCap survey at 10–15 weeks (time 3) (Figure S1). Of the 3,548 individuals initially contacted, 1,173 individuals completed the online survey at time 1 and 1,105 individuals gave birth within the [blind for review] system. We excluded cases of fetal (n=1) or neonatal (n=3) demise and multiple gestations (n=19), resulting in a sample size of n=1082. Cases of multiple gestation were excluded since individuals who birth twins are at higher risk of cesarean birth, PTB, and postpartum hemorrhage (Rao et al. 2004), as well as PPD (Bradshaw et al. 2022). At time 3,

we obtained postpartum data from n=823 (76% retention; M=11.8 weeks postpartum, SD=4.2). Participants provided online consent prior to completing surveys (time 1, time 3) and for childbirth data to be extracted from their medical records (time 2). The Institutional Review Board at [blind for review] approved the study.

Measures

Symptoms of anxiety and depression At time 1, participants completed the Generalized Anxiety Disorder Questionnaire (GAD-7) and Patient Health Questionnaire 2 (PHQ-2). We used clinical cut-off scores of 10 for the GAD-7 (Spitzer et al. 2006) and 3 for the PHQ-2 (Carey et al. 2016). At time 3, PPD was assessed using 9 items of the 10-item Edinburgh Postnatal Depression Scale (EPDS) (Cox and Holden 2003), with item 10 (assessing self-harm) excluded given difficulties associated with monitoring self-harm endorsements online. We used a cut-off score of 10 for the EPDS (Levis et al. 2020).

Patient-reported childbirth trauma At time 3, our team of perinatal psychologists, psychiatrists, and obstetricians developed three items to assess patient-reported birth trauma, each rated on a 4-point scale (1=not at all, 2=somewhat, 3=moderately, 4=extremely/a lot): "how traumatic did you find your birth," "during delivery/immediately after, how much did you fear for your life," and "during delivery/immediately after, how much did you fear for your baby's life." Similar to prior efforts (Abdollahpour et al. 2017), we developed items by reviewing Criterion A from the DSM-5 diagnostic criteria for posttraumatic stress disorder (Hyland et al. 2018), which specifies a traumatic stressor as exposure to actual or threatened death or serious injury. We conducted multiple iterative consultations within our team to finalize an item set that briefly captured patient-reported experiences of traumatic childbirth. We used the three items as indicators for a latent factor indexing childbirth trauma. We also used items to create a "high trauma" group, which included individuals who endorsed "moderately" or "extremely/a lot" for all three items and a "low trauma" group, which included individuals who endorsed "not at all" or "somewhat" for all three items.

Clinician-reported childbirth factors (time 2) We extracted medical record data for childbirth method (cesarean, vaginal), labor analgesia (e.g., general, spinal, epidural, none), PTB (<37 weeks gestational age), placenta removal method (e.g., spontaneous, curettage), blood loss (ml), 5-min Apgar score, assisted vaginal births (e.g., forceps, vacuum) and/or episiotomy, and degree of perineal injury/tearing (e.g., 1st, 2nd, 3rd, or 4th degree).

Demographic covariates We included race, ethnicity, age, marital status, socioeconomic position, and parity as covariates (Table 1). We also covaried for breastfeeding status at time 3, which has been linked to lower risk of PPD (Gagliardi et al. 2012). As described above, we included PTB as a factor hypothesized to be associated with childbirth trauma. However, PTB often precipitates newborn intensive care unit stay, which itself is associated with trauma for caregivers (Roque et al. 2017) and greater risk for PPD (Bonacquisti et al. 2020). Thus, we ran additional analyses focused on links between childbirth trauma and PPD after excluding cases of PTB.

Analytic strategy Study aims were tested within a structural equation modeling framework in Mplus vs. 8.0 (Muthén and Muthén 2018). All participants with complete or partial data (n=1,082) were included in analyses using full-information maximum likelihood estimation with robust standard errors or maximum likelihood estimation and a Monte Carlo numerical integration algorithm (Enders and Bandalos 2001). To address our first aim, we used confirmatory factor analysis and path modeling to test whether a latent factor representing patient-reported childbirth trauma was associated with PPD at time 3, controlling for depression and anxiety at time 1 and demographic covariates. For our second aim, we tested which clinician-reported childbirth factors at time 2 were associated with patient-reported childbirth trauma at time 3. For our third aim, we used path modeling to test indirect pathways between clinician-reported childbirth factors and PPD via patient-reported childbirth trauma, covarying for depression and anxiety during pregnancy and demographic factors as before. Phenotypic data that support the findings of this study are available on request from the corresponding author, but medical record data are not shared.

Results

Descriptive statistics

Table 1 presents descriptive statistics for study variables. Participants were from the following racial groups: White (65.5%), Black (24.4%), Asian (7.4%), and Others/Unknown/Declined (2.7%), with 5.4% participants reporting their ethnicity as Latinx. The mean age of participants was 32.4 years, more than three quarters were married/living with a partner, and more than half were nulliparous (Table 1). At time 1, 7.5% individuals were in the first trimester, 45.1% in the second trimester, and 513 47.4% in the third trimester. At time 2, 72% of participants had vaginal births, 4.9% had PTB, and estimated blood loss ranged between 22.00 and 2159.00 (Table 1). In terms of psychiatric measures, 12.2% of the sample met screening criteria for anxiety during pregnancy, 9.0% met criteria for depression during

Table 1 Descriptive statistics for study variables, including demographic factors, psychiatric factors, and childbirth factors

Demographic factors and covariates		
Maternal age (years) (time 1)		*M* = 32.37, *SD* = 4.98, *range* = 18.00–48.00
Socioeconomic position (time 1)		*M* = −.27, *SD* = .97, *range* = −2.60 to 2.08
Parity (time 1)		*M* =.70, *SD* = 1.06, *range* = 0–9
Race (time 1)	White	65.5%
	Black	24.4%
	Asian	7.4%
	Others	2.7%
Ethnicity (time 1)	Non-Latinx	94.6%
	Latinx	5.4%
Married/living with a partner (time 1)		75.2%
Breastfeeding (time 3)	Yes, exclusively	55.1%
	Combined w/ formula	24.4%
	No, formula only	20.5%
Psychiatric factors		
Anxiety, positive screen (time 1)		12.2%
Depression positive screen (time 1)		9.0%
Postpartum depression positive screen (time 3)		23.2%
Postpartum depression total score (time 3)		*M* = 6.06, *SE* = 4.66, *range* = .00–23.00
Patient-reported childbirth factor		
Patient-reported childbirth trauma total score (time 3)		*M* = 1.76, *SE* =.79, *range* = 1.00–4.00
Clinician-reported childbirth factors		
Blood loss (time 2)		*M* = 515.94, *SE* = 341.69, *range* = 22.00–2500.00
Degree of tearing (time 2)		*M* = .84, *SE* = .93, *range* = 0.00–4.00
Vaginal birth (time 2)		72%
No labor analgesic (time 2)		9.3%
Placental removal (manual/curettage) (time 2)		19.6%
5 min Apgar ≤8 (time 2)		8.4%
Assisted vaginal birth (e.g., forceps, vacuum cup) and/or episiotomy (time 2)		7.7%
PTB (<37 weeks) (time 2)		4.9%

Socioeconomic position was a z-scored composite scale with higher values indicating lower neighborhood position for residences (median family income, % with at least a high school education, % in poverty, and % married; Moore et al., 2016). Degree of tearing was coded as: missing or "no laceration noted" = 0; first degree = 1; second degree = 2; third degree = 3; fourth degree = 4). Note that the 259 of 1,082 participants lost to follow-up at time 3 were younger (t = 7.00, p < .001), lived in more impoverished neighborhoods (t = −5.07, p < .001), and were more likely to report their race as Black ($\chi 2$ = 62.89, df = 1, p < .001), but did not differ on prenatal anxiety (t = −1.39, p = .17) or depression (t = −1.59, p = .11). For differences in demographic, psychiatric, and clinician-reported factors for cesarean versus vaginal births, see Table S1. \

pregnancy, and 23.2% met screening criteria for PPD. (For differences based on mode of childbirth, see Table S1).

Patient-reported childbirth trauma and risk for postpartum depression

A fully saturated model for the patient-reported childbirth trauma factor showed high item-factor loadings (Figure S2) with good scale reliability (α=.75). Binary logistic regression established a significant association between greater patient-reported childbirth trauma and higher likelihood of PPD (*OR*=1.33, 95% CI=1.10, 1.60; Table 2), controlling for race, ethnicity, age, parity, marital status, socioeconomic position, breastfeeding status, and anxiety and depression at time 1. Anxiety and depression in pregnancy were also both associated with greater likelihood of PPD. Estimates were similar using a continuous measure of PPD (i.e., total EPDS scores; Table S2), excluding PTB cases (n=53) (Table S3), and controlling for mode of delivery (Table S4).

Clinician-reported childbirth factors associated with patient-reported childbirth trauma

Overall, cesarean birth was associated with greater patient-reported childbirth trauma than vaginal birth (β=.24, p<.001). Black individuals reported more childbirth trauma than White individuals (β=.27, p<.001), whereas individuals with higher parity (β=−.16, p<.001) and those married/living with a partner reported lower childbirth trauma (β=−.12, p<.001; Table 3).

Table 2 Binary regression model establishing association between greater patient-reported childbirth trauma and postpartum depression, over and above covariates

Postpartum depression (time 3)					
Covariates	*B*	*SE*	*p*	*OR*	*95% CI*
Maternal age (years)	.001	.02	.98	1.00	.96, 1.04
Socioeconomic position	−.07	.11	.54	.93	.75, 1.12
Parity	**.17**	**.08**	**.04**	**1.19**	**1.004, 1.37**
Black vs. White	−.07	.31	.82	.93	.51, 1.56
Asian vs. White	−.07	.34	.85	.94	.47, 1.67
Others vs. White	.04	.54	.95	1.04	.35, 2.56
Latinx vs. Non-Latinx	.03	.42	.94	1.04	.46, 2.06
Married/living with partner (time 1)	−.08	.28	.77	.92	.54, 1,45
Breastfeeding (time 3)	−.12	.11	.30	.89	.72, 1.07
Prenatal anxiety (time 1)	**.93**	**.27**	**.001**	**2.53**	**1.49, 3.95**
Prenatal depression (time 1)	**1.17**	**.31**	**<.001**	**3.22**	**1.75, 5.93**
Predictor					
Patient-reported childbirth trauma (time 3)	**.29**	**.10**	**.003**	**1.33**	**1.10, 1.60**

Significant results are bolded. *OR*, odds ratio. Patient-reported childbirth trauma was modeled as a latent factor with three indicators: "during your delivery or immediately after delivery, how much did you fear for your own life?", "during your delivery or immediately after delivery, how much did you fear for your baby's life?", and "how traumatic did you find your birth experience?" (see Supplemental Figure S2). We modeled pathways between covariates and both patient-reported childbirth trauma and PPD, as well as modeling covariances between all covariates. Estimates were similar using a continuous measure of PPD (total scores for EPSD; Table S2) and after removing women who had PTB (<37 weeks; Table S3). Estimates were also similar when controlling for mode of childbirth (i.e., vaginal vs. cesarean; Table S4). Mode of childbirth was also not a significant moderator of the association between patient-reported childbirth trauma and risk for PPD (Table S5; i.e., higher patient-reported childbirth trauma was associated with greater risk for PPD similarly among individuals who had a vaginal or cesarean birth).

Given the interdependence of the clinician-reported metrics (e.g., labor analgesia) with mode of childbirth, we subsequently examined separate models for cesarean and vaginal births controlling for covariates.

For cesarean births, blood loss was associated with greater patient-reported childbirth trauma (β=.23, p=.001; Table 4, Model 1) but placental removal method, 5-min Apgar score, and PTB were not significant predictors. The blood loss finding remained significant when all factors were entered simultaneously in a model specifying their covariance (i.e., independent association; β=.21, p=.003; Table 4, Model 2). In a post hoc sensitivity test using ANCOVA, individuals who had cesarean births in the "high trauma" group (n=49; M=1073.97, SE=41.51) had significantly more blood loss than individuals in the "low" trauma group (n=146; M=860.67, SE=23.42; F=19.24, df=1, p<.001, *partial* η^2=.10).

For vaginal births, blood loss (β=.18, p=.008) and PTB (β=.13, p=.02) were both associated with greater patient-reported childbirth trauma (Table 4, Model 3), but placental removal method, 5-min Apgar score, labor analgesia, assisted birth and/or episiotomy, and degree of tearing were not significant predictors. Findings for blood loss (β=.18, p=.008) and PTB (β=.13, p=.02) remained significant when all factors were entered simultaneously in the model allowing for their covariance (Table 4, Model 4). In a post hoc sensitivity test, individuals who had vaginal births in the "high trauma" group (n=39; M=424.97,

Table 3 Regression models establishing association between cesarean birth and greater patient-reported childbirth trauma, over and above covariates

Patient-reported childbirth trauma (latent factor)				
Covariates	*B*	*SE*	*β*	*p*
Maternal age	.01	.01	.04	.41
Socioeconomic position	.03	.05	.02	.62
Parity	**−.17**	**.04**	**-.16**	**<.001**
Black vs. White	**.70**	**.17**	**.27**	**<.001**
Asian vs. White	.37	.19	.09	.05
Others vs. White	.34	.31	.05	.26
Latinx vs. Non-Latinx	.01	.21	.001	.98
Married/living with a partner (time 1)	**−.30**	**.15**	**-.12**	**.04**
Breastfeeding (time 3)	−.06	.06	-.04	.28
Prenatal anxiety (time 1)	.10	.16	.03	.52
Prenatal depression (time 1)	.14	.19	.04	.45
Predictor				
Mode of childbirth (cesarean vs. vaginal)	**.59**	**.10**	**.24**	**<.001**

Significant results are bolded. Patient-reported childbirth trauma was modeled as a latent factor with three indicators: "during your delivery or immediately after delivery, how much did you fear for your own life?", "during your delivery or immediately after delivery, how much did you fear for your baby's life?", and "how traumatic did you find your birth experience?" (see Figure S2). We modeled pathways between predictors and covariates and patient-reported childbirth trauma, as well as modeling covariances between all predictors and covariates.

Table 4 Regression models establishing associations between clinician-reported childbirth factors and greater patient-reported childbirth trauma for cesarean and vaginal births, over and above covariates

	Model 1, clinician-reported childbirth factors entered separately (i.e., simple effects)				Model 2, clinician-reported childbirth factors entered simultaneously (i.e., unique effects)			
Cesarean birth	*B*	*SE*	*β*	*p*	*B*	*SE*	*β*	*p*
Blood loss	**.92**	**.27**	**.23**	**.001**	**.86**	**.27**	**.21**	**.003**
Placental removal (manual/curettage) (time 2)	.26	.16	.12	.10	.20	.16	.09	.21
5-min Apgar ≤8 (time 2)	.16	.32	.04	.62	.10	.32	.03	.75
PTB (<37 weeks) (time 2)	.44	.36	.10	.22	.40	.35	.09	.25
	Model 3, clinician-reported childbirth factors entered separately (i.e., simple effects)				**Model 4,** clinician-reported childbirth factors entered simultaneously (i.e., unique effects)			
Vaginal birth	*B*	*SE*	*β*	*p*	*B*	*SE*	*β*	*p*
Blood loss (time 2)	**.99**	**.35**	**.18**	**.008**	**.97**	**.40**	**.18**	**.02**
No labor analgesic (time 2)	.19	.21	.05	.36	.23	.21	.06	.27
Placental removal (manual/curettage) (time 2)	.25	.26	.06	.32	.10	.27	.02	.70
5-min Apgar ≤8 (time 2)	.33	.22	.08	.12	.10	.22	.03	.66
Assisted birth and/or episiotomy (time 2)	.20	.16	.06	.21	.22	.17	.06	.21
Degree of tearing (time 2)	.03	.06	.02	.66	-.02	.07	-.01	.82
PTB (<37 weeks) (time 2)	**.75**	**.33**	**.13**	**.02**	**.82**	**.34**	**.14**	**.02**

Models controlled for race, ethnicity, age, parity, marital status, socioeconomic position, breastfeeding status, and anxiety and depression at time 1 as before; see Table 3. Significant results are bolded. Patient-reported childbirth trauma was modeled as a latent factor with three indicators: "during your delivery or immediately after delivery, how much did you fear for your own life?", "during your delivery or immediately after delivery, how much did you fear for your baby's life?", and "how traumatic did you find your birth experience?" (Figure S2). We modeled pathways between predictors and covariates and patient-reported childbirth trauma, as well as modeling covariances between all predictors and covariates.

SE=29.36) had significantly more blood loss than individuals in the "low" trauma group (*n*=390; *M*=330.62, *SE*=8.80; *F*=9.28, *df*=1, *p*<.001, *partial* η^2=.02).

Indirect pathways between clinician-reported childbirth factors, patient-reported childbirth trauma, and PPD

Overall, cesarean birth was indirectly related to PPD via patient-reported childbirth trauma ($\alpha\beta$=.03 [95% CI=.01, .06], *p*=.02). Within cesarean births, greater blood loss was indirectly related to PPD via patient-reported childbirth trauma ($\alpha\beta$=.06 [95%, CI=.02, .95], *p*=.03). Within vaginal births, there were no indirect pathways from blood loss or PTB to PPD via patient-reported childbirth trauma (Table S6).

Discussion

We investigated risk for PPD focusing on medical records and patient recall of childbirth trauma. We leveraged a large and racially diverse sample within a prospective longitudinal study. We developed a brief measure of childbirth trauma using three items that focused on fearing for one's own life and baby's life and recalling the birth as traumatic. The finding that scores on this measure predicted PPD is clinically important—especially since it was robust across modes of childbirth and after accounting for history of depression or anxiety. Findings are consistent with evidence that trauma is implicated in the emergence of postpartum depressive symptoms (Dekel et al. 2020; Seng 2002) and that PTSD and PPD can develop in concert following childbirth (Handelzalts et al. 2021; Nakić Radoš et al. 2020; Oh et al. 2016).

Our results highlight the need to further validate brief screening measures for childbirth trauma, including establishing scoring rubrics for clinical use, investigating the acceptability of administrating measures, and the prognostic capabilities using online versus paper-based screening approaches (Abdollahpour et al. 2017; Kingston et al. 2017). Notably, although questionnaire measures exist that assess symptoms of PTSD following childbirth (e.g., 20-item City Birth Trauma Scale; Nakić Radoš et al. 2020), few *brief* screeners have been validated to assess childbirth trauma even before individuals are discharged from hospital. At the same time, the strongest predictors of PPD were anxiety or depression disclosed prospectively in pregnancy. Thus, we continue to need repeated screening for depression and anxiety during pregnancy and

follow-up prior to discharge or in the early postpartum period to identify and provide treatment to individuals who could additionally report childbirth trauma (Hutchens and Kearney 2020; Walker et al. 2016).

We also explored medical factors associated with patient-reported childbirth trauma and, in turn, risk for PPD. Our motivation was the fact that many individuals report their childbirths as traumatic even when providers consider them routine (Beck 2004). Overall, cesarean birth, greater blood loss, and vaginal PTB were each associated with more patient-reported childbirth trauma. For cesarean births, there was an indirect pathway from greater blood loss to PPD via patient-reported childbirth trauma. Our sensitivity analysis suggests that at estimated blood loss levels of over 1,000 ml for cesarean births and 400 ml for vaginal births (i.e., consistent with established cut-offs for postpartum hemorrhage; Borovac-Pinheiro et al. 2018), individuals were more likely to recall childbirth as being traumatic and, in turn, be at greater risk for PPD.

Birthing individuals are unlikely to see or be told their estimated blood loss. Thus, aside from potential biological consequences, which are outside the scope of our efforts (e.g., increased inflammatory cytokines, Corwin et al. 2015; postpartum anemia, Kang et al. 2020), there are likely important *unmeasured* clinical factors during labor and childbirth that increase risk of reported trauma. That is, the broader experience of having a cesarean birth or significant blood loss during childbirth may lead to trauma, including as the consequence of an emergent cesarean following attempted vaginal birth (Ryding et al. 1997), a pre-existing fear of childbirth or the operating room (Elvander et al. 2013; Stoll et al. 2018), or loss of sense of consent or control during a highly medicalized childbirth that might see a large and more frantic medical team involved (Abdollahpour and Motaghi 2019; Burcher et al. 2020). A clinical takeaway from our findings is that individuals who have a cesarean birth, PTB, or those who meet the thresholds detailed above for blood loss may benefit from mental health follow-up or trauma-focused counseling prior to hospital discharge, even if the medical team recorded the birth as routine (e.g., Abdollahpour et al. 2019; Gamble et al. 2005).

In addition, specialized training for staff may help to mitigate negative patient experiences that increase risk of experiencing trauma, including fears around surgery, loss of perceived control, or lack of provider trust (Burcher et al. 2020; Stoll et al. 2018; Wada et al. 2019). These efforts may be especially important and could be tailored for Black individuals, given that we found the highest patient-reported childbirth trauma among Black individuals. Indeed, our findings take on urgency in the context of higher postpartum hemorrhage, morbidity, and mortality rates among Black individuals following childbirth (Gur et al. 2020; Gyamfi-Bannerman et al. 2018; Martin and Montagne 2017). Black individuals are also at higher risk for PPD, particularly in the context of the COVID-19 pandemic, which has disproportionately impacted Black communities, likely compounding documented discrimination experienced by Black individuals, including in healthcare settings (Janevic et al. 2020; Njoroge et al. 2022).

Our results should be interpreted in the context of several limitations. First, our appraisal of childbirth trauma was based on a three-item measure that had not previously been validated and was assessed at 10–15 weeks postpartum (i.e., subject to recall bias). Nevertheless, from a psychometric perspective, the CFA established excellent model fit with high item-factor loadings, good internal consistency, and higher scores predicting PPD over and above prior depression and anxiety, representing a robust test of incremental validity. Second, we did not measure prenatal or postpartum PTSD, which is often comorbid with PPD (Dekel et al. 2020). We made this choice to maintain the lowest possible time burden for participants. However, future studies that compare the predictive validity of our brief childbirth trauma factor versus scores on more established (but potentially more burdensome) prenatal or postpartum PTSD scales in relation to PPD are warranted. Third, we only included 9 of the 10 items of the EPDS, dropping the self-harm item due to established difficulties associated with monitoring self-harm endorsements using online surveys, which may have reduced our sensitivity to detect PPD. At the same time, using a cut-off score of 10 or higher, the prevalence of PPD in our sample of 23.2% is higher than global prevalence estimates of 16.6–18.8% reported in recent large-scale meta-analyses conducted prior to the pandemic (Hahn-Holbrook et al. 2018; Shorey et al. 2018), which perhaps speaks to the extra stress faced by birthing individuals during our study period (i.e., 2020–2022) (Gur et al. 2020) and established increases in rates of PPD rates from before the pandemic (Bajaj et al. 2022). Fourth, we did not have information about the *emergent* nature of cesarean births, which could predict heightened perception of trauma (Burcher et al. 2020; Stoll et al. 2018; Wada et al. 2019). Fifth, medical record data were entered by multiple physicians, nurse practitioners, or certified nurse midwifes, with the potential for inaccuracy, particularly in estimating blood loss (Blosser et al. 2021). Future efforts that use formal quantification methods are warranted to generate more precise blood loss estimates that are associated with increased risk for trauma and/or PPD (Blosser et al. 2021).

In sum, we capitalized on a prospective design combining survey and clinical data. The experience of childbirth trauma reported by individuals, whether or not their childbirth is seen as routine by medical professionals, is an important, independent risk factor for PPD. Cesarean birth, blood loss, and PTB represent medical complications that add to our ability to recognize experiences that are appraised as traumatic and implicated in the

development of PPD. Results lay the foundation for preventative interventions for PPD, which will require continued collaboration and communication between obstetrics and gynecology providers, labor and childbirth teams, and perinatal mental health professionals. We suggest early universal postpartum screening for patient-reported traumatic childbirth experiences and specific childbirth complications that increase the risk of PPD, as well as continued screening for depression and anxiety throughout pregnancy. Advancing this research can contribute to improved maternal and newborn health and positive lifespan trajectories of health for children and families.

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Declarations

Conflict of interest Dr. Barzilay is on the scientific board and reports stock ownership in "Taliaz Health," with no conflict of interest relevant to this work. All other authors have nothing to disclose.

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