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Posttraumatic stress disorder, child abuse history, birth weight, and gestational age: A prospective cohort study

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Abstract

Objective—To determine the extent to which prenatal posttraumatic stress disorder (PTSD) is associated with lower birth weight and shorter gestation, and to explore the effects of childhood maltreatment as the antecedent trauma exposure.

Design—Prospective three-cohort study

Setting—Ann Arbor and Detroit, Michigan, United States

Sample—839 diverse nulliparas in PTSD-positive (n=255), trauma-exposed, resilient (n=307), and non-exposed to trauma (n=277) cohorts

Methods—Standardised telephone interview prior to 28 weeks to ascertain trauma history, PTSD, depression, substance use, mental health treatment history, and sociodemographics, with chart abstraction to obtain chronic condition history, antepartum complications, and prenatal care data, as well as outcomes.

Main outcome measures—Infant birth weight and gestational age per delivery record.

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Contributions to authorship

JS, LKL, DR, and IL are co-investigators, and MS is the study coordinator. JS and DR undertook the data analysis. All authors' contributions to the manuscript are consistent with co-authorship.

Interests

The authors have no interests to declare.

Ethics information

The Institutional Review Boards of all three medical centers approved and oversaw the conduct of research for this project; University of Michigan IRBMED #2004-1046, Henry Ford Health System IRB #3533, Wayne State University HIC #059105B3E.

Results—Women with PTSD during pregnancy had a mean birth weight 283 grams less than trauma-exposed, resilient women and 221 grams less than non-exposed women ($F(3, 835) = 5.4, p = .001$). PTSD was also associated with shorter gestation in multivariate models that took childhood abuse history into account. Stratified models indicated that PTSD subsequent to child abuse trauma exposure was most strongly associated with adverse outcomes. PTSD was a stronger predictor than African American race of shorter gestation and a nearly equal predictor of birth weight. Prenatal care was not associated with better outcomes among women abused in childhood.

Conclusions—Abuse-related PTSD may be an additional or alternative explanation for adverse perinatal outcomes associated with low socioeconomic status and African American race in the United States. Biological and interventions research is warranted along with replication studies in other nations.

Keywords

Stress disorder; posttraumatic; perinatal outcomes; birth weight; gestational age; health disparities; childhood maltreatment; abuse

Introduction

Posttraumatic stress disorder (PTSD) is prevalent among women; occurring in the aftermath of traumatic events like war, disaster, childhood maltreatment, rape and battering.¹⁻⁴ Studies with women who are pregnant find prevalence rates near 8% and greatest risk associated with history of abuse trauma ($OR=12, 95\% CI 4, 40$).⁵ Women with low socio-demographic status tend to have higher rates of PTSD in pregnancy, as do African American women.⁶ PTSD might be an additional risk factor for preterm birth and low birth weight among these vulnerable groups.

Evidence continues to accumulate to underscore the importance of addressing preterm birth and the combined low birth weight associated with it. A recent cost analysis conducted on the State of Michigan and US national data found that preterm birth is the leading cause of health problems in infants and is estimated to cost the US more than \$26 billion annually.⁷ This same report found that an African American infant in Michigan is 70% more likely to be born prematurely than an infant of any other race. A recent epidemiological study of cognitive and socioemotional outcomes followed babies to six years of age from the largest city in the state of Michigan, Detroit, and found that even those babies born “late” preterm (at 34 through 36 weeks) had greater risk of clinically significant impairments after controlling for many potential prenatal and childhood confounding factors.⁸ Thus a finding that PTSD—a treatable condition occurring at greater rates in pregnancy among African Americans⁶—is associated with shorter gestation would suggest new avenues for improving perinatal outcomes in high risk populations.

There have been nine studies (Tables S1a and S1b in supplementary material available online)⁹⁻¹⁷ assessing the relationship of prenatal PTSD to birth weight and gestational age. They share a common underlying assumption that PTSD could adversely affect both fetal growth and timing of parturition secondary to stress pathophysiology. These studies have several shortcomings, most importantly small samples of limited diversity and lack of trauma-exposed and non-exposed comparison groups. . They have not considered potential differences, in terms of biological and psychological impact, associated with type or timing of trauma exposure (e.g., interpersonal violence in childhood versus experiencing a disaster as an adult)¹⁸⁻²¹ Few examined co-occurring risk behaviours or known comorbidities of PTSD.²² This study addressed several limitations of these prior studies and considered the

effects of the trauma exposure of childhood abuse in stratified models to provide a better basis for inferences about the effects of PTSD on perinatal outcomes.

Methods

Design

This is a prospective three-cohort study (NIH NR008767, PI Seng). Its primary aim is to determine the extent to which posttraumatic stress disorder (PTSD) is associated with adverse outcomes during the childbearing year, including obstetric, mental health, and bonding outcomes. This paper reports on the perinatal outcomes of gestational age and birth weight. .

Organising framework

The relationships between trauma exposure, PTSD, and health outcomes are influenced by numerous factors. Consideration of these factors such as socio-demographic risk, co-occurring mental health conditions and health risk behaviours must then be taken into account in statistical analyses when exploring the risks of PTSD on childbearing outcomes.²³ In this study a framework was used consistent with research recommendations proposed by the US Centers for Disease Control and Prevention (CDC) for research on violence occurring around the time of pregnancy.²⁴ Figure 1 depicts the components included in this study's models (in bold font) and the measures used to create the variables in the statistical models. In brief, the core proposition is that *trauma exposure* is associated with *adverse outcomes* via *PTSD*. In turn, *PTSD* may be associated with *adverse outcomes* via *risk behaviours and comorbidity*. The strength of this association could be influenced by three broad sets of factors: non-modifiable medical and obstetric risks, modifiable healthcare related factors, and *chronic stress* such as that related to sociodemographic status.²⁴

Recruitment

Recruitment and follow-up took place from August 2005 through March 2008 using three large health systems' prenatal clinics in the State of Michigan. Institutional Review Board approval was obtained from all three entities, and a Confidentiality Certificate was obtained. Details of recruitment, including a flow diagram, have been published⁵ and are summarised here. Half the sample came from urban clinics that served primarily minority and poor women. In order to maintain generalisability of the study results to diverse women, and because poor and African American women have the worse perinatal outcomes in the US , we over-sampled from these settings to allow for the greater attrition that occurs among disadvantaged groups. Eligible women were expecting their first infant, 18 or older, able to speak English without an interpreter, and initiating prenatal care at less than 28 weeks gestation. Nurses invited eligible women to take part in a survey study of "stressful things that happen to women, emotions, and pregnancy." Interested women gave contact information, were provided an information document with the elements of informed consent, and were then contacted by a professional health research survey organization (DataStat, Ann Arbor, Michigan, USA), where verbal consent took place, eligibility was confirmed, and a standardised psychiatric diagnostic interview was conducted using computer-assisted telephone interview (CATI) technology. Participants were reimbursed \$20 by check for the completed interview. The initial sample consisted of 1,581 women in order to enroll for follow-up a target sample size with power to study conditions occurring in as few as two percent of cases (e.g., hyperemesis).

Sample

The CATI scoring algorithm assigned these interview completers to one of four cohorts: Non-exposed to trauma controls (n=350), trauma-exposed, resilient (PTSD-negative) controls (n=380), and PTSD-positive cases (n=319). The fourth cohort included women who did not match one of these definitions (n=532), and these women were dismissed from follow-up. Women assigned to one of the three follow-up cohorts at the end of the interview were invited to continue in the study and provided additional informed consent for medical records review after delivery and follow-up interviews. The three-cohort design is common in PTSD research where the trauma exposure itself is an alternative or additive explanation for outcomes associated with PTSD.²⁵ We divided the PTSD-positive cohort for most analyses into those who had recovered and those who were still affected at the time of the interview. For this report we only include women who had prenatal and delivery medical records and live singleton births (n=839). Figure 2 depicts the definition of the cohorts and composition specific to this report.

Medical records abstraction

Two sites used paper charts, and a labour and delivery nurse abstracted details onto a paper form. Reliability was established early in the project by training, creating decision tools, and revising the form until inter-rater agreement reached 92.7%.²⁶ A five percent audit over the life of the project resulted in 94.4% agreement, which is considered excellent reliability.²⁷ Data were double entered from the paper forms. The third site used an electronic medical record. A list of items, developed by investigators and data managers, were extracted, downloaded and transformed to a flat spreadsheet for cleaning and recoding in SPSS. Manual reading of individual patient electronic medical records was done to redress errors in original data entries, such as data missing by being entered in the wrong field.

Measures and variable construction

Whenever possible established measures were used in the survey interviews. Psychometrics and scoring procedures for measures from the initial psychiatric diagnostic interview have been reported earlier.⁵ Instruments and variable definitions are listed in Table S2 of the supplementary materials available online.²⁸⁻³² The adverse outcomes of childbearing we focused on for this report were gestational age and birth weight, both as interval-level variables and as adverse outcomes. These were defined as preterm (less than 37 completed weeks gestation), and low birth weight (less than 2500 grams).

Analysis plan

We began by accounting for the attrition from the initial interview due to multiple gestation and losses, as well as due to not being able to obtain a record. We also verified that the relationships between PTSD and outcome variables met the assumption of linearity prior to regression modeling. To do this, we tested the hypothesis that PTSD is associated with gestational age and birth weight outcomes via chi-square and ANOVA comparisons across the three cohorts, splitting the PTSD-positive group into lifetime-positive, recovered women (PTSD-recovered) and currently-positive, affected women (PTSD-affected). We then considered the full complexity of the potentially mediating or moderating factors with stepwise linear regression models based on the conceptual framework presented, for both outcomes, birth weight and gestational age. This first set of models involved the whole sample. Then we divided the sample into groups with (n=174) and without (n=665) child abuse history in order to consider how patterns may have differed based on trauma type.

Results

The sample size included in this analysis was 839 women for whom we had complete prenatal and obstetric record data that included the necessary variables in this analysis (birth weight, gestational age, prenatal care information, and pre-pregnancy medical history) and who were known not to have experienced miscarriage ($n=33$) or elective abortion ($n=4$) subsequent to the screening interview, nor multiple gestation ($n=12$), fetal demise, stillbirth, or neonatal death ($n=7$). Prevalence of these reasons for exclusion did not differ significantly across the three cohorts. Within this sample, there were 255 PTSD-positive women, 277 in the non-exposed cohort, and 307 in the trauma exposed, resilient cohort. Within the PTSD-positive cohort, 98 had current PTSD (affected) and 157 had had PTSD previously (recovered). Chi-square comparisons of the 839 women with medical records data and live singleton births and the 1,049 women who were assigned to follow-up based on the first interview indicated that they did not differ in the proportion in each cohort ($X^2(2) = 0.072$, $p = .964$) or in the proportion who were sociodemographically disadvantaged ($X^2(1) = 0.066$, $p = .798$).

Extensive descriptive data on the sample as a whole and comparisons across the four cohorts are depicted in Table 1. The PTSD-affected cohort had more sociodemographic risk factors, more childhood abuse, more substance use, more recent intimate partner violence, and a lower rate of adequate prenatal care than the other cohorts. The PTSD-affected and PTSD-recovered cohorts had similar rates of major depression in the past year and pregnancy mental health treatment. The trauma-exposed, resilient cohort had the fewest sociodemographic disadvantages, lower rates of childhood abuse trauma, a low rate of depression, low levels of substance use and intimate partner violence exposures, and the highest rate of using adequate prenatal care.

We first examined the associations of PTSD symptom count and cohort with the outcomes using bivariate tests. The correlation of current PTSD symptom count with gestational age was not significant ($r = -0.044$, $p = .202$). Grouping by cohort to examine gestational age as a continuous variable showed no significant relationship (Table 2). The negative correlation of current PTSD symptom count with birth weight was significant but weak ($r = -0.122$, $p < .001$). Looking at birth weight in grams by cohort (Table 2), the PTSD-affected cohort differed substantially from the trauma-exposed resilient cohort). In brief, these bivariate tests showed that current PTSD was not significantly associated with preterm birth and current PTSD was significantly associated with lower birth weight, a difference of 283 grams compared with the trauma exposed, resilient cohort and 221 grams compared with the non-exposed cohort ($p = .001$). To meet the requirement for linearity for regression modeling we thus used the trauma-exposed, resilient cohort as the reference category.

We next constructed theory-based stepwise linear regression models, with each step adding co-variables according to the organising framework. First we used the entire sample ($n=839$), so the focus was on the effect of PTSD, taking childhood abuse history into account. We then stratified by childhood abuse history (negative history $n=665$, positive history $n=174$) to assess whether the pattern changed based on antecedent trauma type. Table S3 in the online supplementary materials presents these three models for the birth weight outcome, and Table S4, also available online, presents the models for the gestational age outcome.

In relation to birth weight, in the model on the whole sample, having adjusted for childhood abuse trauma exposure, which was not independently predictive, being in the PTSD-affected cohort, and having an antepartum complication increased risk. Having a pre-existing chronic condition and using adequate prenatal care decreased risk. When the African American race and poverty components of chronic stress were added in the sixth step, they weakened the

relationship of current PTSD and of the pre-existing chronic condition. Overall this model explained 14.7% of variance in birth weight.

Within the subsample that did not experience childhood abuse ($n=665$), the pattern was similar to that found in the entire sample, but race and poverty accounted for more risk and weakened the association of current PTSD with birth weight. The amount of overall variance in birth weight explained by the model was smaller, 5.3%,

Among childhood abuse survivors ($n=174$), the association of current PTSD with lower birth weight was stronger and this factor alone explained 7.9% of variance. The rest of the pattern differed from the overall sample and from the non-abused subsample. Substance use contributed to risk. Adequate prenatal care was not an independently significant protective factor. Poverty was not an independently significant risk factor. Race mediated the association of PTSD. The variance explained within this subset was a larger proportion than for the sample as a whole, 19.2%.

In relation to the gestational age outcome, the pattern was similar for the overall sample to the pattern seen in relation to birth weight, except that neither pre-existing chronic conditions nor poverty were independently significantly associated. The variance explained within the model on all 839 women was 12.2%.

Within the non-abused subset, PTSD was not at all associated with gestational age. Neither was race or poverty. Only antepartum complications and adequate prenatal care were significant independent predictors in a model that nevertheless explained 13.3% of variance.

Within the childhood abuse subset current, PTSD had a similarly strong predictive value for gestational age as it had for birth weight. Antepartum complications and current PTSD conveyed similar levels of risk. Neither race nor poverty were significant predictors of gestational age after the other factors were taken into account. Intimate partner violence was an independently significant predictor associated with longer gestation ($\beta=.167$, $p=.031$). *Post hoc* examination of this counter-intuitive finding showed that, of the 27 cases with past year partner violence, none delivered at less than 34 weeks, 3 were preterm, 18 were term, and 6 (22%) were postdates deliveries. The steps including *PTSD, comorbidities and risk behaviours*, and the *non-modifiable obstetric risk factor* of antepartum complications explained 17.5% of variance, with the adjusting in the *modifiable health care related factors* step adding another 0.5% and the *chronic stress* step contributing no additional variance.

We conducted a *post hoc* examination of the correlation of birth weight with gestational age across cohorts and across child abuse strata. Our rationale for this exploration was that gestational age could be associated with birth weight to varying extents within each stratum. The plausible biological mechanisms for birth weight and for prematurity may be shared or distinct to varying extents based on the mother's psychobiological status. Her psychobiological status would be expected to differ based on factors that distinguish the cohorts and strata, as will be discussed below. The association was not as strong in the stratum abused in childhood ($r = 0.608$, $p<.001$) and in the PTSD-positive cohort ($r = 0.699$, $p<.001$) compared with the non-abused stratum ($r = 0.760$, $p<.001$) and non-exposed cohort ($r = 0.765$, $p<.001$).

Discussion

Results of this study redress gaps in the literature regarding PTSD and perinatal outcomes by using a prospective cohort design, recruiting a diverse sample, considering one major antecedent trauma type, and taking numerous theoretically relevant factors into account. Findings show that there is an association between PTSD diagnosis and the adverse

outcomes of lower birth weight and shorter gestation and that the effect is strongest among women currently affected with PTSD who are childhood abuse survivors. In the abused subsample, substance use and antepartum complications play a role in lower birth weight. African American race weakens the association of prenatal PTSD with birth weight. . . Race is not an independent predictor of prematurity among abuse survivors. Adequate prenatal care, which is a protective factor in the overall and non-abused samples, is not protective in relation to either outcome among childhood abuse survivors. The decrement in birth weight for women with current PTSD is 283 grams compared with the trauma-exposed, resilient cohort and 221 grams compared with the non-exposed cohort. This is a clinically meaningful difference, especially as it co-occurs with the 13.3% low birth weight rate and 22.4% preterm birth rate for this group, suggesting that it could contribute to infant morbidity.

Future research on plausible biological mechanisms for the effects of PTSD on perinatal outcomes should consider that PTSD-related pathophysiology may affect birth weight and gestational length via different mechanisms. Our *post hoc* analysis of the correlation of gestational age with birth weight informs this thinking because the expected high correlation was weakest in the childhood abuse stratum and in the PTSD-positive cohort. For example, women with PTSD from childhood maltreatment could have dysregulation in the oxytocin system stress-response function.³³ This in turn could affect fetal growth via oxytocin's interaction with growth hormones.³⁴ The duration of gestation could be affected by PTSD-associated HPA axis dysregulation.³⁵ This in turn could affect the cervix and chorioamnion by inflammatory and immune system alterations.^{35,36} Other investigators have demonstrated that the impact of stress exposure (i.e., the acute trauma of death of a family member during pregnancy) can differentially affect birth weight and gestational outcomes,³⁷ and that the biological indicators of stress or distress can be better predictors than the psychological factor.³⁸ The different patterns of factors predicting the two outcomes in this clinical study support the need for future studies of mechanisms to continue to model birth weight and gestational age separately. Conversely, population-based research to replicate these findings on large, representative samples is needed. In these future studies, the public health and economic effects of PTSD in pregnancy can be better estimated on the outcome of small size for gestational age which can then be considered in relation to population standards.

The finding that African American race is only variably involved in the pathway between PTSD and these adverse outcomes also seems important from a clinical and public health perspective. Race has been considered a nearly immutable perinatal risk factor in the US , but findings from these models suggest that part of the risk may be shared with the treatable condition of PTSD, especially when the PTSD occurs in the aftermath of childhood abuse. Importantly, our analysis of race as a risk factor for PTSD⁶ indicated that African American women are at no greater risk for onset of PTSD, but they have four-fold greater risk for remaining affected by PTSD at the time of pregnancy. Reasons for this greater risk of PTSD in pregnancy include having had less treatment, and having had more lifetime trauma exposures overall which may maintain or re-activate PTSD. Moreover, because their average age at pregnancy is younger, they would have had less time elapse since childhood abuse occurred, so less chance for remittance. Young age itself also is a risk factor for PTSD.³⁹ Disparities in birth outcomes in other nations may also occur based on disadvantaged status (e.g., immigrant versus native born women;^{e.g.40}) and disadvantaged status likely is associated with greater trauma exposure and PTSD in these settings as well.^{e.g.41} Thus child abuse, gender-based violence, other culturally-specific trauma exposures, and PTSD status should be incorporated into international perinatal epidemiology studies. A public health framework could thus be applied to understand lower birth weight and shorter gestation as the tertiary outcomes of failure to implement primary prevention of trauma exposure and secondary prevention of PTSD prior to pregnancy. Taken together, the

findings from this study suggest heretofore unexamined possibilities to address potentially causative factors for perinatal health disparities.

The finding that prenatal care is not protective for the child abuse survivors is consistent with numerous qualitative⁴² and clinical⁴³⁻⁴⁵ papers indicating that abuse survivors, especially those with histories of sexual abuse, avoid or struggle with prenatal care. Avoidance of reminders of their precipitating trauma (i.e., triggers) is a hallmark and diagnostic criterion for PTSD. So women with abuse-related PTSD may come later to prenatal care or skip visits to avoid triggers such as vaginal examinations or caregiver relationship challenges. Alternatively, when women with a trauma history do adhere to the visit schedule, they may experience PTSD exacerbation, undermining the benefits of care by activating biological and behavioral stress responses. Research is warranted to develop maternity care models that address the needs of this substantial population. A 2008 study of 4,549 children in the US found girls in the 14-17 year old group had a lifetime maltreatment rate of 18.6% (excluding sexual assault by a known adult), and a 13.8% lifetime rate of completed or attempted rape, of which half (7.7%) were by a known adult.⁴⁶ In this study's community sample, 31.6% of women who were maltreated prior to age 16 met PTSD criteria during pregnancy, with childhood abuse-related PTSD accounting for 56.1% of those cases occurring during pregnancy ($X^2(1) = 84.5, p < .001$). It is important to determine what benefit there might be to trauma-informed outreach programs to encourage PTSD-affected women to enter prenatal care earlier. Research is also warranted to develop adapted service delivery models (e.g., continuity to improve trust, referral to obstetricians or midwives interested in psychosomatic care) or enriched models of care such as the use of doulas or outreach workers trained to provide trauma-informed supportive care which might improve adherence to prenatal care. At the very least, integrating screening and treatment for PTSD into prenatal clinic routines would seem reasonable and a critical first step in addressing the potential risks of PTSD on pregnancy outcomes suggested in this investigation and others. This might only represent an incremental change in service delivery in settings where these structures are already in place to address depression or risk of domestic violence. There are evidence-based psychotherapy and pharmacology treatments for PTSD.⁴⁷ Research is warranted to determine their safety and efficacy for pregnant women and to determine if treating PTSD improves perinatal outcomes. It will be an especially high priority to conduct such research and implement programs in settings where minority women are served.

Findings of this study differ somewhat from two studies of childhood sexual abuse survivors that found higher rates of preterm birth. Noll and her colleagues⁴⁸ have followed a Washington, D.C. cohort of girls in child protection services for sexual abuse and a matched comparison group. The rate of preterm birth was 20.6% for the abused group and 10.7% for the comparison group (adjusted OR=2.80, CI +/-1.44, $p < .05$). Leeners and her colleagues⁴⁹ in a retrospective study of 85 mothers in Germany seeking support services for a history of childhood sexual abuse and 170 matched controls found similar rates and odds ratios for preterm birth (18.8% versus 8.2%, OR 2.58, CI 1.19, 5.59). By contrast, our modeling did not find childhood maltreatment (defined as physical, emotional, or sexual abuse or physical neglect) to be a significant independent predictor of preterm birth, but rather found that PTSD that was subsequent to such trauma exposure was implicated instead. *Post hoc* chi-square tests in our data verified that childhood sexual abuse specifically had no significant association with preterm birth. Neither the Noll et al. nor the Leeners et al. studies measured PTSD as a possible mediator of the preterm birth outcome. However, adults whose sexual abuse had resulted in their being identified for child protection services and adults seeking mental health support services for sexual abuse may well have been affected by PTSD that was unmeasured.

Limitations to this study are those inherent to survey research. Recall of trauma exposures and lifetime PTSD symptomatology is retrospective and subject to stigma, such that the levels disclosed here could be under-reported. Conversely, women could erroneously report pregnancy symptoms as PTSD symptoms, decreasing specificity. Not all eligible women accepted the invitation to participate or were reached for the survey, and we have no data about those who did not consent and complete the survey. We did not analyse racial or ethnic groups other than African Americans. We only included women giving birth for the first time, so we do not know the impact of having had a previous traumatic birth or of prior stillbirth or loss of a child; and we do not know if PTSD affects outcomes of subsequent pregnancy to the same extent as it affects first pregnancy. Nor did we have enough women with other high magnitude exposures (e.g., intimate partner violence survivors, combat veterans, refugees) to know the specific effects of these trauma exposures on perinatal health.

There also are several strengths to this study including the three-cohort design, the large, diverse sample, and the organising framework that considers additional relevant predictors including depression, substance use, recent intimate partner violence, medical and obstetric risk, prenatal care and mental health treatment, race and poverty. The ability to stratify to examine abuse-related PTSD specifically was also a strength since this trauma exposure in early development may have been a factor in the inconsistent findings of previous studies, particularly in disaster research where other lifetime exposures are seldom analysed. The potential limitations in trauma history and PTSD measurement were anticipated and addressed by choosing well-established, standardised instruments and a survey research organization experienced in the conduct of mental health research. The Life Stressor Checklist is an established trauma history measure designed specifically for use with women. It queries trauma exposures with behaviorally specific language, separating the query about whether the exposure happened (yes/no) from the evaluation that it was traumatic (i.e., that the woman felt fear, helplessness, or horror) to increase reliability of reporting. We examined the validity of PTSD symptom reporting during pregnancy by comparing the results of our pregnancy survey with the age-matched sample from the National Women's Study⁵⁰ and concluded that the symptom reporting appears to be highly specific to PTSD. The collaboration of three major medical centers permitted inclusion of both affluent and disadvantaged women who would have experienced a range of high- and low-risk models of care with diverse maternity care providers, including trainees and faculty members in obstetrics, family medicine, and midwifery. These strengths contribute to both internal validity and generalisability.

Clinical implications follow from these findings. Assessment for trauma history and PTSD using brief measures validated for primary care settings should be implemented in addition to the depression assessment that is becoming a standard of care. PTSD-affected women should be offered an opportunity to discuss their traumatic stress concerns with a maternity care team member. Referral to specialty care to have decision-making help abuse using evidence-based treatments for PTSD in pregnancy may be desired by some pregnant women. Nursing or education visits to address concerns regarding labour, breastfeeding, or early parenting are likely to be more widely accepted. Interdisciplinary collaboration likely will be useful to maternity care professionals in the short term. Referral is unlikely to be a sufficient response since intrusive medical procedures and labour are particularly triggering situations where it is the maternity care provider who is involved and able to adapt care to make these situations less stressful. Consulting with mental health professionals experienced in working with PTSD can help maternity care providers increase their comfort and skill as they add addressing trauma-related needs to the list of treatment modalities they offer.

There are numerous research implications. PTSD-specific interventions for pregnant women are urgently needed, with priority efforts going toward developing programs that are feasible to implement in low-resource settings, culturally acceptable to minority women, and tailored to address the needs of women with abuse-related PTSD. Studies also are needed to assess the pregnancy-specific benefit-risk profile of existing evidence-based specialty treatments for PTSD (e.g., exposure therapy) and pharmacotherapies (e.g., selective serotonin reuptake inhibitors). Given the effect size of PTSD on the outcomes of birth weight and gestational age, studies are needed on the effects of PTSD on other maternal-child outcomes (e.g., labour processes, breastfeeding, postpartum mental health, and bonding). Biological research is needed to understand the possibly distinct mechanisms of lower birth weight and shorter gestation in PTSD-affected women, especially those with a childhood maltreatment history. Studies also are needed to examine the effect of PTSD on the birth outcomes of other highly traumatised groups, including veterans and refugees, and also on the birth outcomes of multiparous women where previous perinatal loss or traumatic birth may be important antecedent exposures.

Conclusion

The findings of this investigation provide a substantial contribution to our understanding of the effects of PTSD on the perinatal outcomes of birth weight and gestational age in this sample. In particular these findings indicate that PTSD in pregnancy accounts for a decrement of over 200 grams in birth weight, a difference that is more weakly correlated with gestational age among affected women than among controls. These findings further suggest that it may be the greater risk that African Americans carry for having PTSD during pregnancy,⁶ rather than race alone, that accounts for some of the disparity in birth outcomes. The models also indicate that it is the subset of women whose PTSD is secondary to childhood abuse who are most vulnerable to these lower birth weight and shorter gestation outcomes and that prenatal care is not protective for them. Addressing abuse-related PTSD in maternity care settings is thus an additional avenue for improving the childbearing experience, mental health, and perinatal outcomes of sociodemographically and psychologically vulnerable women.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Diagram of conceptual framework organizing the statistical modeling with measures used.

	PTSD-diagnosed (n=255)		Dismissed	Trauma-exposed, resilient (n=307)	Non-exposed (n=277)
	Affected n=98	Recovered n=157			
Reported a potentially traumatic event	Yes	Yes	Possibly	Yes	Possibly
Trauma evoked fear, helplessness, or horror response OR was childhood maltreatment	Yes	Yes	Possibly	Yes	No
Meets lifetime PTSD 6-symptom syndrome criteria: 1 Intrusive reexperiencing 3 Avoidance and numbing 2 Autonomic hyperarousal	Yes	Yes	No	No	No
Mean (SD) lifetime symptom count	11.7 (2.6)	10.1 (2.6)	4.9 (2.4)	1.1 (1.2)	0.4 (0.8)
Mean (SD) current symptom count	10.1 (2.5)	3.5 (2.3)	2.4 (2.4)	0.5 (0.9)	0.2 (0.6)

Note: Per Scheffe post hoc tests all groups differ significantly for lifetime symptom counts. For current symptom counts, the trauma-exposed, resilient and non-exposed cohorts do not differ.

Figure 2.
Cohort definitions.

Table 1

Descriptions of the sample overall and by cohort, depicting all factors included in the multivariate models.

	Total n=839	PTSD-affected 11.8% (98)	PTSD-recovered 18.7% (157)	Non-trauma exposed 36.6% (277)	Trauma-exposed, resilient 33.4% (307)	Statistic	p
				% (n)			
Sociodemographic risk factors							
African American	41.4 (347)	74.5 (73)	40.1 (63)	41.9 (116)	30.9 (95)	X ² =58.2	<.001
Poverty (income <\$15,000)	22.1 (185)	44.9 (44)	23.6 (37)	19.5 (54)	16.3 (50)	X ² =37.6	<.001
Low education (<= high school)	44.5 (373)	76.5 (75)	41.4 (65)	48.4 (134)	32.2 (99)	X ² =61.7	<.001
Pregnant as a teen	21.1 (179)	36.7 (36)	18.5 (29)	24.5 (68)	15.0 (46)	X ² =23.7	<.001
High crime zip code (>US average)	37.3 (313)	67.3 (66)	35.0 (55)	40.1 (111)	26.4 (81)	X ² =54.7	<.001
Trauma history factors							
Child abuse (before age 16)	20.7 (174)	56.1 (55)	40.8 (64)	1.8 (5) *	16.3 (50)	X ² =177.1	<.001
Past-only (not recent) adult abuse	8.4 (74)	20.4 (20)	15.3 (24)	1.4 (4) *	8.5 (26)	X ² =43.3	<.001
Event was index trauma **	10.7 (90)	6.1 (6)	16.6 (26)	4.0 (11) *	15.3 (47)	X ² =27.7	<.001
Mental health and risk exposure							
Major Depression in past year	12.0 (101)	29.6 (29)	29.3 (46)	4.0 (11)	4.9 (15)	X ² =104.5	<.001
Any substance use in pregnancy	25.7 (216)	48.0 (47)	32.5 (51)	19.1 (53)	21.2 (65)	X ² =38.7	<.001
Past year partner violence	3.2 (27)	13.3 (13)	5.7 (9)	1.1 (3)	0.7 (2)	X ² =45.5	<.001
Medical/Obstetric risk factors							
Pre-existing chronic condition	43.6 (366)	31.6 (31)	54.1 (85)	39.0 (108)	46.3 (142)	X ² =16.1	<.001
Antepartum problem	23.8 (200)	18.4 (18)	24.2 (38)	26.7 (74)	22.8 (70)	X ² =3.1	.381
Healthcare related factors							
Adequate prenatal care	64.1 (538)	46.9 (46)	65.6 (103)	62.8 (174)	70.0 (215)	X ² =17.6	.001
Past therapy or medication	31.5 (264)	42.9 (42)	61.1 (96)	14.4 (40)	28.0 (86)	X ² =109.0	<.001
Pregnancy therapy or medication	5.6(47)	14.3 (14)	14.6 (23)	1.8 (5)	1.6 (5)	X ² =55.0	<.001

Df for X² = 3.

* Non-exposed women reported some exposures but none meeting DSM-IV criteria. Childhood abuse was a criterion for inclusion in the trauma-exposed cohort if it was physical or sexual abuse; the non-exposed women's childhood abuse was emotional.

* Potentially traumatic events queried were disaster, war, witnessing or being in an accident, being jailed, serious illness, painful procedure or ritual, separation or divorce, witnessing or being attacked or robbed, being sexually harassed.

Table 2

Birth weight and gestational age comparisons by cohorts

Birthweight in grams				Gestational age			
Group	Mean	SD	ANOVA	Group	Mean	SD	ANOVA
PTSD-affected	3053	682	F=5.4	PTSD-affected	38.7	2.8	F=1.3
PTSD-recovered	3244	521	df 3, 835	PTSD-recovered	39.2	1.8	df=3, 835
Non-exposed	3274	628	p=.001	Non-exposed	39.1	2.5	p=.269
Trauma-resilient	3336	612		Trauma-resilient	39.3	2.4	
Overall	3265	615		Overall	39.1	2.4	

Low birth weight				Preterm birth			
Group	%	n	Chi squared	Group	%	N	Chi squared
PTSD-affected	13.3	13	X2=2.9	PTSD-affected	22.4	22	X2=7.2
PTSD-recovered	8.3	13	df=3	PTSD-recovered	12.1	19	df=3
Non-exposed	8.7	24	p=.414	Non-exposed	17.3	48	p=.067
Trauma-resilient	7.8	24		Trauma-resilient	13.0	40	
Overall	8.8	74		Overall	15.4	129	