Posttraumatic Stress Disorder and Pregnancy Complications

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Objective: To assess the associations between specific pregnancy complications and posttraumatic stress disorder based on neurobiologic and behavioral characteristics, using Michigan Medicaid claims data from 1994–1996.

Methods: Two thousand, two hundred nineteen female recipients of Michigan Medicaid who were of childbearing age had posttraumatic stress disorder on the basis of International Classification of Diseases, 9th Revision (ICD-9) codes. Twenty percent (n = 455) of those recipients and 30% of randomly selected comparison women with no mental health diagnostic codes (n = 638; P << .001) had ICD-9 diagnostic codes for pregnancy complications. We used multiple logistic regression to investigate associations between specific pregnancy complications and posttraumatic stress disorder, controlling for demographic and psychosocial variables. Obstetric complications were hypothesized based on high-risk behaviors and neurobiologic alterations in stress axis function in posttraumatic stress disorder.

Results: After controlling for demographic and psychosocial factors, women with posttraumatic stress disorder had higher odds ratios (ORs) for ectopic pregnancy (OR 1.7, 95% confidence interval [CI] 1.1, 2.8), spontaneous abortion (OR 1.9, 95% CI 1.3, 2.9), hyperemesis (OR 3.9, 95% CI 2.0, 7.4), preterm contractions (OR 1.4, 95% CI 1.1, 1.9), and excessive fetal growth (OR 1.5, 95% CI 1.0, 2.2). Hypothesized labor differences were not confirmed and no differences were found for complications not thought to be related to traumatic stress.

Conclusions: Pregnant women with posttraumatic stress disorder might be at higher risk for certain conditions, and assessment and treatment for undiagnosed posttraumatic stress might be warranted for women with those obstetric complications. Prospective studies are needed to confirm present findings and to determine potential biologic mechanisms. Treatment of traumatic stress symptoms might improve pregnancy morbidity and maternal mental health.

Violence against women is an important risk factor that affects public health. Effects of violence on women’s health might be mediated by biologic and psychosocial sequelae in the form of traumatic stress-related disorders. Large epidemiologic studies using random samples of nonclinical populations showed that the prevalence of lifetime posttraumatic stress disorder among women of all ages was between 10.4% and 12.3%, with rates of 25–50% among women exposed to abuse or assault trauma. An analysis of lifespan exposures to trauma found that rates of exposure to traumas, including assaults, peak between 16 and 20 years of age and decrease precipitously thereafter, suggesting that exposure and posttraumatic stress disorder occurred early enough in life to precede childbearing in many women.
weight (LBW) and preterm birth have been associated with violence between intimate partners during pregnancy, an acute life event stress that might be superimposed on postrauumatic stress disorder. Each of those complications has a behavioral risk factor, a hormonal risk factor related to oxytocin-vasopressin dysregulation, or both (eg, ectopic pregnancy caused by prior infection and dysregulated smooth muscle function in the fallopian tube). The hypothesized complications were consistent with problems identified in the clinical literature about pregnant sexually abused women, a population with a high prevalence of postrauumatic stress disorder. We did not expect that women with postrauumatic stress disorder would have other obstetric complications, such as preeclampsia or gestational diabetes, because we did not see any postrauumatic stress disorder–related mechanism to increase their incidence, although we included them in the analysis as alternative explanations for fetal weight problems, labor induction, and cesarean delivery. Hypotheses about some of the specified complications (infertility, elective abortion, lactation problems, and postpartum mood and attachment disorders) could not be tested because of lack of codes for those conditions in the Medicaid database we used. Therefore, the aim of this preliminary analysis was to test the hypothesis that the following complications were associated with a postrauumatic stress disorder diagnosis: spontaneous abortion, ectopic pregnancy, sexually transmitted disease in pregnancy, hyperemesis, preterm contractions, concerns about fetal weight (inadequate or excessive), postdate gestation with and without oxytocin induction, and dysfunctional labor contractions (precipitous or hypotonic leading to oxytocin augmentation, cesarean birth, or postpartum hemorrhage).

Materials and Methods

We used a dataset with mental health and perinatal data, Michigan’s Medicaid Eligibility and Paid Claims records, to test our hypothesis. The data included the completely processed fee-for-service records beginning January 1, 1994 and ending December 31, 1996 for 526,692 women born from 1950–1983. The data had been encrypted to protect confidentiality, and The University of Michigan institutional review board approved this secondary analysis. Variables for this analysis came from International Classification of Diseases, 9th Revision (ICD-9) diagnostic codes from hospital episodes and some procedure coding gathered by standardized billing forms and hospital chart reviews. Age, ethnicity, and program code variables came from eligibility information. Those data were converted from the multitable relational database to single-spreadsheet variables for analysis using SPSS version 7.5 (SPSS, Inc., Chicago, IL).

Cases of postrauumatic stress disorder were identified by presence of the ICD-9 diagnostic code 309.81. The American Psychiatric Association diagnostic criteria for this code require (A) presence of a qualifying trauma, and (B) one symptom of intrusive reexperiencing, (C) three symptoms of avoidance and numbing, and (D) two symptoms of arousal, with symptom duration longer than 1 month and significant functional impairment. Female recipients of Medicaid who had inpatient or outpatient ICD-9 code 309.81 were selected (n = 2219). An equal number of records were extracted by random-case selection process among female recipients who had no psychiatric diagnostic codes to form a comparison group. Among the 4438 women, 1093 had at least one diagnostic code relating to pregnancy (ICD-9 codes 630–676) and no code for multiple gestation because many of the hypothesized complications are associated with multiple gestation. Diagnostic bivariate and regression tests to assess the effect of including censored data showed no significant differences between groups. Given the cross-sectional nature of this preliminary study, in which no longitudinal analyses were planned, data from those cases were retained. Thus, the analysis included 455 women (41.6%) in the postrauumatic stress disorder group and 638 women (58.4%) in the comparison group.

Three categories of variables were developed. Demographic variables included ethnicity, age, and program code (ie, reason for eligibility) in effect at the last pregnancy-related service. Bivariate analysis showed that being eligible for Medicaid because of disability correlated strongly with postrauumatic stress disorder diagnosis (Table 1). We eliminated the disability demographic variable because it violated the noncorrelated independent variables assumption of regression analysis. From those data we could not tell whether the disabled women had postrauumatic stress disorder subsequent to a disabling injury or illness or whether the psychiatric disorder was the cause of disability. If the latter was true, those cases represent a level of severity of postrauumatic stress that might affect generalizability. Psychosocial screening variables included drug dependence complicating pregnancy (code 648.3), mental disorder complicating pregnancy (code 648.4), and a proxy variable for abuse and assault combining v-codes for emergency room observations after rape (code v71.5) or inflicted injury (code v71.6), and current domestic violence and counseling visits relating to abuse (codes v61.11 and v61.21). Obstetric variables show that diagnosis did or did not occur in the record.

Bivariate comparisons are presented for descriptive purposes. Comparisons that were significant after Bon-
ferroni correction for multiple comparisons\textsuperscript{16} are indicated. Given the exploratory nature of this analysis, focusing on variables that are significant by the stringent Bonferroni criterion ($P < .002$) would likely result in a type II error. Therefore, all potential variables were included in the initial regression analysis.

The logistic regression model constructed for this analysis estimated association of multiple demographic, psychosocial, and obstetric variables with the single, dichotomous grouping variable (diagnosed with posttraumatic stress disorder or not). That model (Table 2) resulted from backward elimination of nonsignificant obstetric variables from among conditions we hypothesized were associated with posttraumatic stress disorder and any potentially confounding factors, such as preeclampsia accounting for induction and gestational diabetes accounting for excessive fetal weight. The variables were entered in a forward stepwise progression\textsuperscript{15} so that differences between groups on the basis of obstetric conditions have already taken into account the women’s demographic and psychosocial factors. Model efficacy was evaluated using lambda-$p$\textsuperscript{15} (cases incorrectly predicted subtracted from cases correctly predicted) to determine the proportion reduction in error of prediction from using this model compared with chance.

### Results

Among 526,629 female Medicaid recipients with fee-for-service data from 1994–1996, 104,287 (19.8%) had at least one mental health diagnostic code from among the ICD-9 codes 290–347. Among those women, 2219 (2.1%) had code 309.81 for posttraumatic stress disorder. That is a prevalence of 0.4%, which likely represents an underreporting of the disorder.\textsuperscript{2}

Bivariate tests on demographic variables (Table 1) showed no group differences in age. There were more white women in the diagnosed group, although it cannot be ascertained from the data if that was caused by differences in exposure to trauma, vulnerability, or likelihood of clinician assigning the posttraumatic stress disorder diagnosis. In the posttraumatic stress disorder group, 18.9% of women were in a disability program, versus 1.6% in the comparison group. Among women with posttraumatic stress disorder diagnoses, 17.4% had hospital episodes in which posttraumatic stress disorder was the primary diagnosis, and 22% of them also had substance abuse diagnoses.

Groups differed significantly on all psychosocial proxies. Emergency room observations after alleged rape and inflicted injury, or counseling visits related to abuse had been recorded for 6.4% of the posttraumatic stress disorder group and 0.8% in the comparison group. Half of the 29 women with victim service codes had hospital episodes in which posttraumatic stress disorder was the primary diagnosis, and 22% of them also had substance abuse diagnoses.

### Table 1. Comparison of Demographic and Psychosocial Characteristics\textsuperscript{*}

<table>
<thead>
<tr>
<th>Screening variable</th>
<th>Diagnosed group ($n = 455$)</th>
<th>Comparison group ($n = 638$)</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (y)</td>
<td>23.3</td>
<td>24.0</td>
<td>.06</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>370 (81.3)</td>
<td>419 (65.7)</td>
<td>&lt;.001\textsuperscript{16}</td>
</tr>
<tr>
<td>Black</td>
<td>67 (14.7)</td>
<td>169 (26.5)</td>
<td></td>
</tr>
<tr>
<td>Native</td>
<td>3 (0.7)</td>
<td>1 (0.2)</td>
<td></td>
</tr>
<tr>
<td>American/Alaskan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian/multiracial</td>
<td>2 (0.4)</td>
<td>10 (1.6)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>7 (1.5)</td>
<td>9 (1.4)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>6 (1.3)</td>
<td>30 (4.7)</td>
<td></td>
</tr>
<tr>
<td>Reason for eligibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poverty program</td>
<td>288 (63.3)</td>
<td>305 (47.8)</td>
<td>&lt;.001\textsuperscript{1}</td>
</tr>
<tr>
<td>Disability program</td>
<td>86 (18.9)</td>
<td>10 (1.6)</td>
<td></td>
</tr>
<tr>
<td>Pregnancy program</td>
<td>81 (17.8)</td>
<td>323 (50.6)</td>
<td></td>
</tr>
<tr>
<td>Hospital psychiatric episode</td>
<td>79 (17.4)</td>
<td>0 (0.0)</td>
<td>By selection</td>
</tr>
<tr>
<td>Substance abuse psychiatric code</td>
<td>100 (22.0)</td>
<td>0 (0.0)</td>
<td>By selection</td>
</tr>
<tr>
<td>Drug abuse maternity code\textsuperscript{a}</td>
<td>12 (2.6)</td>
<td>2 (0.3)</td>
<td>&lt;.001\textsuperscript{1}</td>
</tr>
<tr>
<td>Mental disorder maternity code\textsuperscript{b}</td>
<td>29 (6.4)</td>
<td>2 (0.3)</td>
<td>&lt;.001\textsuperscript{1}</td>
</tr>
<tr>
<td>Victim of violence code\textsuperscript{c}</td>
<td>29 (6.4)</td>
<td>5 (0.8)</td>
<td>&lt;.001\textsuperscript{1}</td>
</tr>
</tbody>
</table>

\textsuperscript{*} All data are presented as n (%) with P value based on $\chi^2$ test or Fisher exact test where appropriate, except for $t$ test of mean ages.

\textsuperscript{1} Significant after Bonferroni correction for multiple comparisons.

\textsuperscript{2} $\chi^2$ test compared white women with all women of color.

\textsuperscript{a} By Fisher exact test.

### Table 2. Demographic, Psychosocial, and Obstetric Associations With Posttraumatic Stress Disorder

<table>
<thead>
<tr>
<th></th>
<th>Odds ratio (95% CI)</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (odds ratio is per year)</td>
<td>0.98 (0.95, 1.0)</td>
<td>.04</td>
</tr>
<tr>
<td>Ethnicity (reference group, white)</td>
<td>2.5 (1.8, 3.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Psychosocial screening variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Victim of violence</td>
<td>7.4 (2.7, 20.2)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Obstetric drug diagnostic code</td>
<td>7.4 (1.5, 36.8)</td>
<td>.02</td>
</tr>
<tr>
<td>Obstetric psychiatric diagnostic code</td>
<td>18.9 (4.4, 81.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Obstetric complication variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ectopic</td>
<td>1.7 (1.1, 2.8)</td>
<td>.03</td>
</tr>
<tr>
<td>Miscarriage</td>
<td>1.9 (1.3, 2.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Hyperemesis</td>
<td>3.9 (2.0, 7.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Preterm contractions</td>
<td>1.4 (1.1, 1.9)</td>
<td>.02</td>
</tr>
<tr>
<td>Excessive fetal growth</td>
<td>1.5 (1.0, 2.2)</td>
<td>.04</td>
</tr>
</tbody>
</table>

CI = confidence interval.

\textsuperscript{*} $n = 1093$.

\textsuperscript{1} Model significance $P < .001$.

\textsuperscript{2} Proportional reduction in error by $\lambda$-$p$ = 19%.
Fisher exact test, as appropriate.

comparisons.

codes, such as uterine inertia or cesarean delivery. 

and dysfunctional labor diagnostic and treatment 

oxytocin dysregulation, including postdate gestation 

conditions that were hypothesized to be related to 

and preeclampsia, did not occur at significantly 

problems that were hypothesized to be unrelated to 

the posttraumatic stress disorder group. Pregnancy 

rights between groups. There were no signifi-

cant bivariate differences between groups for some 

that were hypothesized to be related to 

and dysfunctional labor diagnostic and treatment 

codes, such as uterine inertia or cesarean delivery.

The logistic regression model (Table 2) found five of 
the hypothesized complications to be significantly asso-

ciated with posttraumatic stress disorder, after control-

ing for demographic and psychosocial factors. Women 

who had excessive vomiting were most likely to have 

been diagnosed with posttraumatic stress disorder. 

the disorder-diagnosed women were first exposed to abuse 

within 3 years of age. Second, service usage data ap-

pear to underreport posttraumatic stress disorder,

women with the posttraumatic stress disorder diagnos-

who had excessive vomiting were most likely to have 

trauma. Women with such trauma exposures as car 

accidents or house fires might be less likely to be 

triggered by and become symptomatic during preg-

nancy, making it less likely that their childbearing 

would be disrupted by posttraumatic stress. Fourth, 

women with the posttraumatic stress disorder diagnosis 

likely receive some treatment for the disorder 

that might decrease its effect on their pregnancies. 

Epidemiologic data suggest that it is likely that most 

disorder-diagnosed women were first exposed to abuse 

that might decrease its effect on their pregnancies. 

Discussion

Our findings suggest that women with posttraumatic 
stress disorder might be at higher risk for some physical 

pregnancy problems, which were predicted based on 

known behavioral and neuroendocrine sequelae of 

traumatic stress, including ectopic pregnancy, sponta-

neous abortion, hyperemesis, preterm contractions, and 

excessive fetal growth. Hypothesized labor differences 

were not confirmed in those data. No differences were 

found in complication rates that were not believed to be 

related to traumatic stress, such as preeclampsia or 

gestational diabetes.

A number of limitations of our study exist. First, 
results of this study cannot be generalized to insured 

women, although they might be relevant to the United 

States Medicaid population. Second, these existing 

service usage data appear to underreport posttraumatic 

stress disorder, which might cause underestimation of 

associations studied because undiagnosed women with 

posttraumatic stress disorder were included in the 

comparison group. It is also possible that only the most 

severely affected women were diagnosed. Third, service 

usage data provide no information about antecedent 

trauma. Women with such trauma exposures as car 

accidents or house fires might be less likely to be 

triggered by and become symptomatic during preg-
nancy, making it less likely that their childbearing 

would be disrupted by posttraumatic stress. Fourth, 

women with the posttraumatic stress disorder diagnosis 

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that might decrease its effect on their pregnancies. 

Epidemiologic data suggest that it is likely that most 

disorder-diagnosed women were first exposed to abuse

Table 3. Rates of Hospital Coding for Obstetric Complications

<table>
<thead>
<tr>
<th>Obstetric complication</th>
<th>Diagnosed group (n = 455)</th>
<th>Comparison group (n = 638)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ectopic pregnancy</td>
<td>45 (9.9)</td>
<td>36 (5.6)</td>
<td>.008*</td>
</tr>
<tr>
<td>Miscarriage</td>
<td>74 (16.3)</td>
<td>58 (9.1)</td>
<td>&lt;.001†</td>
</tr>
<tr>
<td>Sexually transmitted disease in pregnancy</td>
<td>12 (2.6)</td>
<td>11 (1.7)</td>
<td>.30</td>
</tr>
<tr>
<td>Excessive vomiting</td>
<td>39 (8.6)</td>
<td>15 (2.4)</td>
<td>&lt;.001†</td>
</tr>
<tr>
<td>Gestational diabetes</td>
<td>52 (11.4)</td>
<td>86 (13.5)</td>
<td>.31</td>
</tr>
<tr>
<td>Preterm contractions</td>
<td>138 (30.3)</td>
<td>144 (22.6)</td>
<td>.004*</td>
</tr>
<tr>
<td>Preterm delivery</td>
<td>33 (7.3)</td>
<td>35 (5.5)</td>
<td>.23</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>15 (3.3)</td>
<td>19 (3.0)</td>
<td>.77</td>
</tr>
<tr>
<td>Poor fetal growth</td>
<td>211 (46.4)</td>
<td>254 (39.8)</td>
<td>.03†</td>
</tr>
<tr>
<td>Excessive fetal growth</td>
<td>78 (17.1)</td>
<td>73 (11.4)</td>
<td>.007*</td>
</tr>
<tr>
<td>Intratuterine fetal death§</td>
<td>10 (2.2)</td>
<td>7 (1.1)</td>
<td>.214</td>
</tr>
<tr>
<td>Prolonged pregnancy</td>
<td>36 (7.9)</td>
<td>47 (7.4)</td>
<td>.74</td>
</tr>
<tr>
<td>Oxytocin induction</td>
<td>34 (7.5)</td>
<td>34 (5.5)</td>
<td>.15</td>
</tr>
<tr>
<td>Fetal distress code</td>
<td>62 (13.6)</td>
<td>114 (17.9)</td>
<td>.06</td>
</tr>
<tr>
<td>Uterine inertia</td>
<td>29 (6.4)</td>
<td>51 (8.0)</td>
<td>.31</td>
</tr>
<tr>
<td>Precipitate labor§</td>
<td>8 (1.8)</td>
<td>15 (2.4)</td>
<td>.327</td>
</tr>
<tr>
<td>Long labor</td>
<td>20 (4.4)</td>
<td>30 (4.7)</td>
<td>.81</td>
</tr>
<tr>
<td>Forceps or vacuum delivery</td>
<td>25 (5.5)</td>
<td>52 (8.2)</td>
<td>.09</td>
</tr>
<tr>
<td>Postpartum hemorrhage</td>
<td>19 (4.2)</td>
<td>16 (2.5)</td>
<td>.12</td>
</tr>
<tr>
<td>Cesarean delivery</td>
<td>68 (14.9)</td>
<td>93 (14.6)</td>
<td>.87</td>
</tr>
</tbody>
</table>

* All data are presented as n (%) with P value based on \( \chi^2 \) testing or Fisher exact test, as appropriate.
† Significant at trend level after Bonferroni correction for multiple comparisons.
‡ Significant after Bonferroni correction for multiple comparisons.
§ By Fisher exact test.
and affected by traumatic stress symptoms before pregnancy.\textsuperscript{3–7} However, given the 3-year time limit of those data, it is impossible to determine chronology with certainty. It is also possible that posttraumatic stress disorder developed in women subsequent to pregnancy. Generally, that source of error would introduce a conservative bias by diluting differences between groups because the disorder acquired after pregnancy could not logically cause complications. However, a condition such as ectopic pregnancy could be life-threatening and thus be a traumatic stressor causing a new incidence of the disorder. Post hoc determination of dates for posttraumatic stress disorder codes and ectopic pregnancy codes was done for the 45 women in the posttraumatic stress disorder group who had ectopic pregnancies. The posttraumatic stress disorder code predated the ectopic code for 32 women (71%). Posttraumatic stress disorder is a chronic recurrent condition,\textsuperscript{18} so it is likely that few, if any, of the remaining cases had new onset after ectopic pregnancy diagnoses, and thus are unlikely to significantly affect results. The question of whether traumatic stress results from some obstetric experiences is a separate question that also warrants study.

This preliminary study from existing data expands current thinking about the effect of stress in pregnancy by considering traumatic stress rather than life-event stressors, daily stress, or anxiety.\textsuperscript{19} It also differs from prior studies by considering specifically the complications that could be mediated by behavioral and neuroendocrine mechanisms among women with posttraumatic stress disorder, particularly those mediated by oxytocin.

Future research is needed to corroborate and extend our findings, examine causality, study biologic mechanisms, and identify posttraumatic stress disorder–related interventions. Prospective studies should measure trauma exposure and posttraumatic stress disorder with instruments validated for use with women.\textsuperscript{20,21} Posttraumatic stress disorder and childbearing are both complex phenomena with many likely mediating or moderating factors, such as current battering, socioeconomic stressors, life events, social support, and comorbid obstetric, medical, and psychiatric conditions. Additional moderators such as women’s coping strategies, prior or current mental health care, and client-provider alliance in maternity care should also be considered.

The preliminary data presented here point toward potentially important clinical implications. Should women’s health care providers screen for posttraumatic stress symptoms and the associated problems with eating, substance abuse, and high-risk sex, especially among women with histories of abuse or assault? There are treatments available for posttraumatic stress disorder.\textsuperscript{22} Treatment early enough to precede conception might lead to prevention of some risk behaviors and some childbearing morbidity. For gravidas with ideopathic hyperemesis or preterm contractions, posttraumatic stress disorder could be an additional differential diagnosis. Psychopharmacologic and psychologic interventions for posttraumatic stress might bring quick relief. For those women, an oxytocin antagonist might be the more effective tocolytic. Last but not least, getting mental health treatment for the mother before birth also might improve the well-being of her infant.

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Received April 3, 2000.
Received in revised form July 25, 2000.
Accepted September 21, 2000.

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