

Stressful Events During Pregnancy and Postpartum Depressive Symptoms

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Abstract

Background: Understanding the influence of perinatal stressors on the prevalence of postpartum depressive symptoms (PDS) and help-seeking for PDS using surveillance data can inform service provision and improve health outcomes.

Methods: We used Massachusetts Pregnancy Risk Assessment Monitoring System (MA-PRAMS) 2007–2010 data to evaluate associations between selected perinatal stressors and PDS and with subsequent help-seeking behaviors. We categorized 12 stressors into 4 groups: partner, traumatic, financial, and emotional. We defined PDS as reporting “always” or “often” to any depressive symptoms on PRAMS Phase 5, or to a composite score ≥ 10 on PRAMS Phase 6 depression questions, compared with women reporting “sometimes,” “rarely” or “never” to all depressive symptoms. The median response time to MA-PRAMS survey was 3.2 months (interquartile range, 2.9–4.0 months). We estimated prevalence ratios (PRs) and 95% confidence intervals (95% CIs) using modified Poisson regression models, controlling for socioeconomic status indicators, pregnancy intention and prior mental health visits.

Results: Among 5,395 participants, 58% reported ≥ 1 stressor (partner = 26%, traumatic = 16%, financial = 29% and emotional = 30%). Reporting of ≥ 1 stressor was associated with increased prevalence of PDS (PR = 1.68, 95% CI: 1.42–1.98). The strongest association was observed for partner stress (PR = 1.90, 95% CI: 1.51–2.38). Thirty-eight percent of mothers with PDS sought help. Mothers with partner-related stressors were less likely to seek help, compared with mothers with other grouped stressors.

Conclusions: Women who reported perinatal common stressors—particularly partner-related stressors—had an increased prevalence of PDS. These data suggest that women should be routinely screened during pregnancy for a range of stressors and encouraged to seek help for PDS.

Introduction

POSTPARTUM DEPRESSIVE SYMPTOMS (PDS) include feelings of sadness and hopelessness during the year after giving birth.¹ The prevalence of PDS in the United States ranges from 80% for mothers with transient “baby-blues” to 10%–15% for mothers fulfilling criteria for major postpartum depression (PPD, a major depressive episode occurring postpartum).² While studies have consistently shown an association between PPD and poor infant and child outcomes, including delayed language development and difficulty in school,^{1,3–5} studies suggest that even moderate PDS, which doesn't meet *Diagnostic and Statistical Manual of Mental*

Disorders, 4th edition, (DSM-IV) or DSM-V criteria for PPD, can have profound long-term consequences for mothers and families if left untreated, impairing mother–infant bonding and delaying children's social and cognitive development.^{1,5,6} Despite the serious consequences of PDS, 50%–80% of mothers with PDS do not seek help, even though effective treatments are available.^{1,7–11}

Depressive symptoms occur in 10%–15% of women of reproductive age in the United States.^{12,13} Although a history of major depressive episodes and other severe psychiatric illnesses such as psychosis are known risk factors for PDS,^{1,14–16} 25%–75% of women who experience PDS do not report a psychiatric history.^{1,15} Catastrophic perinatal events, such as

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trauma,^{14,17,18} terrorist attack,¹⁹ natural and man-made disasters (e.g., earthquakes, tsunamis, Chernobyl)^{20–23} are predictors of PDS for mothers in the general population. However, studies of other risk factors for PDS, including birth defects, preterm delivery, maternal employment, age, education, and mode of delivery, have been inconclusive due to differences in the populations examined, the measurement of risk factors, and the definition of PDS.^{2,24–27} Although effective treatments for PDS, including cognitive behavioral therapies and pharmacological interventions, are readily available, seeking help for PDS is still underutilized.^{28–32} By examining the associations between potential risk factors for PDS as risk factors for subsequently seeking help, clinicians and policymakers can target intervention programs to women at increased risk of PDS who may be less likely to seek treatment.

Our study assesses the association between self-reported life stressors and the development of PDS in a representative population of mothers who recently gave birth in Massachusetts during 2007–2010. We also examine the association between specific groups of life stressors and seeking help for depressive symptoms among mothers who reported PDS.

Materials and Methods

Participants and procedures

Study subjects were mothers who participated in the Massachusetts Pregnancy Risk Assessment Monitoring System (MA-PRAMS) between 2007 and 2010. PRAMS is a multistate, population-based surveillance system funded by the Centers for Disease Control and Prevention (CDC) in collaboration with state health departments. PRAMS surveys include both core questions that are administered in all participating states, and state-specific questions. PRAMS collects data on maternal experiences and behaviors that occur before, during, and after pregnancy as well as in early infancy. Details of PRAMS methodology and protocols have been published elsewhere.³³ MA-PRAMS includes questions on maternal characteristics, pregnancy intention, cigarette and alcohol use, specific stressful events, and intimate partner violence during the 12 months prior to birth and questions on birth outcomes, maternal mood, and health after birth. PRAMS participants are randomly selected between 2 and 6 months postpartum from state birth certificate information, representing approximately 3.0% of all Massachusetts women delivering a live birth during the study period. Mothers who are selected receive a mailed survey, with nonrespondents receiving follow-up mail surveys and telephone contact. The majority of mothers completed the PRAMS survey 3–4 months postpartum (median 3.2 months, interquartile range 2.9–4.0 months). To ensure adequate representation of racial/ethnic minority groups, MA-PRAMS oversamples women by race/ethnicity and has a 69.0% weighted response rate for these 4 years combined. The survey is administered in both English and Spanish. Mothers of twins and triplets have one infant randomly selected by the state's Department of Public Health to be the index infant. Mothers whose pregnancy ended in stillbirth or multiple births greater than triplets are excluded. In both MA-PRAMS 2007/2008 and 2009 Surveillance Reports,^{34,35} mothers who responded to PRAMS questionnaires were comparable to the state birth population in maternal characteristics of race/ethnicity, age, language, and marital status. The study was approved by the Institu-

tional Review Board at the Massachusetts Department of Public Health.

Exposures

PRAMS asked mothers if they had experienced 13 specific stressful events during the 12 months before their new infant was born (yes vs. no). These events were listed as: (1) mother argued with partner more than usual, (2) someone very close to mother had a bad problem with drinking/drugs, (3) partner said didn't want pregnancy, (4) separation/divorce, (5) partner or mother went to jail, (6) mother was in a physical fight, (7) moved to new address, (8) had a lot of bills mother couldn't pay, (9) partner lost job, (10) mother herself lost job, (11) mother homeless, (12) close family member sick, and (13) someone very close to mother died. Because "moved to new address" could be either a positive experience or the negative result of financial decline, we decided not to include this event in our analysis. We created a single binary (yes/no) variable for experiencing any of the remaining 12 stressful events. We also grouped the 12 stressful events into 4 categories based on the work of Ahluwalia³⁶ and utilized in the PRAMS 2008 CDC report:³⁷ partner-related (questions numbers 1, 3, 4); traumatic (2, 5, 6, and 11); financial (8–10); and emotional (12–13), with "no reported stressors" as our reference.

Outcomes

PRAMS asks mothers about their mood using a Likert-like scale with questions similar to those asked on the Patient Health Questionnaire-2 (PHQ-2) depression model,³⁸ an effective screening tool for depressive symptoms.^{39,40} PRAMS questions about PDS were modified and piloted by the Centers for Disease Control and Prevention. PRAMS Phase 5 (2007–2008) asked:

- (1) Since your new baby was born, how often have you felt down, depressed or hopeless?
- (2) Since your new baby was born, how often have you had little interest or little pleasure in doing things?

Response options were: always, often, sometimes, rarely, and never.

PRAMS Phase 6 (2009–2010) posed this question:

Below is a list of feelings and experiences that women sometimes have after childbirth. Read each item to determine how well it describes your feelings and experiences. Then write on the line the number of the choice that best describes how often you have felt or experienced things this way since your new baby was born: (A) I felt down, depressed, or sad. (B) I felt hopeless. (C) I felt slowed down.

Response options for each question (A, B, C) were on a Likert scale with never = 1, rarely = 2, sometimes = 3, often = 4, and always = 5.

Our definition of PDS was informed by component questions used to identify depression in the PHQ-2, and by the CDC (*Guidelines for Analyzing Phase 6 Core Depression Question*, unpublished report, 2012). For Phase 5 participants, we defined mothers as having PDS if they reported "always" or "often" to either question on depressive symptoms in Phase 5. As recommended by the CDC, for Phase 6 participants, we summed the scores of depression

symptom responses and defined mothers as having PDS if their depressive symptom scores ≥ 10 . To have greater comparability with Phase 5 participants, we also defined mothers as having PDS if they reported “always” or “often” to either part A or B of Phase 6 questions. Mothers who reported “sometimes/rarely/never” to all questions were our reference group. This method yields 63% sensitivity and 83% specificity for depression in Phase 5, and 56.8% sensitivity and 86.6% specificity in Phase 6, compared with the PHQ-2.

PRAMS also asks about help-seeking behavior specifically for depression:

Since your new baby was born, have you asked for help for depression from a doctor, nurse or other health care provider? Responses were “yes” or “no.”

We then examined the association between categories of stressors and seeking help among mothers with PDS.

Covariates

Informed by directed acyclic graphs, a visual tool used to help understand the relationship between variables on a causal path,⁴¹ and guided by the literature,^{27,42,43} we considered covariates that are associated with both stressful life events and PDS as potential confounders. These include mothers’ age, education, yearly family income, marital status, cigarette use in pregnancy; intimate partner violence; government-paid health care during pregnancy, delivery, and postnatally; pregnancy intention; congenital malformations; birthweight; race/ethnicity; parity; prepregnancy body mass index (BMI); infant sex; plurality (singleton vs. multiple birth); gestational age; mode of delivery; stay in neonatal intensive care unit (NICU); length of hospital stay; and mother’s prior mental health visits (available for PRAMS Phase 6).

Exclusions

Of the 5,899 mothers who completed PRAMS in 2007, 2008, 2009, or 2010, we excluded 504 mothers who had missing or implausible data on specific stressors ($n=315$) or PDS ($n=256$) variables, or whose infant had died shortly after birth, before the opportunity for completion of PRAMS ($n=40$); 5,395 mothers remained for analysis.

Data analysis

We used SUDAAN (RTI International) to account for the complex survey design of PRAMS and to obtain prevalence estimates weighted by race/ethnicity. We used modified Poisson regression models with robust error variance to estimate prevalence ratios (PR) and 95% confidence intervals (CI) for the associations between stressors and PDS,⁴⁴ and between stressors and help-seeking behavior among women with PDS. Only those potential confounders that changed the effect estimate by greater than 10% were retained in the final model, provided they were not believed to be potential causal intermediates.^{45,46} Based on these criteria, we controlled for maternal age (categories based on frequency distributions: <20, 20–24, 25–29, 30–34, ≥ 35 years); education (<high school diploma, high school diploma, some college, and completed college); family income (<\$15k, \$15k–24.9k, \$25k–49.9k, and \geq \$50k), smoking (any, none); marital status (married vs. not married); pregnancy intention (wanted pregnancy then or

sooner, wanted pregnancy later, and did not want pregnancy); and prior mental health visit (in Phase 6—mother reported prepregnancy visit for anxiety or depression, yes/no). We also controlled for calendar year because of notable secular changes during 2007–2010 including the economic decline in Massachusetts and the increased awareness of depression from mental health campaigns.⁴⁷ Among mothers who reported PDS, we used modified Poisson regression models with robust error variance to estimate the association between stressors and help-seeking behavior. Regression analyses used SAS version 9.3 (SAS Institute, Inc.).

Results

Selected baseline characteristics of mothers and their infants are presented in Table 1. Mothers who reported any stressor were more likely to be younger, unmarried, overweight or obese, smokers, and have lower education and family income than mothers who reported no stressors. Mothers who reported any stressors were also more likely to report a pregnancy intention of “later” (32.0%) or “did not want pregnancy” (8.4%) compared with mothers who reported no stressors (16.8% and 3.6% respectively). We did not observe any appreciable differences in the prevalence of stressors according to mode of delivery. Mothers excluded from analysis because of missing data or because their infant had died were more likely to have lower education, lower family income, be of Black non-Hispanic or Hispanic race/ethnicity, have three or more children, have had no prenatal care in the first trimester, or have had an infant with a birth defect compared with mothers who were included in our analysis (Supplementary Table S1; Supplementary Data are available online at www.liebertpub.com/jwh).

Frequency distributions of the 12 individual stressors and 4 categories of stressors are presented in Table 2. The prevalence of stressors ranged from 2.0% for “mother in a physical fight” to 23.1% for “family member very sick.” The prevalence of grouped stressors ranged from 16.4% for traumatic stressors to 29.8% for emotional stressors. Frequencies of specific responses to PDS questions are provided in Supplementary Table S2.

Using the combined 2007–2010 data, unadjusted and adjusted PRs for associations between stressful events and PDS are presented in Table 3. Of the 3,181 mothers with ≥ 1 stressor, 16.0% reported PDS, compared with 6.9% among the 2,214 mothers who reported no stressors. The unadjusted PR for PDS among mothers with any stressors compared with mothers without any stressors was 2.07 (95% CI: 1.78–2.40). PRs from multivariable models that adjusted for the presence of other stressors and for maternal age, education, family income, pregnancy intention, government paid care for pregnancy and/or delivery, participation in the Women, Infants, and Children (WIC) nutrition services, smoking, marital status, and intimate partner violence were attenuated. However, partner-related stressors remained significantly associated with PDS, showing nearly a two-fold increase in PDS prevalence, relative to no stressors.

Multivariable models that further adjusted for early prenatal care and calendar year showed only slight attenuation and had wide CIs (data not shown). Almost half of the mothers had between one and three stressors (47.7%), while 9.3% had four

TABLE 1. CHARACTERISTICS OF MOTHERS AND THEIR INFANTS IN MASSACHUSETTS PREGNANCY RISK ASSESSMENT MONITORING SYSTEM, 2007–2010

<i>Maternal characteristics</i>	<i>Any stressor^a</i> (n = 3,181)	<i>No stressor^a</i> (n = 2,214)	<i>PDS^a</i> (n = 806)	<i>No PDS^a</i> (n = 4,589)
Maternal age (years), mean (SE)	28.3 (0.15)	30.9 (0.15)	28.0 (0.31)	29.6 (0.12)
Maternal age (years) %				
<20	7.9	3.5	8.8	5.7
20–24	22.2	9.0	22.3	15.7
25–29	26.0	23.6	23.2	25.2
30–34	26.6	37.7	28.2	31.6
≥35	17.3	26.2	15.6	21.8
Maternal education (%)				
<High school diploma	11.7	6.6	12.8	9.1
High school diploma	32.1	17.0	34.2	24.7
Some college	22.0	14.5	20.2	18.7
Completed college	34.2	61.8	32.7	47.5
Family income (%)				
<\$15,000	27.7	11.3	34.7	18.9
\$15,000–\$24,999	11.4	5.3	12.6	8.4
\$25,000–\$49,999	19.6	12.5	15.6	16.8
≥\$50,000	41.3	70.9	37.1	56.0
Maternal race (%)				
White non-Hispanic	67.1	72.2	56.1	71.1
Black non-Hispanic	10.0	5.2	11.7	7.6
Hispanic	16.2	10.2	20.0	12.8
Asian	5.4	11.1	10.5	7.4
Other, non-Hispanic	1.3	1.1	1.7	1.1
Married (%), no	46.8	18.0	50.0	32.7
Smoking in pregnancy (%)	10.5	2.3	10.8	6.5
Pregnancy intention (%)				
Then or sooner	59.6	79.6	50.6	70.4
Later	32.0	16.8	37.8	23.9
Did not want pregnancy	8.4	3.6	11.6	5.7
Gov't paid pregnancy/delivery or WIC use ^b (%)	57.1	28.3	63.7	42.5
Parity (%)				
First born	49.7	49.3	48.8	49.7
Second born	30.8	34.7	28.3	33.0
Third or higher	19.5	16.0	23.0	17.4
Prepregnancy BMI (%)				
Underweight (<18.5)	3.8	4.5	5.3	4.0
Normal (18.5–24.9)	52.3	62.5	49.8	57.5
Overweight (25.0–29.9)	23.4	20.0	20.8	22.2
Obese (≥30.0)	20.5	12.9	24.0	16.4
No prenatal care in first trimester (%)	13.3	6.9	15.8	9.9
Cesarean delivery (%)	31.8	32.5	38.2	31.2
Intimate partner violence (%), any	2.0	n/r ^c	3.0	1.0
Depression/anxiety visit before pregnancy ^d (%)	17.7	9.8	30.2	12.4
Infant characteristics				
Infant had birth defect (%)	6.1	5.8	8.8	5.6
Gestational age < 37 weeks (%)	6.6	7.1	10.2	6.3
Birth weight < 2500g (%)	7.0	6.8	10.3	6.4
NICU stay (%)	12.5	11.5	16.7	11.5

^aPopulation-based frequencies were weighted by race/ethnicity.

^bIncludes Medicaid, Commonwealth Care, Free-Care, or WIC use during prenatal care or delivery.

^cNot reportable. Calculations based on fewer than 11 events are suppressed to maintain the privacy of data subjects per request from the Massachusetts Department of Public Health Privacy and Data Access Office.

^dQuestion in MA-PRAMS 2009–2010 surveys, total $n=2,631$; $n=1,611$ with stressor exposure, $n=1,020$ with no stressors, $n=341$ with PDS, and $n=2,290$ with no PDS.

BMI, body mass index; MA-PRAMS, Massachusetts Pregnancy Risk Assessment Monitoring System; NICU, neonatal intensive care unit; PDS, postpartum depressive symptoms, SE, standard error; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

TABLE 2. FREQUENCY OF STRESSORS, POSTPARTUM DEPRESSIVE SYMPTOMS AND HELP-SEEKING BY MA-PRAMS PHASE

<i>PRAMS stressors and PDS prevalence</i>	<i>All mothers (N = 5,395)^a</i>	<i>2007–2008 Phase 5 (N = 2,764)^a</i>	<i>2009–2010 Phase 6 (N = 2,631)^a</i>
Any of 12 stressors (%)	58.4	56.7	60.0
Partner related stressors—arguing included (%)	26.3	26.6	25.8
Argued with partner more than usual	22.0	22.3	21.6
Separation/divorce	6.5	6.1	6.7
Partner didn't want pregnancy	7.4	7.5	7.2
Partner-related stressors—arguing excluded	11.4	11.5	11.3
Traumatic stressors (%)	16.4	15.5	17.3
Someone close had alcohol/drug problem	12.3	11.5	13.2
Mother in a physical fight	2.0	2.1	2.0
Mother or partner went to jail	2.5	2.9	2.0
Homeless	3.2	2.8	3.5
Financial stressors (%)	29.0	26.9 ^b	31.2 ^b
Had bills could not pay	19.9	19.2	20.5
Partner lost job	11.9	9.4 ^b	14.5 ^b
Mother lost job	8.4	8.3	8.3
Emotional stressors (%)	29.8	28.4	31.2
Family member very sick	23.1	21.3	24.4
Someone close died	16.2	15.8	16.6
Number of stressors (%)			
1–3 Stressors	47.7	46.7	48.7
4–6 Stressors	9.3	8.4 ^b	10.4 ^b
≥7 Stressors	1.3	1.7	1.0
PDS (%)	12.3 ^c	12.7 ^d	11.8 ^e

^aPopulation-based frequencies were weighted by race/ethnicity.

^bDifference in prevalence between Phase 5 and Phase 6 $p < 0.03$.

^cUnweighted $n = 806$.

^dUnweighted $n = 465$.

^eUnweighted $n = 341$.

to six stressors, and 1.3% had seven or more stressors. We observed a strong dose–response relationship between the number of stressors reported by mothers and PDS prevalence. In the adjusted models, PRs were 1.54 (95% CI: 1.30–1.84) for 1–3 stressors, 2.39 (95% CI: 1.92–2.99) for 4–6 stressors, and 3.50 (95% CI: 2.58–4.75) for ≥7 stressors, each compared with

no stressors. PRs and 95% CIs for the associations between stressors and PDS stratified by phase of MA-PRAMS are presented in Supplementary Table S3. Although PRs for Phase 6 mothers with ≥1 stressor were higher than PRs for Phase 5 mothers, among the grouped stressors the PRs were similar and have overlapping confidence intervals.

TABLE 3. ASSOCIATION BETWEEN PERINATAL STRESSORS, PDS PREVALENCE AND HELP-SEEKING BEHAVIORS AMONG 2007–2010 MA-PRAMS MOTHERS

	<i>n (%)^a</i>	<i>% With PDS^a</i>	<i>Unadjusted PR (95% CI)</i>	<i>Adjusted PR^b (95% CI)</i>	<i>Among PDS, % sought help^a</i>	<i>Adjusted PR^c (95% CI)</i>
No stressor ^d	2,214 (41.6%)	6.9	1.00 (reference)	1.00 (reference)	27.2%	1.00 (reference)
Any stressor	3,181 (58.4%)	16.0	2.07 (1.78–2.40)	1.68 (1.42–1.98)	41.4%	2.25 (1.87–2.71)
Group of stressors ^e						
Partner	1,599 (26.3%)	23.1	2.79 (2.39–3.26)	1.90 (1.51–2.38)	40.8%	1.21 (0.96–1.51)
Trauma	845 (16.4%)	21.7	2.79 (2.34–3.32)	1.13 (0.78–1.63)	43.2%	1.39 (1.10–1.77)
Financial	1,701 (29.0%)	20.5	2.38 (2.03–2.79)	1.22 (0.94–1.57)	48.1%	1.53 (1.21–1.94)
Emotional	1,445 (29.7%)	13.9	1.92 (1.61–2.28)	1.05 (0.81–1.36)	45.9%	1.40 (1.13–1.74)
1–3 Stressors	2,578 (47.7%)	13.1	1.72 (1.47–2.02)	1.54 (1.30–1.84)	38.9%	1.52 (1.09–2.10)
4–6 Stressors	518 (9.3%)	27.2	3.26 (2.71–3.93)	2.39 (1.92–2.99)	39.8%	1.79 (1.20–2.65)
≥7 Stressors	85 (1.3%)	43.3	5.26 (4.07–6.80)	3.50 (2.58–4.75)	75.7%	2.84 (1.86–4.36)

^aPopulation-based frequencies were weight by race/ethnicity.

^bAdjusted for other grouped stressors and maternal age, education, family income, pregnancy intention, government paid pregnancy care/WIC use, smoking, marital status, and intimate partner violence.

^cAdjusted for other grouped stressors.

^dReference group for all analyses.

^eSubjects may have stressors in more than one group; therefore % may total more than 100.

CI, confidence interval; PR, prevalence ratio.

TABLE 4. ASSOCIATION BETWEEN INDIVIDUAL STRESSORS AND PREVALENCE OF SEEKING HELP AMONG PRAMS-MA MOTHERS REPORTING PDS, 2007–2010

	<i>Sought help^{a,b} (%)</i>	<i>Unadjusted PR (95% CI)</i>	<i>Adjusted PR^c (95% CI)</i>
No stressor ^d	27.2	1.00 (reference)	1.00 (reference)
Partner related stressors			
Argued with partner more than usual	41.3	1.70 (1.26–2.29)	1.23 (0.85–1.78)
Separation/divorce	39.6	1.82 (1.28–2.58)	1.19 (0.60–2.35)
Partner did not want pregnancy	34.7	1.57 (1.10–2.25)	1.35 (0.64–2.82)
Traumatic stressors			
Someone close had alcohol/drug problem	43.8	2.10 (1.52–2.91)	1.56 (0.92–2.65)
Mother in a physical fight	55.4	2.40 (1.66–3.48)	1.45 (0.56–3.77)
Mother or partner went to jail	51.2	2.09 (1.36–3.20)	2.07 (0.82–5.23)
Homeless	52.5	1.93 (1.31–2.84)	1.95 (1.03–3.69)
Financial stressors			
Had bills couldn't pay	52.3	2.06 (1.53–2.77)	2.06 (1.43–2.98)
Partner lost job	41.0	1.64 (1.16–2.34)	1.21 (0.64–2.29)
Mother lost job	41.7	1.69 (1.19–2.40)	1.16 (0.68–2.96)
Emotional stressors			
Family member very sick	47.2	2.05 (1.50–2.80)	1.86 (1.26–2.73)
Someone close died	46.6	1.90 (1.36–2.63)	1.18 (0.69–2.02)

^aPopulation-based frequencies were weighted by race/ethnicity.

^bAmong mothers with PDS.

^cAdjusted for other stressors.

^dReference group for all analyses.

Mothers with a history of mental health conditions are at an increased risk of developing PDS,^{14,48–50} and such a history may increase the risk of stressful life events, meeting our criteria for a potential confounding variable. Beginning with Phase 6, MA-PRAMS asked about mother's prior mental health using the question, "Did you visit a health care worker to be checked or treated for depression or anxiety? yes/no." Although mothers with a prior report of a mental health visit had higher prevalence of PDS compared with mothers without a prior report, the PRs for the association between stressors and PDS were similar between the two groups (Supplementary Table S4).

Nearly half of the mothers with PDS reported a partner-related (49.6%) or financial-related (48.6%) stressor. While 94.2% of mothers reported having a postpartum checkup, less than half of all mothers (38.8%) with PDS who experienced any of the categories of stressors discussed their depressive symptoms at the postpartum visit or sought help for their PDS (Table 3). The PRAMS question regarding mental health help seeking specifically asked about seeking help for depression. Moreover, the question was not limited to care sought from a mental health provider, but included care from any doctor, nurse or other health professional.

Among mothers with partner-related stressors, only 40.8% sought help, and among mothers with traumatic stressors, less than half (43.2%) sought help. In our adjusted models, trauma, financial, and emotional stressors were associated with help-seeking behavior, while the association between partner stressors—experienced by more than one in four mothers—and help-seeking behavior for PDS had wide confidence intervals. Mothers with ≥ 4 stressors were more likely to seek help than were mothers with 1–3 stressors. While in unadjusted models, each of the individual stressors was initially associated with an increase in seeking help, controlling for the presence of other stressors mitigated the associations between stressors and help seeking except "homeless" and "had bills that I couldn't pay" (Table 4).

We also investigated whether mothers who had reported prior mental health service utilization would be more likely to seek help for their PDS compared with mothers who had no such history. While mothers with a prior mental health visit had a higher prevalence of seeking help for PDS, we observed little difference in association of stressors with help-seeking behavior in the models that stratified on prior mental health visits (Supplementary Table S4).

Discussion

In this population-based study representative of Massachusetts mothers who gave birth during 2007–2010, we found (1) a positive association between the report of more than one life stressor and certain groups of stressors during the perinatal period, and the prevalence of PDS, showing a dose-response relationship with the prevalence of PDS increasing as the number of stressors increases; and (2) a positive association between the report of certain groups of stressors with help-seeking behavior for PDS.

Our findings of an association between life stressors and PDS are consistent with the literature on stress and mood dysregulation during the peripartum period. In a 2004 study of mothers in British Columbia, Dennis et al. found that the report of life stressors within 12 months of giving birth to be a robust predictor of developing postpartum depression.⁴² However, this study restricted the assessment of depressive symptoms to one week postpartum. In an earlier study of 131 Canadian first-time mothers, Seguin et al. found that chronic stressors, life events, and lack of social support were significantly associated with depressive symptomatology in the third and ninth weeks postpartum.⁴³

These findings from the social sciences are supported by biological studies of stress and cortisol.^{51–53} Prolonged stress can alter neuroplasticity, contributing to reduction in size of both the hippocampus and prefrontal cortex, areas that are

involved in memory and concentration.⁵⁴ Furthermore, prolonged stress can increase amygdala activity, affecting mood, and has been associated with elevated corticotrophin releasing hormones and elevated cortisol and corticosteroid levels.^{55,56}

Our second finding contributes to the nascent literature on the association of stressors and seeking help for PDS. Examples of barriers to help seeking for depressive symptoms in the literature include perception that primary health care providers lack training and skills in mental health,^{9,10,57–59} lack of insight into patient's state-of-mood,¹¹ stigma,^{11,60,61} and lack of services.⁶²

The prevalence of financial-related stressors, particularly "partner lost job" and the association between mothers with financial-related stressors and seeking help for PDS both increased in the 2009–2010 PRAMS compared with 2007–2008 reports. These increases coincide with both the national economic downturn, which, for Massachusetts, bottomed out in 2009, and with an increase in awareness of depression, in part due to media campaigns by such groups as Families for Depression Awareness.⁴⁷ A history of depression or anxiety is a known risk factor for PDS, however, when we adjusted for previous mental health visits, our estimates of association persisted.

Herrick found that, among mothers with PDS, a greater proportion of mothers who reported that their partner did not want the pregnancy sought help, compared with mothers who reported that their partner wanted the pregnancy.⁸ Bennett et al found that mothers were more likely to seek help if the topic was broached first by their prenatal caregiver, and black mothers were more likely to seek help compared with white mothers.⁹

Inconsistencies in predictors occur across age groups, and reflect variations in geographic region (urban versus rural), education, race/ethnicity, and parity, as well as family income and relationship status with partner/father of baby. In Massachusetts, health care insurance has been mandatory since 2007,⁶³ including parity with mental health needs. Mothers who do not have or cannot afford private insurance are eligible for medical insurance through MassHealth/Commonwealth Care. Results after further adjustment for access to medical care via starting prenatal care in the first trimester and having a postpartum checkup were not appreciably different from the results of the model without these covariates, suggesting that access to pregnancy-related medical care was not a strong confounder of our results.

Report of a prior mental health visit indicates that a mother had insight, access, and willingness to seek help. However, even if a mother has sought mental health care prior to pregnancy, this does not equate with current ability to seek care. An overburdened mother may not make time to seek mental health care, even if she has insurance to help pay for services. Mothers suffering from clinical depressive symptoms such as psychomotor retardation or reduced concentration may be so burdened by these depressive symptoms that they are unable to utilize mental health services. Other, nonfinancial obstacles including work-related, partner-related, distance from clinic, and childcare stressors may further reduce access to postpartum care. Access to prenatal medical care is likely to differ from access to mental health care. For many women, pregnancy-related care is their sole form of contact with the health care system. Thus, after their 6-week postpartum

checkup, these women no longer have routine contact with medical services. Moreover, several studies suggest that some mothers feel that obstetrical care is not an appropriate venue for seeking mental health care, even though these providers can direct mothers to appropriate care.^{9,29,58,59}

Our study has strengths and limitations. Our study used a population-based survey, which was weighted to be representative of all mothers who recently gave birth while living in Massachusetts. PRAMS had a 69.0% weighted response rate for these 4 years combined. With no exposure or outcome data for nonrespondents, we could not directly evaluate the influence of selection bias. If participation was lower among mothers with PDS as well as among mothers experiencing ≥ 1 stressors, then our observed PR would be underestimated. Because the majority of PRAMS surveys were completed within 4 months postpartum, some mothers who reported not experiencing PDS at the time of PRAMS may have subsequently developed or recognized these symptoms. This would have led to underascertainment of cases and potentially a conservative PR if misclassification was influenced by exposure or if the specificity of outcome classification was less than 100%. However, studies indicate that the vast majority of mothers who develop PDS have symptoms by 3 months postpartum.^{64–66}

If PDS case ascertainment was not influenced by stress exposure (i.e., nondifferential and independent), then misclassification would likely bias our results toward the null, suggesting a stronger PR than what we observed. We lacked measures of severity, frequency, or duration of each stressor (i.e., the nature or timing of a family member's illness or death or duration of unemployment) and thus had no measure of the stress level that these exposures would contribute.

PRAMS was used to ascertain both exposure and outcome data, increasing the possibility of dependent misclassification (e.g., if some women are more likely to overreport both PDS and arguing with their partner). However, we evaluated the potential impact of dependent error in our data using quantitative bias analysis software (developed by Lash and colleagues)^{67,68} by looking for rates of dependent error that would lead a null association to appear as the data we observed in our study. Even in cases where we assumed that the rate of dependent misclassification was 15% (i.e., if 15% of nonexposed noncases were erroneously coded as exposed cases, or if 15% of cases erroneously reported exposure due to their case status), the true association between exposure and outcome would still be positive. We chose a definition of PDS that included debilitating symptoms but did not require a clinical diagnosis. Because it is unlikely for mothers to report depressive symptoms in the absence of these symptoms, we think it is unlikely for the 15% threshold of dependent misclassification to have been reached. Furthermore, the PRAMS questions related to depression are very similar to those questions asked in a clinical setting, which also rely on self-report from the patient. In addition, 11 of the 12 PRAMS stressor items are concrete events (i.e., lost job, partner went to jail) from which mothers are unlikely to suffer recall bias.

Our study adds to the growing literature documenting an association between pre- and perinatal stressors and the development of PDS using population-based data. Stressful events in the perinatal period were common in our cohort: more than half of all mothers reported at least one specified stressors, and one out of five reported at least three stressors.

The prevalence of PDS in our study (12.3%) is consistent with nationally reported PDS prevalence estimates,^{1,37} suggesting that our findings might extend to populations in other states. In agreement with other studies,^{25,48,49} the association between pre- and perinatal stressors and PDS persisted among young mothers (<20 years), mothers with low family income (<\$15k) and mothers with less than a high school diploma, suggesting that our findings may apply to a larger population.

The report of common life stressors during pregnancy was strongly associated with an increased prevalence of PDS, with the strongest association seen for partner-related stressors, the most common stressor. However, mothers who experienced partner-related stressors were also the least likely to seek help for their PDS. This is an important public health finding because mothers are still in frequent contact with health care professionals during pregnancy and early postpartum, providing opportunities for monitoring mood and early intervention for mothers experiencing partner-related stressors. Such mothers may need additional encouragement and support to seek help.

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