Pregnancy Intention and Postpartum Depressive Symptoms:
An Analysis of PRAMS Data


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**Abstract**

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*Background:* Understanding the effect of pregnancy intention on the prevalence of postpartum

depressive symptoms (PPDS) and the influence of discussing depression risk during prenatal care can

inform prenatal care provision and improve maternal and child health outcomes.

*Objective:* The aims of the study were to measure the association between pregnancy intention and

PPDS and to assess how this association is modified by the dissemination of postpartum depression

information during pregnancy.

*Methods:* We conducted a population-based cross-sectional study using a sample of 140,011 births in

the United States. Using Center for Disease Control and Prevention (CDC) Pregnancy Risk Assessment

Monitoring System (PRAMS) data from 2009-2012, we compared those with PPDS (N=17,800) to those

without PPDS (N=122,211). We defined pregnancy intention using the categories "wanted then",

"wanted sooner", "wanted later", "did not want then or at any time in the future", and "was not sure",

as well as collapsed into 3 groups (unintended, mistimed, and intended). PPDS was defined by reporting

"always" or "often" to any depressive symptoms on PRAMS Phase 7, or to a composite score ≥ 10 on PRAMS Phase 6 depression questions, compared with women reporting "sometimes, "rarely", or "never" to all depressive symptoms. We estimated prevalence ratios (PRs) and 95% confidence intervals (95% CIs) using Poisson regression, controlling for marital status, maternal education, insurance status, and secular year.

*Results:* Unintended pregnancy was significantly associated with PPDS, showing a nearly two-fold increase in prevalence of PPDS relative to those with an intended pregnancy (aPR: 1.92, 95% CI: 1.78, 2.08). Women with an unintended pregnancy who did not talk to their health care worker about depression during their pregnancy were more likely to have postpartum depression than those with an intended pregnancy (aPR: 2.05, 95% CI: 1.81-2.33). This risk was attenuated for women with unintended pregnancy who did talk to their health care worker about postpartum depression, compared to women whose pregnancy was intended (aPR: 1.45, 95% CI: 1.31-1.61).

*Conclusions:* Unintended pregnancy is one of many factors that contribute to the risk of developing postpartum depression. Women with unintended pregnancy have an increased risk of developing postpartum depressive symptoms, and discussing the risk of developing depression during prenatal care reduces this risk. The data suggest that providers should routinely discuss risk of postpartum depression with women, especially those whose pregnancy was unintended.

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**Introduction**

Postpartum depression is the most common complication of childbirth, with a prevalence of 13% among women of reproductive age, and a prevalence that is twice as high for adolescent mothers[1]. The Diagnostic and Statistical Manual of Mental Disorders (DSM) does not recognize postpartum depression to be a unique disorder. Rather, women with postpartum depression meet the diagnostic criteria for a major depressive episode with a modifier for perinatal onset. Cases occur soon after delivery or up to a year later, with most occurring within the first 3 months of the postpartum period. While the features of depression in the postpartum period are not different from those experienced at other times during a woman's life course, the focus of the depressive symptoms is often on the infant or role of motherhood. For example, feelings of inadequacy might focus on inability to cope with caring for the infant or excessive worry about the infant's health. Postpartum depression can be self-limiting, resolving within a few months of onset. However, for many women, childbirth may trigger the start of recurrent or chronic episodes of depressive disorder[1]. Compared to unaffected mothers, women suffering from postpartum depression exhibit reduced sensitivity and responsiveness to their infants, as well as reduced healthy feeding and poor sleeping practices[2]. As a result, the children of affected mothers can experience impaired attachment, behavioral problems, social and cognitive limitations, and low self-esteem[3]. Therefore, postpartum depression and depressive symptoms can have serious implications for the health of both mother and child.

Known risk factors for postpartum depression include previous history of mental illness, young age, low educational attainment, and low socioeconomic status[1,3]. While a history of major depressive episodes or other severe psychiatric illness is a known risk factor for developing postpartum depression, 50% of women who experience postpartum depressive symptoms do not report a psychiatric history[4]. Experiencing stressful life events or having low levels of social support during pregnancy have also been implicated in the development of postpartum depression[1].

Each year, about 50% of pregnancies in the U.S. are unintended, with 60% of them resulting in a live birth[5]. Unintended pregnancy may increase the likelihood of anxiety or stress during pregnancy, therefore increasing the risk for developing postpartum depression. The vulnerability-stress model of psychosocial risk outlined by Bernazzani et al (2005) contains three domains of risk or protective factors for postpartum depression: stressful life events, social support, and maternal feelings/adaptation[6]. While pregnancy itself can be a stressful event, a pregnancy that is unintended, and thus unexpected, may be even more stressful. Additionally, the unintended pregnancy may have resulted from a stressful period of time that led the woman or couple to be inconsistent with their contraceptive use. A woman's level of social support for her pregnancy may vary, depending on how her feelings about the pregnancy differ from her partner's, her family's, or her friends' feelings[7]. Women who have become pregnant unintentionally may garner less support from their otherwise supportive network. Furthermore, women who have planned their pregnancy may be quicker to adapt to the new social role and demands of motherhood than women with an unintended or unplanned pregnancy.

Experts increasingly recognize that pregnancy intention should be categorized into three groups-unwanted, mistimed, and intended. Maxson et al (2011) assert that these three categories more appropriately identify "intention phenotypes" than the dichotomized categories do, and that women in these three groups may respond differently to their pregnancies and have distinct characteristics[8]. These differences may have implications for the development of postpartum depression. Neither of the two prior studies of pregnancy intention and post-partum depression described below used this approach in classifying pregnancy intention.

Previous research has found elevated risks of postpartum depression among women reporting an unintended pregnancy, but the results have not been statistically significant. Abbasi et al (2013) and Mercier et al (2013) conducted secondary analyses of data from prospective pregnancy cohorts in Pennsylvania and North Carolina, respectively. Abbasi et al assessed pregnancy intention at 17-21 weeks

of gestation, and found that 32% of the pregnancies in their sample were unintended. Postpartum depressive symptoms were measured at one month postpartum using the Edinburgh Postnatal Depression Scale (EPDS), with 5.1% of the women in the sample above the threshold for postpartum depression. Controlling for pre-pregnancy depression/anxiety, age, race, education, marital status, and poverty, the authors did not find a statistically significant association between unintended pregnancy and postpartum depression at one month postpartum (adjusted OR: 1.41, 95% CI: 0.91, 2.18). The assessment of depression at one month postpartum may not be a long enough period of time for women to develop depressive symptoms, as evidenced by the low prevalence estimate reported. Additionally, their sample was mostly comprised of white, married, and highly educated women aged 18-35 in Pennsylvania, which limits the generalizability of their findings beyond traditionally low risk groups.

Mercier et al (2013) questioned participants about pregnancy intention at 15-19 weeks of gestation, finding that 36% of the women in their sample reported an unintended pregnancy. They then used the EPDS to screen women for depression at three months postpartum, reporting a point prevalence of 7% for postpartum depressive symptoms at this time point. The authors found no association between unintended pregnancy and the development of postpartum depression by three months postpartum, after adjusting for age, poverty, and education (adjusted RR: 1.2, 95% CI: 0.6, 2.1). Similar to Abbasi et al, their study sample was comprised of women receiving prenatal care at the University of North Carolina in Chapel Hill, who were mostly white, married women with a mean age of 29.4 years and a mean income of 423% FPL, which may limit generalizability to other populations of women. The fact that these studies both grouped mistimed and unintended pregnancies together may have obscured a significant association between unintended pregnancy and postpartum depressive symptoms.

Depression screening during pregnancy has been promoted as a way to potentially reduce postpartum depressive symptoms and improve maternal and child health outcomes by identifying and treating undiagnosed depression that would otherwise go untreated or be treated at a more severe stage[11]. However, screening is not a standard practice among providers, and thus many womens' depression goes undiagnosed. Discussion between providers and pregnant women about mental health concerns and the risk of developing postpartum depression may help providers to effectively target new mothers and new mothers to identify symptoms early in the postpartum period and receive appropriate help.

This study aimed to explore the association between pregnancy intention and postpartum depressive symptoms among women in the United States. We conducted a population-based cross-sectional study using multistate Center for Disease Control and Prevention (CDC) Pregnancy Risk Assessment Monitoring System (PRAMS) data from 2009-2012. Specifically, we aimed to:

1. *Primary aim:* Measure the association between pregnancy intention and postpartum depressive symptoms.

2. *Secondary aim:* Assess how dissemination of postpartum depression information modifies the association between pregnancy intention and postpartum depressive symptoms.

**Methods**

*Study Design and Subjects*

We conducted a population-based cross-sectional study using PRAMS data from 2009-2012 in states with response rates ≥ 65%. PRAMS is a national surveillance system of new mothers conducted annually by the CDC and state health departments. It is designed to monitor self-reported behaviors, health care use, and morbidities of women before, during, and after pregnancy. The PRAMS survey is sent by mail to a random sample of new mothers two to six months post-delivery, and telephone follow-up is undertaken for women who do not return the mailed survey. The survey data are linked to

extracted birth certificate data items to aid analysis and are weighted for sample design, non-response, and non-coverage. Demographic characteristics are collected from the birth certificate and from the PRAMS questionnaire. PRAMS data can be used to produce statewide estimates of the prevalence of various perinatal health behaviors and experiences among women who delivered a live infant. PRAMS has a minimum overall response rate threshold policy for the release of data, so data from all 41 participating states/cities were not available. The 31 states and 1 city included in our study were AK, AR, CO, DE, GA, HI, IL, MA, MD, ME, MI, MN, MO, MS, NE, NJ, NM, NY, NYC, OH, OK, OR, PA, RI, TN, TX, UT, VT, WA, WI, WV, and WY. Different PRAMS questionnaires, called Phases, have been administered during different years. Phase 7 is the most recent iteration of questions, and the year 2012 is the only year available from this phase so far. Data from the years 2009-2011 correspond to the Phase 6 questionnaire. We used data from both Phases 6 and 7. Of the 148,317 women who completed PRAMS from 2009-2012, we excluded 8,306 mothers for whom data were missing for the pregnancy intention (31%) or postpartum depressive symptom questions (69%).

*Exposure*

The exposure, pregnancy intention, was assessed by response to the following PRAMS question: "Thinking back to just before you got pregnant with your new baby, how did you feel about becoming pregnant?" Those who responded "I wanted to be pregnant then" or "I wanted to be pregnant sooner" were classified as intended pregnancies. Those who responded, "I wanted to be pregnant later" were classified as mistimed pregnancies. Those who responded "I didn't want to be pregnant then or at any time in the future" were classified as unintended pregnancies. A fifth response option was "I wasn't sure what I wanted".

*Outcome*

The outcome, postpartum depression (PPDS), was ascertained from PRAMS questions that reflect core symptoms of an episode of major depressive disorder, according to DSM 5 (12). The PPDS

questions changed between Phase 6 and Phase 7. For Phase 6, women were asked three PPDS questions about how they felt since their baby was born: "I felt down, depressed, or sad", "I felt hopeless", and "I felt slowed down." Response options included "always," "often," "sometimes, "rarely," or "never," corresponding to numeric scores of 5, 4, 3, 2, 1. PPDS was defined as a composite score ≥ 10 for the 3 questions.

In Phase 7, women were asked the two core depression symptom questions from the PHQ-9: "Since your new baby was born, how often have you felt down, depressed, or hopeless?" and "Since your new baby was born, how often have you had little interest or little pleasure in doing things?" The PHQ-2 has been validated and is used widely[20]. Response options included "always," "often," "sometimes, "rarely," or "never," corresponding to numeric scores of 5, 4, 3, 2, 1. The time frame of the PRAMS PPDS questions and the PHQ-2 depression screener differ; the PHQ-2 asks only about the last two weeks. We defined PPDS as reporting "always" or "often" to any depressive symptoms, compared with women reporting "sometimes, "rarely", or "never" to all depressive symptoms.

*Covariates*

Other risk factors for development of postpartum depressive symptoms that were examined include pregnancy stressors and depression/anxiety evaluation before pregnancy. The potential effect modifier was determined from the answer to the following question on the PRAMS survey: "During any of your prenatal care visits, did a doctor, nurse, or other health care worker do any of the things listed below?" The response "What to do if I feel depressed during my pregnancy or after my baby is born" allowed us to stratify women into one of two categories based on whether or not they received information about the risk of developing depression.

*Data Analysis*

We used StataMP version 13.1 to account for the complex survey design of PRAMS, by describing the PRAMS primary sampling unit, finite population correction, sampling scheme, and

weighting variable to the analysis software. We used Poisson regression models to estimate the prevalence ratio and 95% confidence interval (CI) for the association between unintended pregnancy and postpartum depressive symptoms. We examined potential confounders that are associated with both pregnancy intention and postpartum depression, including maternal age group (<20, 20-24, 25-34, 35+), maternal race/ethnicity (White Non-Hispanic, Black Non-Hispanic, Hispanic, Asian/Pacific Islander, Native American), maternal education (high school degree or less, high school graduate, more than high school), insurance status (Medicaid, non-Medicaid), and marital status (married, other). Other variables that were examined included pregnancy stressors (financial, emotional, partner, traumatic), pre-pregnancy BMI, cigarette use during pregnancy, parity, infant in NICU, infant with birth defect, low birth weight infant, preterm infant, method of delivery, number of prenatal care visits, month of first prenatal care visit, Kotelchuck index, and pre-pregnancy check or treatment for depression or anxiety. Confounders that changed the effect estimate by 10% or more were retained in the final model.

The pregnancy intention question has changed between Phase 6 and Phase 7, with the addition of a fifth answer choice "I wasn't sure what I wanted" in Phase 7. Because the comparability between the Phases is uncertain, we conducted sensitivity analyses to assess the impact of this additional answer choice and of the categorization of answer choices. Additionally, we examined as a potential effect modifier whether or not during her pregnancy the mother was given information about what to do if she were to become depressed during the peripartum period. We also conducted mediation sub-analyses of key pregnancy stressors, such as partner not wanting the pregnancy or arguing with the partner more than usual during pregnancy.

**Results**

Selected baseline characteristics of mothers and their infants are presented in Table 1. Mothers who reported PPDS were more likely to be younger, on Medicaid, unmarried, smokers, less educated, and to have experienced intimate partner violence. These women were also more likely to have higher

numbers of pregnancy stressors, lower utilization of prenatal care, and to have been checked or treated for depression or anxiety prior to their pregnancy. Additionally, women with PPDS were more likely to report that they did not want their pregnancy or that they wanted their pregnancy later, and less likely to report that they wanted their pregnancy then or sooner. Their infants were more likely to have a low birth weight or be born preterm. Missing data for most variables was less than 5%, with the exception of number of prenatal care visits, prenatal care in 1st trimester, and Kotelchuck index. For these variables, the proportion of data missing was slightly higher for those with PPDS. Among the total sample, 11.1% of women reported PPDS, and 9.6% reported an unintended pregnancy, i.e., they didn't want a pregnancy then or any time in the future.

Using the combined 2009-2012 data, unadjusted and adjusted prevalence ratios for associations between unintended pregnancy and postpartum depressive symptoms are presented in Table 2. Among the women with unintended pregnancies, 19% also reported PPDS, while 13% reported PPDS among those with mistimed pregnancies and 8% reported PPDS among those with intended pregnancies. The unadjusted PR for PPDS among mothers with an unintended pregnancy compared to mothers with an intended pregnancy was 2.28 (95% CI: 2.13, 2.46). PRs from multivariate models that adjusted for confounders (marital status, maternal education, and insurance status) and secular year were attenuated. Unintended pregnancy remained significantly associated with PPDS, showing a nearly two-fold increase in prevalence of PPDS relative to those with an intended pregnancy (aPR: 1.92, 95% CI: 1.78, 2.08).

Tables 3 and 3a demonstrate the sensitivity analysis for Phase 6 (2009-2011). When the pregnancy intention groups are no longer collapsed into three categories (intended, unintended, mistimed), the association between unintended pregnancy and postpartum depression is strengthened among the group that "Did not want" the pregnancy (unintended), as well as among the "Later" (mistimed) group.

Tables 4, 4a, and 4b demonstrate the sensitivity analysis for Phase 7 (2012). As shown in Table 4a, adding the "not sure" pregnancy intention category did not change the effect sizes of the associations between pregnancy intention and PPDS. Women who were "Not sure" about their pregnancy intention had a 1.70 (95% CI: 1.46-1.98) times higher likelihood of PPDS than those with an intended pregnancy, which falls between the associations for the mistimed and unintended groups, closer to unintended. However, when the pregnancy intention choices are not collapsed into three categories, the association between unintended pregnancy and PPDS is strengthened among the group that "Did not want" the pregnancy (unintended), as well as among the "Later" (mistimed) group.

Women with postpartum depressive symptoms were less likely to have talked with their healthcare worker about depression (Table 1). As shown in Table 5, among women who did not talk with their health care worker about risk of depression during pregnancy, those with unintended pregnancy were twice as likely to have PPDS as those with an intended pregnancy (aPR: 2.05, 95% CI: 1.81-2.33). This risk was lower for women with unintended pregnancy who did talk with their health care worker about depression during their pregnancy (aPR: 1.45, 95% CI: 1.31-1.61). Controlling for prenatal care utilization in this model did not change the effect size.

Women reporting postpartum depressive symptoms were more likely to have a partner who did not want the pregnancy, and were more likely to have argued with their partner more than usual during their pregnancy. Adjusting for partner's feelings about the pregnancy attenuated the association between unintended pregnancy and postpartum depressive symptoms (aPR: 1.72, 95% CI: 1.59-1.87). Adjusting for stress related to arguing with one's partner also attenuated the association (aPR: 1.65, 95% CI: 1.53-1.78).

**Discussion**

In this population-based study representative of U.S. mothers who gave birth during 2009-2012, we found a positive association between the report of unintended pregnancy and the prevalence of

PPDS, with women reporting an unintended pregnancy having a nearly two times higher risk of PPDS. As these data are cross-sectional, we cannot state that this is a causal relationship; it is possible that women with unintended pregnancies had depression prior to their pregnancy. However, we controlled for other major risk factors for PPDS, such as maternal education and insurance status (proxy for socioeconomic status). Additionally, women with PPDS were more likely to have been checked or treated for depression prior to their pregnancy. The prevalence of PPDS we found indicates that these women either had not fully recovered from or received treatment for their previous depression, or that they developed a new episode of depression, in addition to capturing women who were newly suffering from depressive symptoms in the postpartum period.

We also found that categorization of the pregnancy intention variable affected the association with PPDS. Past research by Maxson et al (2011) recommend that pregnancy intention be collapsed into three groups (unintended, intended, and mistimed), with women who wanted their pregnancy "Then" and women who wanted their pregnancy "Sooner" both being categorized as "Intended"[8]. We found that including the women who wanted their pregnancy "Sooner" in the "Intended" group weakens the magnitude of effect sizes, as the "Sooner" group is actually more similar to the "Mistimed" group. This indicates that pregnancy timing, rather than intent to become pregnant, is a more important predictor of depressive symptoms in the postpartum period. Women who wanted their pregnancy to happen sooner were 1.43 times more likely to report PPDS (95% CI: 1.22-1.67) than those who reported wanting their pregnancy to happen then, indicating that having a delayed intended pregnancy has similar effects on women's mental health as having a premature intended pregnancy. Adding a fifth "Not sure" group did not impact the overall effect sizes. This group had a higher risk of PPDS than those who wanted their pregnancy "Later" and "Then", but a lower risk of PPDS than those who reported they "Did not want" their pregnancy. The option to state an unsure pregnancy intention may be responsible for the fact that

there was a smaller proportion of unintended pregnancies and that the association between unintended pregnancy and PPDS was weaker in 2012 compared to 2009-2011.

Furthermore, we found that discussing the risk of developing depression with a health care worker reduced the risk of PPDS associated with having an unintended pregnancy by 30%. Women with low prenatal care attendance were not less likely to have talked with their health care worker about depression, and thus lower prenatal care utilization among women with unintended pregnancy was not responsible for this finding. Dissemination of postpartum depression information may be particularly effective among women at higher risk of developing postpartum depression, such as those who have an unintended pregnancy.

These results indicating a positive, statistically significant association between unintended pregnancy and PPDS differ from that previously reported in the literature. Previous research conducted by Mercier et al (2013) and Abbasi et al (2013) showed non-significant, positive associations of smaller magnitude between unintended pregnancy and PPDS[9,10]. Our sample size was much larger than these past studies, which may have provided us with more power to detect significant results. Additionally, as we found that collapsing pregnancy intention categories into 3 groups attenuated the association between unintended pregnancy and PPDS compared to expanded categorization, these authors may have found smaller associations due to their collapsing of the intention categories into just two groups (unintended and intended). Our results indicate that, had they not collapsed their categories and obscured differences between different "intention phenotypes"[8], they may have found stronger associations between unintended pregnancy and PPDS.

In the two prior studies samples were restricted to mostly white, highly educated women from a single state, while the PRAMS sample was economically and racially diverse and representative of women in 31 states and NYC. The prevalence of PPDS in our PRAMS study was higher (11.1% vs. 5.1% and 7%), but the percent of women with unintended pregnancies was markedly lower (9.6% vs 32% and

36%) than in the prior studies. Abbasi et al (2013) grouped "Later" and "Did not want" pregnancy intentions as "unintended", while Mercier et al (2013) grouped "mistimed" and "unwanted" pregnancies as "unintended". When we grouped our data this way, we found the prevalence of unintended pregnancy to be 40% in our sample. This broader definition of "unintended" contributes to the higher prevalence found in these studies.

Pregnancy stressors such as lack of partner support for the pregnancy and stress related to arguing with one's partner attenuated the association between unintended pregnancy and PPDS. It is possible that an unintended pregnancy could lead to reduced social support as well as increased conflict in the relationship, causing higher levels of stress that contribute to PPDS. This could be especially true if these pregnancy stressors also contributed to other risk factors for unintended pregnancy, such as lower household income or single parenthood. That these pregnancy stressors attenuated the association between unintended pregnancy and PPDS is consistent with the idea that these factors are likely mediators along the causal pathway. Because this is a cross-sectional study, and directionality is uncertain, mediation cannot be established. This could be assessed better in a longitudinal study.

PRAMS is a weighted representation of all recent mothers in participating states in an attempt to ensure a study population representative of the entire U.S. While the data are weighted for nonresponse, noncoverage, and sampling design, there is the potential for differential missingness of data, as participants who do not respond or return questionnaires with questions skipped may differ from those with complete data. Those with postpartum depression may be more or less likely to skip the PPDS questions or to return the survey, and we do not have data on these women to assess the extent of missing data. As those with PPDS and those without PPDS were equally likely to skip the pregnancy intention questions, the association is not biased due to differential missing data for pregnancy intention information. We also had limited information about prior medical and psychiatric history and

treatments. In addition, we lacked information on severity, frequency, and duration of pregnancy stressors, as well as strength of support network or partner attitudes towards pregnancy.

An important consideration for the study of this association is that the measure of exposure—unintended pregnancy—is dependent on self-report and participant recall. However, PRAMS is the only source of population-based data on the prevalence of unintended pregnancy among women having a live birth in most states. Additionally, pregnancy intendedness is an inherently subjective measure, and thus any studies measuring this exposure would be subject to these same concerns. Since the information about pregnancy intention is collected after the birth, it is possible that, retrospectively, responses will be affected by the arrival of the baby. If misreporting pre-delivery pregnancy intention postpartum is differential for depressed and non-depressed mothers, results may be biased. Studies of retrospective pregnancy intention have found that 80% of women do not change their pregnancy intention status from during pregnancy to postpartum[18-19]. However, the likelihood of reporting a birth as intended tends to increase over time and is also likely to be influenced by external social and situational factors.

While PRAMS only includes 2 questions measuring postpartum depressive symptoms, these questions are similar to those asked on the PHQ-2 depression screener, which has been validated as an effective screening tool for depressive symptoms[4]. Studies have determined the feasibility of using 2-item screening scales to identify women at risk for postpartum depressive and anxiety disorders[13], with the two depression items in the PRAMS questionnaire yielding 83% specificity, 63% sensitivity, and positive predictive value of 55%. Due to the relatively low prevalence of depression and anxiety, high specificity is particularly important to achieve precise estimates of prevalence[13]. The CDC adapted the questions as a surveillance tool for self-reported postpartum depression on PRAMS[14]. Previous critiques of PRAMS data usage for studying postpartum depression centered around the fact that it is difficult to ascertain prior history of depression and thus, residual confounding may be large and may obscure any

true association. However, other studies, such as one by Rich-Edwards et al (2006), have examined socioeconomic predictors of postpartum depression and have concluded that "unwanted pregnancy remained associated with antenatal depression" among women with no history of mental illness, which suggests that the risks associated with unintended pregnancy are not solely artifacts of pre-pregnancy depression symptoms[15]. Additionally, as PRAMS is administered 2-6 months postpartum, it is possible that we will miss women who do not develop postpartum depression until later in the postpartum period, biasing our results towards the null, as fewer cases of depression will have been captured. However, studies have demonstrated that most women develop symptoms between six weeks[16] and three months postpartum[17].

**Conclusion**

We conducted a population-based study using a representative sample of PRAMS data to ascertain the association between pregnancy intention and postpartum depressive symptoms among U.S. women from 2009-2012. Unintended pregnancy is one of many factors that contribute to the risk of developing postpartum depression. We found that women with unintended pregnancy have an increased risk of developing postpartum depressive symptoms, and discussing the risk of developing depression during prenatal care reduces this increased risk. The large sample size and population-based nature of the study enabled us to have better power for detecting significant associations and to assess the association in a diverse and generalizable population of U.S. women. Our results suggest that providers should routinely discuss risk of postpartum depression with women, especially those whose pregnancy was unintended. Discussing the risks and possibility of developing postpartum depression during the perinatal period may help women to better navigate the social role transition to motherhood, as well as reduce negative affective and cognitive symptoms and ensure improved long-term health for both mother and child.

## Tables

**Table 1: Characteristics of women in the U.S. 2-6 months post-delivery with or without postpartum depressive symptoms (PPDS), 2009-2012 (N=140,011)** [†]

| Maternal Characteristics | Phase 6 (N=111092) | | | | Phase 7 (N=28919) | | | |
|---|---|---|---|---|---|---|---|---|
| | PPDS n=13855 (11.0%) | | No PPDS n=97237 (89.0%) | | PPDS n=3945 (11.5%) | | No PPDS n=24974 (88.5%) | |
| | n | % | n | % | n | % | n | % |
| Age (years) | | | | | | | | |
| <20 | 1524 | 11.4 | 8723 | 9.0 | 479 | 11.7 | 1776 | 6.1 |
| 20-24 | 3611 | 28.0 | 21932 | 22.0 | 1077 | 27.8 | 5125 | 20.0 |
| 25-29 | 3570 | 28.6 | 27694 | 29.2 | 1046 | 27.0 | 7288 | 30.2 |
| 30-34 | 2647 | 21.3 | 23734 | 25.5 | 851 | 22.4 | 6907 | 28.0 |
| ≥35 | 1648 | 10.7 | 15149 | 14.4 | 492 | 11.1 | 3877 | 15.8 |
| Race/ethnicity | | | | | | | | |
| White Non-Hispanic | 7382 | 60.2 | 50115 | 59.5 | 1675 | 55.1 | 12687 | 62.1 |
| Black Non-Hispanic | 2279 | 14.8 | 14219 | 13.3 | 748 | 17.7 | 3329 | 12.8 |
| Hispanic | 1738 | 18.3 | 13709 | 19.3 | 511 | 14.2 | 3572 | 15.2 |
| Asian | 617 | 3.2 | 6990 | 4.7 | 424 | 7.9 | 2054 | 5.8 |
| Native American | 426 | 1.0 | 2235 | 0.7 | 118 | 1.3 | 558 | 0.8 |
| Hawaiian/Alaskan Native | 200 | 0.3 | 1641 | 0.3 | 78 | 0.5 | 549 | 0.4 |
| Mixed/Other Race | 531 | 2.3 | 3347 | 2.3 | 226 | 3.4 | 1008 | 2.8 |
| Education | | | | | | | | |
| Less than High School | 2505 | 18.9 | 14398 | 16.0 | 749 | 19.7 | 3343 | 13.1 |
| High School | 4277 | 30.5 | 25092 | 25.3 | 1246 | 30.9 | 6014 | 23.0 |
| Some College | 3996 | 28.8 | 26145 | 26.4 | 1125 | 28.8 | 6891 | 27.6 |
| College or More | 2893 | 21.8 | 30546 | 32.3 | 755 | 20.6 | 8403 | 36.3 |
| Insurance status | | | | | | | | |
| Medicaid | 3556 | 23.8 | 18674 | 17.4 | 1325 | 31.3 | 5269 | 18.6 |
| Non-Medicaid | 10285 | 76.2 | 78434 | 82.6 | 2604 | 68.7 | 19658 | 81.4 |
| Number of previous live births | | | | | | | | |
| 0 | 5627 | 39.2 | 41702 | 41.9 | 1650 | 42.5 | 10463 | 41.1 |
| 1 | 4157 | 32.1 | 29836 | 32.0 | 1106 | 29.2 | 7756 | 32.5 |
| 2 | 2244 | 16.6 | 14967 | 15.7 | 655 | 16.6 | 3877 | 16.0 |
| 3-5 | 1610 | 11.2 | 9481 | 9.7 | 467 | 10.9 | 2554 | 9.4 |
| 6+ | 143 | 0.9 | 785 | 0.8 | 45 | 0.9 | 220 | 0.9 |
| Marital status | | | | | | | | |
| Married | 6910 | 49.6 | 59821 | 62.3 | 1871 | 47.0 | 15490 | 64.1 |
| Other | 6928 | 50.5 | 37352 | 37.7 | 2072 | 53.0 | 9471 | 35.9 |
| Smoking in pregnancy | | | | | | | | |
| Yes | 2834 | 18.5 | 11094 | 9.3 | 669 | 16.5 | 2308 | 8.5 |
| No | 10932 | 81.5 | 85636 | 90.7 | 3205 | 83.5 | 22286 | 91.5 |
| Pregnancy intention | | | | | | | | |
| Wanted later | 5082 | 37.8 | 29702 | 31.5 | 1143 | 30.0 | 6005 | 23.4 |
| Wanted sooner | 2287 | 15.1 | 18499 | 18.0 | 516 | 12.4 | 3506 | 13.9 |
| Wanted then | 4002 | 29.2 | 39543 | 41.5 | 1106 | 28.3 | 10513 | 44.0 |
| Did not want then or any time in future | 2484 | 17.9 | 9493 | 9.1 | 426 | 10.0 | 1525 | 6.0 |
| Was not sure (Phase 7 only) | | | | | 754 | 19.3 | 3425 | 12.6 |
| Vaginal delivery | | | | | | | | |
| Yes | 8231 | 62.9 | 62865 | 67.7 | 2516 | 67.8 | 16465 | 68.7 |
| No | 5606 | 37.1 | 34209 | 32.4 | 1418 | 32.3 | 8444 | 31.3 |
| Number of prenatal care visits | | | | | | | | |
| 8 or Fewer | 3816 | 23.0 | 20028 | 18.7 | 997 | 20.7 | 4890 | 17.6 |
| 9-11 | 3875 | 31.2 | 29578 | 32.4 | 1123 | 30.3 | 7706 | 32.5 |
| 12 or More | 5469 | 45.8 | 43493 | 49.0 | 1620 | 49.1 | 11257 | 49.9 |
| Missing | 695 | 5.4 | 4138 | 4.8 | 205 | 5.4 | 1121 | 5.0 |
| Checked (or treated [Phase 6]) for depression/anxiety before pregnancy | | | | | | | | |
| Yes | 3744 | 25.0 | 10885 | 10.2 | 1208 | 28.1 | 4206 | 15.9 |
| No | 10029 | 75.0 | 85812 | 89.8 | 2710 | 71.9 | 20592 | 84.1 |
| Talked with health care worker about depression | | | | | | | | |
| Yes | 8875 | 67.3 | 68603 | 71.6 | 2629 | 68.2 | 17600 | 72.5 |

| | n | % | n | % | n | % | n | % |
|---|---|---|---|---|---|---|---|---|
| No | 4663 | 32.7 | 26910 | 28.4 | 1196 | 31.8 | 6833 | 27.5 |
| **Pregnancy stressors** | | | | | | | | |
| 0 | 1808 | 14.4 | 29625 | 31.4 | 643 | 16.6 | 7400 | 31.8 |
| 1-2 | 4554 | 34.4 | 41656 | 43.1 | 1255 | 32.6 | 10376 | 40.6 |
| 3-5 | 5038 | 35.2 | 21280 | 21.3 | 1414 | 35.6 | 5716 | 22.2 |
| 6 or More | 2422 | 16.3 | 4473 | 4.3 | 608 | 15.2 | 1364 | 5.5 |
| **Prenatal care 1st trimester** | | | | | | | | |
| Yes | 10132 | 78.2 | 75164 | 82.0 | 2867 | 78.7 | 19375 | 83.6 |
| No | 2587 | 21.8 | 15184 | 18.1 | 752 | 21.3 | 3740 | 16.4 |
| Missing | 1136 | 8.7 | 6889 | 7.9 | 326 | 10.1 | 1859 | 8.9 |
| **Intimate partner violence** | | | | | | | | |
| Yes | 1210 | 8.8 | 2345 | 2.2 | 263 | 7.2 | 506 | 1.8 |
| No | 12462 | 91.2 | 93735 | 97.8 | 3628 | 92.8 | 24199 | 98.2 |
| **Kotelchuck index** | | | | | | | | |
| Inadequate | 1931 | 15.5 | 10659 | 12.4 | 553 | 14.0 | 2715 | 11.2 |
| Intermediate | 1472 | 13.1 | 11293 | 12.9 | 414 | 11.4 | 2842 | 13.0 |
| Adequate | 4790 | 41.4 | 39463 | 46.3 | 1444 | 42.8 | 10290 | 47.0 |
| Adequate Plus | 5026 | 30.1 | 31916 | 28.4 | 1346 | 31.8 | 8059 | 28.8 |
| Missing | 636 | 4.9 | 3906 | 4.5 | 188 | 5.1 | 1068 | 4.8 |
| **Infant Characteristics** | **n** | **%** | **n** | **%** | **n** | **%** | **n** | **%** |
| **Birth defect** | | | | | | | | |
| Yes | 326 | 1.1 | 1665 | 0.9 | 52 | 0.5 | 290 | 0.5 |
| No | 13277 | 98.9 | 94165 | 99.1 | 3797 | 99.5 | 24210 | 99.5 |
| **Low birth weight (<2500 g)** | | | | | | | | |
| Yes | 4951 | 10.1 | 24046 | 6.8 | 1150 | 10.0 | 5390 | 6.6 |
| No | 8857 | 89.9 | 72934 | 93.2 | 2779 | 90.0 | 19470 | 93.4 |
| **NICU stay** | | | | | | | | |
| Yes | 3841 | 15.1 | 18764 | 11.6 | 944 | 14.7 | 4606 | 11.3 |
| No | 861 | 84.9 | 77683 | 88.5 | 2930 | 85.3 | 20060 | 88.7 |
| **Preterm birth (<37 weeks)*** | | | | | | | | |
| Yes | 4166 | 12.0 | 19110 | 8.6 | 966 | 11.5 | 4382 | 8.3 |
| No | 654 | 88.1 | 77906 | 91.4 | 2967 | 88.5 | 20511 | 91.7 |
| **Infant alive** | | | | | | | | |
| Yes | 12792 | 97.9 | 94923 | 99.6 | 3689 | 98.2 | 24291 | 99.7 |
| No | 835 | 2.1 | 766 | 0.4 | 171 | 1.9 | 188 | 0.3 |
| **Multiple gestations** | | | | | | | | |
| Single | 12697 | 97.6 | 90406 | 98.1 | 3668 | 97.8 | 23139 | 98.1 |
| Twin | 778 | 2.4 | 3915 | 1.8 | 163 | 2.2 | 914 | 1.8 |
| Other multiple | 27 | 0.1 | 148 | 0.1 | 3 | 0.0 | 30 | 0.0 |

*Clinical estimate of gestational age
†Missing data < 5% unless otherwise noted

**Table 2: Association between pregnancy intention and postpartum depressive symptom (PPDS) status among women 2-6 months post-delivery in the U.S., 2009-2012 (N=135,832)**

| | PPDS n=17,046 | | | | | |
|---|---|---|---|---|---|---|
| | n | % | Unadjusted PR | 95% CI | Adjusted PR[†] | 95% CI |
| **Pregnancy Intention** | | | | | | |
| Unintended (N=13,928) | 2,910 | 19.3 | 2.28* | 2.13-2.46 | 1.92* | 1.78-2.08 |
| Mistimed (N=41,932) | 6,225 | 13.2 | 1.56* | 1.47-1.65 | 1.33* | 1.24-1.41 |
| Intended (N=79,972) | 7,911 | 8.4 | 1.00 | *-ref-* | 1.00 | *-ref-* |

[†]Adjusted for confounders: maternal education, insurance status, marital status; adjusted for secular year
*p-value<0.05


**Table 3: Association between pregnancy intention (collapsed into 3 categories) and postpartum depressive symptom (PPDS) status among women 2-6 months post-delivery in the U.S., 2009-2011 (N=111,092)**

| | PPDS n=13,855 | | | | | |
|---|---|---|---|---|---|---|
| | n | % | Unadjusted PR | 95% CI | Adjusted PR[†] | 95% CI |
| **Pregnancy Intention** | | | | | | |
| Unintended (N=11,977) | 2,484 | 19.6 | 2.32* | 2.14-2.51 | 1.99* | 1.83-2.17 |
| Mistimed (N=34,784) | 5,082 | 12.9 | 1.53* | 1.43-1.63 | 1.36* | 1.23-1.42 |
| Intended (N=64,331) | 6,289 | 8.4 | 1.00 | *-ref-* | 1.00 | *-ref-* |

[†]Adjusted for confounders: maternal education, insurance status, marital status; adjusted for secular year
*p-value<0.05


**Table 3a: Association between pregnancy intention (not collapsed) and postpartum depressive symptom (PPDS) status among women 2-6 months post-delivery in the U.S., 2009-2011 (N=111,092)**

| | PPDS N=13,855 | | | | | |
|---|---|---|---|---|---|---|
| | n | % | Unadjusted PR | 95% CI | Adjusted PR[†] | 95% CI |
| **Pregnancy Intention** | | | | | | |
| Did not want (N=11,977) | 2,484 | 19.6 | 2.30* | 1.93-2.73 | 2.11* | 1.93-2.31 |
| Later (N=34,784) | 5,082 | 12.9 | 1.84* | 1.63-2.09 | 1.41* | 1.30-1.52 |
| Sooner (N=20,786) | 2,287 | 9.4 | 1.35* | 1.15-1.57 | 1.22* | 1.11-1.33 |
| Then (N=43,545) | 4,002 | 8.0 | 1.00 | *-ref-* | 1.00 | *-ref-* |

[†]Adjusted for confounders: maternal education, insurance status, marital status; adjusted for secular year
*p-value<0.05


**Table 4: Association between pregnancy intention (collapsed into 3 categories) and postpartum depressive symptom (PPDS) status among women 2-6 months post-delivery in the U.S., 2012 (N=24,740)**

| | PPDS n=3,191 | | | | | |
|---|---|---|---|---|---|---|
| | n | % | Unadjusted PR | 95% CI | Adjusted PR[†] | 95% CI |
| **Pregnancy Intention** | | | | | | |
| Unintended (N=1,951) | 426 | 17.8 | 2.12* | 1.80-2.50 | 1.62* | 1.35-1.93 |
| Mistimed (N=7,148) | 1,143 | 14.3 | 1.70* | 1.52-1.90 | 1.33* | 1.17-1.51 |
| Intended (N=15,641) | 1,622 | 8.4 | 1.00 | *-ref-* | 1.00 | *-ref-* |

[†]Adjusted for confounders: maternal education, insurance status, marital status; adjusted for secular year
*p-value<0.05

**Table 4a: Association between pregnancy intention (collapsed into 3 categories, new group added) and postpartum depressive symptom (PPDS) status among women 2-6 months post-delivery in the U.S., 2012 (N=28,919)**

| | PPDS n=3,945 | | | | | |
|---|---|---|---|---|---|---|
| | n | % | Unadjusted PR | 95% CI | Adjusted PR[†] | 95% CI |
| **Pregnancy Intention** | | | | | | |
| Unintended (N=1,951) | 426 | 17.8 | 2.30* | 1.93-2.73 | 1.64* | 1.37-1.95 |
| Not sure (N=4,179) | 754 | 16.6 | 2.15* | 1.87-2.47 | 1.55* | 1.35-1.78 |
| Mistimed (N=7,148) | 1,143 | 14.3 | 1.84* | 1.63-2.09 | 1.35* | 1.19-1.52 |
| Intended (N=15,641) | 1,622 | 8.4 | 1.00 | -ref- | 1.00 | -ref- |

[†]Adjusted for confounders: maternal education, insurance status, marital status; adjusted for secular year
*p-value<0.05

**Table 4b: Association between pregnancy intention (not collapsed, new group added) and postpartum depressive symptom (PPDS) status among women 2-6 months post-delivery in the U.S., 2012 (N=28,919)**

| | PPDS n=3,945 | | | | | |
|---|---|---|---|---|---|---|
| | n | % | Unadjusted PR | 95% CI | Adjusted PR[†] | 95% CI |
| **Pregnancy Intention** | | | | | | |
| Did not want (N=1,951) | 426 | 17.8 | 2.30* | 1.93-2.73 | 1.80* | 1.49-2.16 |
| Not sure (N=4,179) | 754 | 16.6 | 2.15* | 1.87-2.47 | 1.70* | 1.46-1.98 |
| Later (N=7,148) | 1,143 | 14.3 | 1.84* | 1.63-2.09 | 1.48* | 1.29-1.69 |
| Sooner (N=4,022) | 516 | 10.4 | 1.35* | 1.15-1.57 | 1.43* | 1.22-1.67 |
| Then (N=11,619) | 1,106 | 7.8 | 1.00 | -ref- | 1.00 | -ref- |

[†]Adjusted for confounders: maternal education, insurance status, marital status; adjusted for secular year
*p-value<0.05

**Table 5: Association between pregnancy intention and postpartum depressive symptom (PPDS) status by those who did and did not talk with their health care worker (HCW) during prenatal care about PPD among women 2-6 months post-delivery in the U.S., 2009-2012 (N=133,271)**

| Did not talk with HCW  (N=38,492) | | | | | Talked with HCW (N=94,779) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PPDS (n=5,647) | | | | | PPDS (n=10,995) | | | | |
| | n | % | aPR[†] | 95% CI | | n | % | aPR[†] | 95% CI |
| **Pregnancy Intention** | | | | | **Pregnancy Intention** | | | | |
| Unintended (N=3,949) | 949 | 23.4 | 2.05* | 1.81-2.33 | Unintended (N=9,495) | 1,826 | 17.2 | 1.45* | 1.31-1.61 |
| Mistimed (N=10,709) | 1,933 | 15.0 | 1.34* | 1.21-1.49 | Mistimed (N=30,348) | 4,158 | 12.4 | 1.06 | 0.97-1.16 |
| Intended (N=23,834) | 2,765 | 9.5 | 1.00 | -ref- | Intended (N=54,936) | 5,011 | 7.9 | 1.00 | -ref- |

[†]Adjusted for confounders: maternal education, insurance status, marital status; adjusted for secular year
*p-value<0.05

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