Are Maternal Depression or Symptom Severity Associated With Breastfeeding Intention or Outcomes?

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Objective: Breastfeeding confers many health benefits to mothers and infants, while depression negatively affects mothers and infants. The aims of this study were to determine relationships between (1) major depressive disorder (MDD) and depressive symptom severity during pregnancy and breastfeeding intention; (2) MDD and depressive symptom severity during pregnancy and breastfeeding initiation and status at 2 and 12 weeks; and (3) serotonin reuptake inhibitor (SRI) use and breastfeeding intention, initiation, and status at 2 and 12 weeks.

Method: Women were followed prospectively from pregnancy through 12 weeks postpartum for infant feeding intention (breast, breast and formula, formula, and uncertain), feeding practices and MDD (Structured Clinical Interview for *DSM-IV* Disorders), and depressive symptom severity (Hamilton Depression Rating Scale). Bivariate analyses and multivariable regression modeling were conducted. The study was conducted from July 2004 to September 2007.

Results: Study participants (intention n = 168, initiation n = 151, 2 weeks n = 137, 12 weeks n = 103) were well educated (63% college degrees), older (49% ≥ 31 years), and predominantly white (77%). At enrollment, 23% had MDD, 21% had significant depressive symptoms, and 16% were taking an SRI. Neither MDD nor depressive symptom severity in pregnancy was related to breastfeeding intention, initiation or duration at 2 and 12 weeks. Intention to exclusively breastfeed was the most significant predictor of breastfeeding initiation and duration. SRI use in pregnancy was negatively associated with breastfeeding intention. SRI use at 2 weeks was negatively associated with 12-week breastfeeding status.

Conclusion: Pregnancy is the optimal time to intervene to increase breastfeeding rates. Future research should identify strategies to overcome breastfeeding barriers posed by SRI use.

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Breastfeeding is a public health priority in the United States.[1,2] It provides ideal nutrition for infants, confers numerous short and long term health benefits for mothers and infants,[2,3] and promotes mother-infant attachment.[4,5] According to a meta-analysis published by The Agency for Health Care Research and Quality (AHRQ),[6] in developed countries, breastfeeding decreases women's risk of developing Type 2 diabetes and breast and ovarian cancers and decreases infants' risk of ear infections, diarrheal illnesses, pneumonia, asthma, obesity, and leukemia.

Major depressive disorder (MDD) during pregnancy or postpartum may negatively impact breastfeeding practices. Maternal MDD, which occurs in 12%–14% of postpartum women,[7] is associated with a variety of adverse outcomes in exposed children, such as insecure or weak attachment, failure-to-thrive, obesity, developmental delay, and lower IQ.[8–11] MDD may also negatively impact women's breastfeeding intention and practices. Young black women in the United States are the least likely to breastfeed[12] and also have high rates of postpartum MDD.[13]

Major depressive disorder may interfere with breastfeeding because depressed women lack energy and miss infant feeding cues. On the other hand, it is possible that difficulties with breastfeeding, which occur in up to 14% of motivated and committed women,[14] contribute to the development of depression, particularly among women with a high investment in breastfeeding. Biologic studies suggest that breastfeeding compared to formula feeding is associated with a reduced stress response,[15,16] reduced perceived stress, and positive mood.[17] While these studies and the stress-reducing properties of the lactational neuropeptides (oxytocin and prolactin) in experimental animals are compelling,[18,19] there is also evidence that postpartum depression precedes breastfeeding cessation.[20,21]

The published literature regarding the relationship between maternal MDD and breastfeeding is limited and contradictory.[21–29] Some findings suggest that depressive symptoms are associated with lower rates of breastfeeding initiation,[20,24,30,31] earlier breastfeeding cessation[22,23,26,32] or both,[24] while others do not confirm these associations.[25,28] In a systematic review of the literature in this area, Dennis and McQueen[29] reported that "women with depressive symptomatology in the early postpartum period may be at increased risk for negative infant-feeding outcomes including decreased breastfeeding duration, increased breastfeeding difficulties, and decreased levels of breastfeeding self-efficacy."[29(pe736)] The AHRQ report noted that "more investigation will be

needed to determine the nature of the association" between postpartum depression and breastfeeding and suggested that published studies have a number of methodological limitations.[33(p7)] Prior studies used maternal self-reported depressive symptoms scales such as the Edinburgh Postnatal Depression Scale[22,30,34–39] or the Center for Epidemiologic Studies Depression Scale.[40–42] None used diagnostic criteria for MDD or clinician administered depressive symptom scales. Infant feeding data were retrospective and any level of breastfeeding was considered rather than categorization of breastfeeding as exclusive or partial. Breastfeeding intention, a strong predictor of actual breastfeeding,[43] was not considered and few studies controlled for covariates associated with either breastfeeding or depression, such as smoking, prior experience, and obesity. The AHRQ report concluded that "…it is plausible that depression led to early cessation of breastfeeding, as opposed to breastfeeding altering the risk of depression. Both effects might occur concurrently."[33(p131)]

Peripartum antidepressant use has also increased over the past decade.[44,45] Up to 8% of women are prescribed an antidepressant during pregnancy; therefore it is important to understand how this impacts breastfeeding intention and practices.[44] Published reports, including a meta-analysis, have summarized the relative safety of breastfeeding for infants whose mothers take a serotonin reuptake inhibitor (SRI).[46,47] Despite these reports, exposure to antidepressants is the most common reason doctors call a Teratogen Information Service related to lactation.[48] Like doctors, women also have hesitations about combining medications and breastfeeding; studies suggest that women are hesitant to take an antidepressant when breastfeeding, even when provided with education.[49–52]

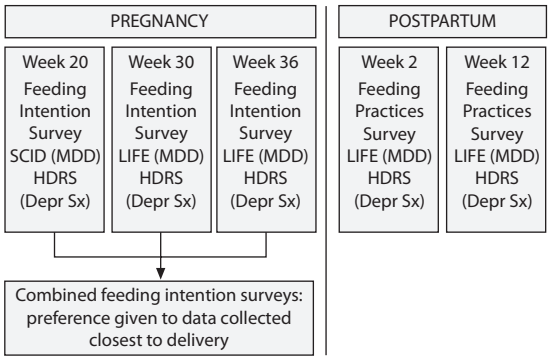
Using a design to address limitations of prior studies, our objectives were to determine the relationships between (1) MDD and depressive symptoms during pregnancy and breastfeeding intention; (2) MDD and depressive symptoms during and after pregnancy and breastfeeding initiation and status at 2 and 12 weeks postpartum; and (3) use of SRI and breastfeeding intention, initiation, and breastfeeding status at 2 and 12 weeks postpartum. We hypothesized that (1) women with MDD in pregnancy would be less likely to intend to breastfeed. (2) Among women who intended to breastfeed, women with MDD during pregnancy or postpartum would be less likely to be fully breastfeeding at 2 and 12 weeks. (3) Women taking an SRI during pregnancy or postpartum would be less likely to intend to breastfeed and be less likely to be breastfeeding at 2 and 12 weeks.

METHOD

Overall Design and Sample Description

Women aged 16 to 45 years were enrolled by 20 weeks' gestation into a naturalistic study of MDD (MH R01 060335; K.L.W., principal investigator) and were followed longitudinally through pregnancy to 2 years postpartum. Women were recruited by radio and print advertisements, posters in obstetrical offices, referrals from community obstetricians, family physicians and psychiatrists, and by solicitation during pregnancy ultrasound appointments. Data from study visits at 20, 30, and 36 gestational weeks and 2 and 12 weeks postpartum are included in this report. The initially defined study groups included (1) physically healthy women who were taking an SRI during pregnancy for treatment of MDD, (2) pregnant women who had MDD at the time of enrollment and did not have gestational antidepressant exposure, and (3) women with no current major psychiatric disorder and no antidepressant treatment. Women in this observational study were not randomly assigned to treatment. Women with untreated or inadequately treated MDD were encouraged to seek treatment during pregnancy. Women with bipolar disorder, drug abuse or dependence, methadone therapy, and HIV (human immunodeficiency virus) infection were excluded. Details of the parent study and reasons for inclusion and exclusion criteria were previously published.[53] Figure 1 provides an overview of the study design and data collected at each visit. The study, conducted from July 2004 to September 2007, was approved by the University of Pittsburgh Institutional Review Board. Study participants provided written informed consent.

Figure 1. Overall Study Design and Key Variables Collected at Each Visit



Abbreviations: Depr Sx = depressive symptoms, HDRS = Hamilton Depression Rating Scale, LIFE = Longitudinal Interval Follow-Up Evaluation, MDD = major depressive disorder, SCID = Structured Clinical Interview for *DSM-IV* Disorders.

Depression Status

Terminology regarding depression is often inconsistent. In this article, MDD is major depressive disorder as defined in *DSM-IV*.[54] This may occur during pregnancy or postpartum. Depressive symptoms are monitored to assess depression severity and response to treatment over time. Maternal depression, the broadest of terms, refers to either MDD or depressive symptoms either during pregnancy or postpartum.

In this study, we evaluated the association between infant feeding intention, initiation, and breastfeeding status at 2 and 12 weeks and 2 indices of depression, (1) a clinical diagnosis of MDD and (2) a clinician administered depressive

symptom severity scale. Although MDD and depressive symptoms are related, many women have significant depressive symptoms but do not meet criteria for MDD.

At study enrollment, women were evaluated with the Structured Clinical Interview for *DSM-IV* Disorders (SCID).[54] Based on the SCID, women were defined as meeting or not meeting diagnostic criteria for MDD at enrollment. At subsequent visits, the SCID Longitudinal Interval Follow-Up Evaluation[55] was used to determine the MDD diagnosis status during the interval period. Women's depressive symptom severity was assessed at each visit using the 17-item Hamilton Depression Rating Scale (HDRS). Because a diagnosis of MDD requires a minimum of 2 weeks of high depressive symptoms, there were women with high symptom levels who did not meet criteria for MDD. Conversely, because women can experience substantial symptom level fluctuations, particularly as the episode resolves, not all women with MDD reported high symptom levels. Women with MDD who were medicated reported lower symptoms and improved function compared to women with MDD who did not take an SRI.[53]

For the intention models, depression indices at study enrollment were included. For 2-week breastfeeding models, depression indices at enrollment, delivery, and the 2-week postpartum visit were included. For 12-week breastfeeding models, depression indices at enrollment, delivery, and 2- and 12-week postpartum visits were included.

Among study participants who took an antidepressant during pregnancy or postpartum, all took a selective serotonin reuptake inhibitor (SSRI) (n = 38) or serotonin norepinephrine reuptake inhibitor (n = 4) and 2 also took bupropion.

Breastfeeding Intention

A feeding intention survey, created for this study, was completed at each pregnancy visit (20, 30, and 36 weeks). The survey was used to assess women's infant feeding intention. Consistency in women's responses to feeding intention items over the 3 pregnancy interviews was assessed. Among the 71% of women who completed more than 1 feeding intention survey, 90% reported the same intention across all of their responses and fewer than 3% changed from any breastfeeding to no breastfeeding or vice versa. Given the consistency of responses across pregnancy, a single response for each item was determined using the following rules. If 1 intention survey was completed, the responses from that survey were used. If more than 1 survey was completed, responses on the survey completed closest to delivery were used.

Women's infant feeding intention was grouped as intend to breastfeed only (exclusive), combine breast and formula feed (partial), formula feed only, or unsure. Women's certainty about their feeding choice was explored with the following 3 items (response choices in parentheses after each item): (1) "Which of the following best describes how *sure* you are of your choice?" (I am definite in my choice, I am pretty sure that my choice is right for me and my baby, I am still considering both options, and I haven't even thought about this issue). (2) "If you are considering breastfeeding, how *determined* are you to breastfeed your baby?" (not at all determined, somewhat determined, determined, and very determined). (3) "If you are considering breastfeeding, how *confident* are you that you can breastfeed your baby?" (not at all confident, somewhat confident, confident, and very confident). Because of skewed responses toward very sure, very determined and very confident, responses to each item were dichotomized as follows: definite/not definite, very determined/not very determined, and very confident/not very confident.

Breastfeeding Initiation and Duration

Self-report feeding practice surveys were completed at 2 and 12 weeks postpartum. To assess breastfeeding initiation, the first item asked was, "Did you ever try to breastfeed your baby, even one time?" Women who responded yes, indicating breastfeeding initiation, also completed items to assess duration of exclusive and partial breastfeeding. Clinicians also recorded women's infant feeding practices during study visits, including the proportion of feedings that were breast milk. The survey and clinician breastfeeding data were combined to determine breastfeeding status. When clinician and survey data were not entirely consistent (< 3% inconsistent), preference was given to the self-report survey.

For initiation status, only women who intended to breastfeed or were unsure of their intentions and had initiation data were included. Women were grouped into never breastfed versus initiated breastfeeding (at least 1 attempt at breastfeeding). For 2-week breastfeeding status, women were grouped into 4 categories: not breastfeeding at 2 weeks, partially breastfeeding at 2 weeks, primarily breastfeeding at 2 weeks, and breastfeeding but unknown proportion of breastfeeding. Few women in the study met classic criteria for exclusive breastfeeding, feeding nothing but breast milk.[56] This is consistent with the US experience, in which a quarter of breastfeeding women give their baby formula within the first 2 days of life.[12] Therefore, for this study, primarily breastfeeding at 2 weeks included women who were giving their infant expressed breast milk or fed from the breast at least 90% of the time. Partial breastfeeding was defined as women who were giving their infant expressed breast milk or fed from the breast less than 90% of the time.

For 12-week breastfeeding status, women were grouped as still breastfeeding or stopped breastfeeding before 12 weeks.

Key Covariates

Covariates were selected based upon their associations reported in the literature with breastfeeding (outcome) and/or MDD (predictor). Women's *prior breastfeeding experience* is an important predictor of future infant feeding behavior. Prior experience was stratified into 3 groups: primiparous, multiparous without prior experience, and multiparous with prior experience. Given that primiparous women could have

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Table 1. Percent of Women's Infant Feeding Intentions by Sample Characteristics

	Infant Feeding Intention								
	Breast Only, n = 80 (48%)		Breast and Formula, n = 54 (32%)		Formula Only, n = 17 (9%)		Unsure, n = 17 (9%)		
Characteristic of Women	n	%	n	%	n	%	n	%	P[a,b]
Age, y									.22
< 31	35	41	29	34	9	11	12	14	
≥ 31	45	54	25	30	8	10	5	6	
Race									**.02**[c]
African American	9	26	15	43	6	17	5	14	
White/other	71	53	39	29	11	8	12	9	
Has college degree									**< .001**
No	10	32	12	39	5	16	4	13	
Yes	64	62	28	28	8	6	6	5	
Married or living as married									.11
Yes	64	52	37	30	9	7	12	10	
No	16	35	17	37	8	17	5	11	
Smoking during pregnancy									.09
Yes	6	27	8	36	3	14	5	23	
No	74	51	46	32	14	10	12	8	
Prepregnancy BMI, kg/m^2									**.005**
< 30	67	56	31	26	11	9	11	9	
≥ 30	13	27	23	48	6	12	6	12	
Return to work or school plans after delivery									**.02**
< 3 mo	19	40	11	23	10	21	7	15	
≥ 3 mo	43	57	24	32	3	4	5	7	
No plans	18	39	19	41	4	9	5	11	
Parity									.06
Primiparous	39	59	19	29	3	5	5	8	
Multiparous	41	40	35	34	14	14	12	12	
Prior breastfeeding experience[d]									**< .001**
Yes	40	51	30	39	3	4	5	6	
No	1	4	5	21	11	46	7	29	
Certain of infant feeding decision									**< .001**
Definite	63	57	34	31	11	10	3	3	
Not definite	17	30	20	35	6	11	14	25	
Determination to breastfeed									**< .001**
Very determined	69	78	19	22	0	0	0	0	
Not very determined	10	14	35	51	7	10	17	25	
Confidence to breastfeed									**< .001**
Very confident	56	74	18	24	0	0	2	3	
Not very confident	23	29	36	45	7	9	14	18	

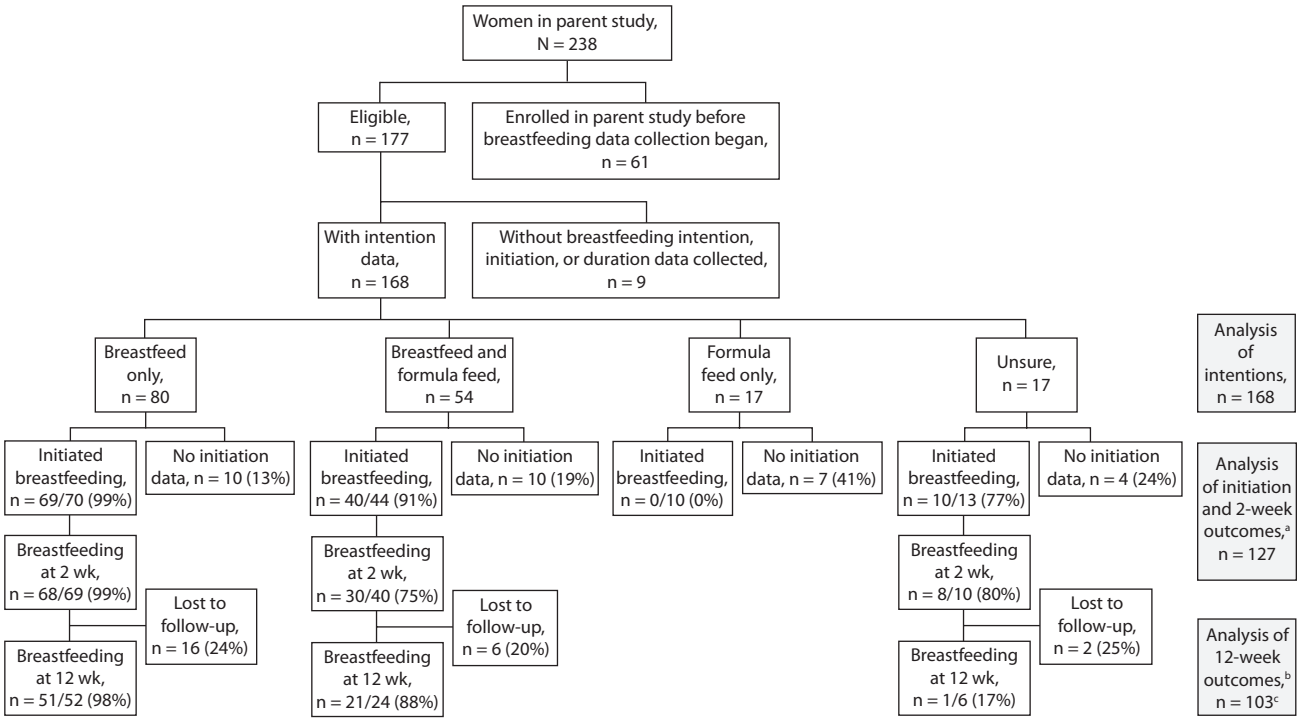
[a] P values in bold font are significant at $P < .05$.
[b] Fisher exact test due to small sample size.
[c] When other is combined with white, African American women were less likely to intend to exclusively breastfeed and more likely to intend to combine breast and formula feeding.
[d] The statistic was computed only on the multiparous women.
Abbreviation: BMI = body mass index.

no previous opportunities to breastfeed, it was important to separate this group from the multiparous women who had no prior breastfeeding experience. In the United States, older women are more likely to breastfeed; therefore *maternal age* was considered in all models. Initially 4 categories of maternal age were considered. However, mothers aged 17 to 24 were similar to those aged 25 to 30 years and mothers over 35 years were similar to mothers aged 31 to 35 with respect to feeding intention and depression measures. Only 4 women were less than 20 years old. Therefore, in the models, age was grouped as younger than 31 or 31 years or older. For the regression models, *race* was entered as African American or white/other. There were not enough women of other races (n = 5) to consider as a separate group and most were Asian American. Asian was grouped with white because Asian American women breastfeed at similar if not higher rates than white women (Table 1).[57] *Marital status* was grouped as married/living as married and single/living without partner. *Smoking* is an important covariate because smokers are less likely to initiate breastfeeding and more likely to breastfeed for shorter durations than nonsmokers.[58–61] *Maternal obesity*, defined as a body mass index (BMI) of 30 kg/m^2 or higher[62] is associated with lower rates of breastfeeding initiation and duration.[63–66] *Return to work plans* after delivery also plays a role in women's breastfeeding practices.[67–69] *SRI use* was based upon subject self-report and confirmed by serum concentrations.

Analysis

Study sample characteristics by infant feeding intention groups were compared with Pearson χ^2 statistics and Fisher Exact test when required because of small numbers of observations and analyses of variance for the continuous symptom measure (eg, HDRS) (Table 1).

Figure 2. Study Participation and Feeding Outcomes by Feeding Intention



[a]Excludes women with no follow-up data (n = 31) and women with no intention to breastfeed (n = 10).
[b]Excludes women who were breastfeeding at 2 weeks and had missing data at 12 weeks (n = 24).
[c]There were 24 women lost to follow-up between week 2 and week 12.

Breastfeeding intention was modeled in 2 stages. First, the impact of MDD status, depressive symptoms, and SRI use at enrollment were tested in multivariable models without including other covariates. Second, covariates identified as important in past literature were added to the models. Selection of covariates to be included in the multivariable models was based on the bivariate significance of each potential covariate and feeding outcomes. For intention, the covariates tested included prior breastfeeding experience, maternal age, race, education, marital status, smoking status, prepregnancy BMI ≥ 30, and work plans postpartum. Intention models were carried out with 4 group polychotomous logistic regression, and covariates were retained if they were significant at the $P < .05$ level.

Similar strategies were used to model 2-week postpartum breastfeeding status with polychotomous logistic regression. In addition to the variables included in the intention models, the following additional variables were tested in the 2-week models: infant feeding intention, determination to breastfeed, confidence to breastfeed, MDD and SRI status at delivery and 2 weeks postpartum, delivery method, infant gender, gestational age, and infant admission to the neonatal intensive care unit.

For breastfeeding at 12 weeks, a multivariable logistic regression model compared breastfeeding versus nonbreastfeeding women. All the variables in the 2-week breastfeeding models were considered in addition to MDD, depressive symptom score, and SRI use at 12 weeks postpartum.

The number of observations used in the analyses decreased due to attrition from the parent study, which reduced the number of covariates that could be appropriately included in the regression models. For the 2- and 12-week models, potential predictors were assessed for and included in the multivariate models only if (1) there was bivariate relationship with $P < .10$ and (2) there were greater than 10 women in each of the categories of the covariates. Polychotomous logistic regression models allowed us to identify different predictors for the different feeding groups. Exclusion of variables with very small frequencies made it possible to develop these models. For example, the variable that indexed no prior breastfeeding experience in multiparous women was not included in multivariable models of 2- and 12-week breastfeeding status because there were so few women in this category that initiated breastfeeding their infants. Analyses were completed with STATA, v.10 (2007, Stata Corp, Austin, Texas).

RESULTS

Sample Description

Breastfeeding intention data were available for 168 women, a subset of the 238 women reported in the parent study (Figure 2).[53] The 70 women without breastfeeding questionnaires either were enrolled before the questionnaires were added to the protocol in July 2004 (n = 61) or did not complete the questionnaires (n = 9). Of the 177 women with potential breastfeeding intention data, the 9 with no data were more

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likely to be taking an SRI medication at enrollment (44% vs 16%, Fisher exact $P = .05$). There were no other significant differences in demographic or exposure data (data not shown).

Study participants were predominantly white and had college degrees. At study enrollment, the mean HDRS score was 6.66 (range, 0–27; standard deviation (SD) = 5.23). Among the 23% of women with MDD at enrollment, the mean HDRS score was 13.28 (range, 6–27; SD = 4.4). Among those pregnant at enrollment, 30% had at least 1 episode of MDD. Compared to women without MDD at enrollment, women with MDD had less education (39% vs 71% had college degrees, $P = .001$), were more likely to have other children (74% vs 57% multiparous, $P = .06$), and were more likely to be unemployed (49% vs 30% unemployed and not in school, $P = .02$). At enrollment, 16% of women were taking an SRI while 25% took one sometime during pregnancy. Women who were older (≥ 31 years), who were white, and with at least a college education were more likely to be taking an SRI during pregnancy. Among 102 multiparous women, 78 (76%) had prior breastfeeding experience.

Breastfeeding initiation and 2-week data were available for 137 women (82%), 10 of whom did not intend to breastfeed. The 31 women without initiation data were less likely to be married (55% vs 77%, $P = .02$) and have a college degree (31% vs 64%, $P = .001$) and were more likely to smoke in pregnancy (26% vs 10%, $P = .04$) and to have MDD at enrollment (51% vs 17%, $P = .00$). These differences reflect the patterns of loss to follow-up in the parent study. In addition, women who did not intend to breastfeed (n = 34) were less likely to have postpartum data (68% vs 85%, $P = .03$) than those who intended any breastfeeding. Of the 151 women who intended to breastfeed or were unsure, 103 (68%) had an infant feeding status at 12 weeks.

Association Between MDD During Pregnancy and Breastfeeding Intention

Race, education, return to work/school plans, prior breastfeeding experience, and being obese were associated with women's infant feeding intentions (see Table 1). Although not statistically significant, women who smoked during pregnancy were less likely to intend to breastfeed ($P = .09$, 27% vs 51% for intention to breastfeed only).

There was a strong association between parity plus prior breastfeeding experience and feeding intention. For primiparous and multiparous women with prior breastfeeding experience, nearly all (88% and 90%, respectively) intended to exclusively breastfeed or combine breast and formula feeding. In contrast, only 25% of multiparous women without prior breastfeeding experience intended any breastfeeding ($P < .000$).

In bivariate analyses, depressive symptom scores at enrollment were higher in women who were unsure of their breastfeeding intentions than women who intended to exclusively breastfeed (9.65 vs 6.04, $P = .057$). However, depressive symptom scores were not significantly associated with the 4 category breastfeeding intention variable in the final multivariable model ($P = .46$).

In bivariate analysis, SRI use at enrollment was significantly associated with intending only to formula feed ($P = .002$). In the multivariable model (Table 2), SRI at enrollment (relative risk ratio (RRR) = 12.3), planning to go back to work before 12 weeks (RRR = 4.53) and not breastfeeding previous children (RRR = 92.4) were significant predictors of intending to formula feed. Having at least a college degree was the only variable that was significantly different between those planning to exclusively breastfeed versus combining breast and formula feeding (RRR = 0.29).

Women who intended to exclusively breastfeed their babies were more certain of their feeding decision, more determined to succeed at breastfeeding, and more confident that they would be able to breastfeed successfully. For women who intended to exclusively breastfeed, 61% were very determined to breastfeed, very confident that they could breastfeed, and very sure of their intention compared to 20% of the women who intended to combine breast and formula feeding (Fisher exact $P < .001$).

Association Between MDD and Breastfeeding Initiation

Most (96%) of the women who intended to breastfeed did so compared to 77% of those who were unsure of their infant feeding plans ($P = .009$) and none of the 10 who intended to only formula feed (see Figure 2). Of the women who intended to breastfeed or were unsure of their intention (n = 127), only 8 did not initiate breastfeeding.

Significant bivariate predictors of initiating breastfeeding were intending to breastfeed exclusively or combined with formula versus being unsure ($P = .009$), having at least a college degree ($P = .001$), being white ($P = .009$), and being very determined to breastfeed ($P = .05$). Major depressive disorder status at enrollment and delivery, depression symptom score, and SRI status at enrollment and delivery were not related to initiating breastfeeding ($P > .22$ for all). The depressive symptom scale was not administered at delivery. The number of women not initiating breastfeeding was too small to develop a multivariable model for initiation.

Association Between MDD and 2-Week Breastfeeding Status

Women's infant feeding intention was a strong predictor of infant feeding status at 2 weeks; 68 of 70 women (97%) who intended to only breastfeed, 30 of 44 (68%) who intended to combine breast and formula feeding, and 8 of 13 (62%) who were unsure were still breastfeeding at 2 weeks ($P < .001$). Among those breastfeeding at 2 weeks, 62 of 77 (81%) were primarily breastfeeding. Parity and past experience were important predictors of breastfeeding at 2 weeks; 84% of the primiparous women, 81% of multiparous women with prior experience, and 35% of multiparous women with no prior experience continued to breastfeed at 2 weeks ($P = .005$). Because none of the women who intended to only formula feed (n = 10) initiated breastfeeding,

Table 2. Multivariable Covariates of Intention and 2- and 12-Week Breastfeeding Status[a]

	Infant Feeding Intention (n = 168)						
		Breast and Formula		Formula Only		Unsure	
Covariate of Intention	Breast Only	RRR	95% CI	RRR	95% CI	RRR	95% CI
SRI at enrollment	Baseline	2.55	0.85–7.66	**12.31**	**2.50–60.66**	**4.72**	**1.01–21.9**
Multiparous without prior breastfeeding experience[b]	Baseline	5.52	0.60–51.2	**92.4**	**9.02–946.0**	**30.2**	**3.12–293.0**
College degree	Baseline	**0.29**	**0.12–0.59**	0.37	0.08–1.60	**0.19**	**0.05–0.67**
Planning to return to work before 12 wk	Baseline	0.78	0.32–1.89	**4.53**	**1.10–18.7**	1.92	0.55–6.72

	Breastfeeding Status at 2 Weeks Postpartum (n = 127)						
		Partial Breastfeeding		Breastfeeding but Unknown Quantity[c]		Stopped Breastfeeding	
Covariate of 2-Week Breastfeeding Status	Primarily Breastfeeding	RRR	95% CI	RRR	95% CI	RRR	95% CI
In pregnancy, intending to exclusively breastfeed	Baseline	**0.15**	**0.04–0.50**	0.39	0.15–1.05	**0.05**	**0.01–0.25**
College degree	Baseline	0.52	0.15–1.83	1.78	0 .50–6.46	**0.17**	**0.05–0.62**

	Breastfeeding Status at 12 Weeks Postpartum (n = 99)[d]		
		Stopped Breastfeeding	
Covariate of 12-Week Breastfeeding Status	Breastfeeding	RRR	95% CI
Intending to exclusively breastfeed	Baseline	**0.05**	**0.01–0.25**
Primarily breastfeeding at 2 weeks	Baseline	**0.09**	**0.02–0.54**
SRI use at 2 weeks postpartum			
HDRS score < 9[e]	Baseline	**12.0**	**1.64–88.3**
HDRS score ≥ 9	Baseline	**0.28**	**0.04–1.71**

[a]Bold font indicates significance. [b]Women with children that had not breastfed any of their previous children. [c]Breastfeeding but level of breastfeeding could not be ascertained. [d]Four women were missing the 2-week HDRS and were not included in the multivariable analysis. [e]For this analysis, the HDRS score at 2 weeks was dichotomized at the lower 75% versus higher 25% of the scores.
Abbreviations: HDRS = Hamilton Depression Rating Scale, RRR = relative risk ratio, SRI = serotonin reuptake inhibitor.

they were excluded from analyses of 2- and 12-week breast feeding analyses.

In bivariate analyses of breastfeeding at 2 weeks, the following covariates were significantly related to breastfeeding status: race ($P = .03$), having a college degree ($P < .0001$), being married ($P = .01$), not being obese ($P = .001$), intention to exclusively breastfeed ($P < .0001$), breastfeeding determination ($P < .0001$), confidence in being successful at breastfeeding ($P = .05$), having a male infant ($P = .03$), and not taking an SRI at 2 weeks postpartum ($P = .04$).

In multivariable analyses (Table 2), not breastfeeding at 2 weeks compared to primarily breastfeeding was negatively associated with intending to exclusively breastfeed (RRR = 0.05) and having a college degree (RRR = 0.17). Partially breastfeeding compared to primarily breastfeeding was negatively associated with intention to exclusively breastfeed (RRR = 0.15). In the multivariable models, neither MDD nor depressive symptom scores at enrollment or 2 weeks was associated with 2-week breastfeeding status.

Association Between MDD and Breastfeeding at 12 Weeks Postpartum

Among 103 women with 12-week data, 73 (71%) were breastfeeding. In bivariate analyses, the factors associated with any breastfeeding at 12 weeks included: intending to exclusively breastfeed ($P < .000$), primarily breastfeeding at 2 weeks postpartum ($P < .000$), white or other race ($P = .001$), BMI < 30.0 ($P = .004$), having a college degree ($P < .001$), being married ($P < .001$), being very determined to breastfeed ($P < .001$), being very sure of one's breastfeeding choice ($P = .03$), and taking an SSRI at 2 weeks postpartum ($P = .04$).

In multivariable logistic regression models that included only MDD status, depressive symptoms, and SRI status, the continuous depressive symptom scale at 2 weeks postpartum (RR = 0.76) and taking an SRI at 2 weeks postpartum (RR = 6.42) were related to breastfeeding at 12 weeks. However, neither MDD status nor depressive symptom scores at enrollment in pregnancy or 12 weeks postpartum were associated with breastfeeding status at 12 weeks. In the multivariable model that included intention and determination as well as significant covariates from the bivariate models, those who were not breastfeeding were less likely (RRR = 0.04) to have intended to exclusively breastfeed and less likely to have been primarily breastfeeding at 2 weeks (RRR = 0.09) than women who were breastfeeding. An unexpected interaction between the continuous depressive symptom score at 2 weeks and SRI use at 2 weeks emerged in this analysis. Women who were taking an SRI and had lower depression scores (HDRS < 9) were less likely to be breastfeeding (RRR = 12.0) in comparison to women not taking an SRI and women taking an SRI who had higher depression scores (HDRS ≥ 9) (see Table 2).

DISCUSSION

This was the first longitudinal study to evaluate the association between maternal MDD and breastfeeding intention

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and early practices that used prospectively collected infant feeding data and clinician assessed depression measures. Our findings by aims follow: (1) Neither MDD nor depressive symptom severity were associated with infant feeding intention. (2) Neither MDD nor depressive symptom severity during pregnancy or early postpartum were associated with breastfeeding initiation or status at 2 weeks or 12 weeks. (3) Women who took an SRI during pregnancy were significantly less likely to intend to breastfeed exclusively or in combination with formula. The strongest predictor of primarily breastfeeding was women's intention to only breastfeed. This supports recommendations of The American Congress of Obstetricians and Gynecologists to "impart accurate information about breastfeeding to expectant mothers…."[70(p1)]

This study addresses several limitations of previously reported literature relating breastfeeding and maternal depression. First, in this study, widely accepted and validated standards for measuring MDD (SCID) and depressive symptoms (HDRS) were employed. Second, the breastfeeding data were collected prospectively, and primarily breastfeeding was separated from partial breastfeeding. Third, a large number of potential covariates identified from the literature as being related either to the predictor (MDD) and/or outcome variable (breastfeeding intention and practices) were included in multivariate models. When controlling for covariates, we did not find an association between MDD or depressive symptoms and infant feeding intention or practices.

We conducted analyses similar to previous research in which any breastfeeding and breastfeeding at 2 weeks postpartum were considered outcomes and all women were grouped regardless of intention or parity. Like others, in these analyses, we did find bivariate associations between depressive symptoms and breastfeeding outcomes. However, these associations were better explained in the multivariable analyses by different distributions of depression in African American and white/other women and between women with and without college educations. Therefore, our bivariate results are consistent with previous research but our comprehensive models suggest more complexity than previously evaluated. We also considered whether MDD was a moderator of the relationship between breastfeeding intention and initiation through its impact on maternal confidence and certainty in infant feeding intention. We did not confirm this mechanism in our data. The interactions between the myriad of factors associated with either breastfeeding and/or depression is more complex than can be evaluated in cross-sectional studies. These findings suggest the need for careful longitudinal studies to assess the relative contribution of factors to actual outcomes.

We found that SRI use was strongly associated with intention not to breastfeed. Serotonin reuptake inhibitors are increasingly prescribed for pregnant and postpartum women.[38,39] There is a growing body of literature demonstrating that only small amounts of antidepressant drug are present in breast milk and they are often below the limit of quantifiability in the serum of breastfeeding-exposed infants.[63] This relatively new information may not be well known by medical providers or mothers. To date, little has been reported about the association between SRI use and infant feeding practices. Pearlstein et al[71] reported that women with MDD who were breastfeeding were more likely to self-select nonpharmacologic treatment for MDD when given a choice between SSRI alone, SSRI plus interpersonal psychotherapy, and interpersonal psychotherapy alone. Others have reported that women stop breastfeeding when they are prescribed antibiotics or antiepileptics or do not take a prescribed medication in order to breastfeed.[65,66] It is interesting to consider that women who expose their fetus to a medication during pregnancy choose not to expose their infant via breastfeeding. This may seem counterintuitive to clinicians who understand that medications in general transfer more readily across the placenta to the fetus while little enters the breast milk. With SSRIs, there are data to suggest negative effects from placental transfer of medication, including preterm birth and respiratory distress.[72] In contrast, there is increasing information about the relative safety of SRI use during breastfeeding.[46,47] There are also readily available resources on the internet to address physician concerns about medications and lactation, including the National Library of Medicine Drugs and Lactation Database Web site, LactMed (http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?LACT). Maternal perceptions may be different and deserve further exploration. Some women may feel they have no choice but to expose the baby in pregnancy while postpartum they can choose to formula feed and stop any additional exposure. It is important in this case to consider the adverse effects of formula feeding in this decision. There may be an important role for increased or improved patient education regarding relative risks and benefits of breastfeeding and perinatal use of SRIs.

Prior studies have demonstrated that a variety of social, demographic and personal factors are associated with breastfeeding intention and practices.[58] Findings across studies have consistently demonstrated that young, less educated, low-income, minority women are less likely to initiate and to continue breastfeeding than older, more highly educated, higher income, white women and that work status influences breastfeeding duration.[68,69] However, these factors are strongly associated with one another and therefore difficult to tease apart in studies. For example, in our study, race, education, and marital status were confounded in the breastfeeding intention regression model necessitating interaction terms be included. Our study findings were consistent with previously reported findings; that is, race and education were associated with intention and in turn, breastfeeding intention strongly predicted breastfeeding initiation and breastfeeding at 2 and 12 weeks. An important uncontrolled factor in this study is social support, which has been shown to be related to breastfeeding intention, initiation, and duration.[70–72] Social support could explain why mothers with MDD in this study were still able to breastfeed. However, many of the demographic factors associated with social support were included in our models—such as education, marital status, prior experience,

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and parity. Because of the small number of smokers in our dataset and the confounding of smoking status and education attainment, it was not possible to adequately test the relationship between smoking status and intention and practices.

Our study population limits the generalizability of the study. Participants were predominantly white and African American and well educated. The breastfeeding initiation rate of 87% among women in the study exceeds the national rate of 74% and the Pennsylvania rate of 67%.[73] The results may not generalize to other groups such as women of Hispanic ethnicity or predominantly less educated populations. The sample of women with MDD in this study was relatively small and therefore may have limited our ability to detect moderate to small differences in intention and duration.

In summary, we found that intention to exclusively breastfeed as reported in pregnancy was the best predictor of breastfeeding status at 2 and 12 weeks postpartum. Neither MDD nor depressive symptoms was associated with infant feeding practices. Taking an SRI during pregnancy is associated with lower rates of breastfeeding intention during pregnancy. These findings indicate that pregnancy is an optimal time to intervene to increase early breastfeeding, especially among women taking an SRI during pregnancy. For women who do not take an SRI during pregnancy but are at high risk for depression after delivery, pregnancy would also be the ideal time to address this issue given the strength of the association between intention and actual breastfeeding practices. Given the significant short and long-term health benefits of breastfeeding to mothers and infants,[6] and the potential health care savings associated with breastfeeding,[74] it important for doctors who prescribe SRIs and other medications to have evidence-based discussions about the risks and benefits of breastfeeding and taking medications with mothers, in line with discussion of taking medications during pregnancy.[75] Additional research is needed to determine strategies to overcome the barrier posed by SRI use on breastfeeding, including physician and patient specific barriers.

Drug names: bupropion (Wellbutrin and others), methadone (Dolophine, Methadose, and others).

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