

Compromised Weight Gain, Milk Intake, and Feeding Behavior in Breastfed Newborns of Depressive Mothers

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Objective To explore depressed mood in the breastfeeding dyad. **Method** $N = 50$ mothers of 12-day-olds reported depressed mood (EPDS) and anxiety (STAI), then were videotaped while breastfeeding. Infants were weighed before and after breastfeeding. **Results** An ANCOVA on weight gain, which controlled for infant age and birth weight, found EPDS inversely related to weight gain. Following a significant MANCOVA on infant biobehavioral measures, ANCOVAs which controlled for birth weight, age, hunger at time of testing, and degree of exclusivity in breastfeeding, found EPDS inversely related to infants' milk intake and latch quality. Following a significant MANOVA on maternal behaviors, ANOVAs revealed EPDS inversely related to mothers' sensitive positioning and touch frequency. Contrastingly, anxiety was associated with increased touch. **Conclusion** In the breastfed newborn, mothers' depressed mood is associated with lesser weight gain, lower milk intake, poorer latch to the breast, and receiving less frequent touch and less-sensitive positioning at the breast by mother.

Key words breastfeeding; depression; infant weight gain; milk intake; mother–infant interaction.

Introduction

In the pregnant and postpartum mother, depression has been associated with a host of adverse child outcomes relating to behavioral functioning, emotion regulation, attachment, cognitive and intellectual functioning, motor development, and neuroendocrine and psychophysiological functioning (Goodman & Brand, 2009; Murray & Cooper 1997). Recently, growth outcomes have received investigative attention (O'Brien, Heycock, Hanna, Jones, & Cox, 2004; Wright, Parkinson, & Drewett, 2006). A large-scale prospective longitudinal study by Wright and associates found that regardless of feeding method, infants with slow weight gain, defined as weight gain below the 5th percentile, during the first four months of life had mothers with higher levels of depression symptoms on the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987).

Wright and associates (Wright, Parkinson, & Drewett, 2006; Wright, Parkinson, & Scott, 2006) also reported that by 12 months, weight gain no longer differed with maternal depression. Although this suggests that effects of maternal depression on infant weight gain are merely transient, the findings are troubling given recent evidence that when it occurs during the initial weeks of infancy, slow weight gain is associated with later neurological and cognitive deficits (Emond, Blair, Emmett, & Drewett, 2007). Moreover, in the breastfed infant, slow weight gain places the infant at risk for early breastfeeding cessation (Lawrence & Lawrence, 2005; Riordan & Wambach, 2009). This is of great concern as it would prevent infants and mothers from deriving the numerous and substantial benefits of breastfeeding (see American Academy of Pediatrics, 2005). The greater degree to which the breastfed infant is placed at risk by slow weight gain during the early postpartum period

calls for specific attention to breastfed infants of mothers with depressed mood.

Evidence of risk to breastfed infants of depressed mothers emerged indirectly from work on infant exposure to antidepressant medication via breast milk. In comparison with infants of nondepressed breastfeeding mothers, infants of depressed breastfeeding mothers who took antidepressant medication were found to show less weight gain (Chambers et al., 1999). Subsequent work, in which all mothers suffered from depression and all took antidepressant drugs (Hendrick, Smith, Hwang, Altshuler & Haynes, 2003) reported that weight gain of 6-month-old infants of breastfeeding mothers who took antidepressants, including, fluvoxamine, sertraline, and paroxetine, did not differ from that of breastfed infants from normative populations. These findings have led to suggestions that such exposure may not be unsafe for the breastfed infant (Kendall-Tackett & Hale, 2009). However, Hendrick and associates (Hendrick et al., 2003) also reported that if mothers relapsed to major depressive episodes lasting 2 months or more, their infants weighed less than infants of mothers who had not relapsed, or had relapsed to depressive episodes lasting <2 months. Thus, rather than implicating exposure to medication, these studies point to maternal depression itself as representing risk to the breastfed infant, as evidenced by compromised weight gain.

Depression in the lactating mother has also been associated with reports of feeding difficulties and lesser satisfaction with breastfeeding (Field, Hernandez-Reif, & Feijo, 2002; Hellin & Waller, 1992; Milligan, Parks, & Lenz, 1990). This is troubling as these experiences have been associated with increased risk of supplementing with formula and earlier termination of breastfeeding in the depressed breastfeeding dyad (Cooper, Murray, & Stein, 1993; Dennis & McQueen, 2009; McCarter-Spaulding & Horowitz, 2007; Taveras et al., 2003). In an abundance of anecdotal accounts, maternal stress has been linked with reduced milk output. Nevertheless, milk output was found unrelated to mother's negative mood and distress (Hill, Aldag, Chatterton, & Zinaman, 2005; Hill, Aldag, Demirtas, Zinaman, & Chatterton, 2006).

Notwithstanding feeding difficulties and dissatisfaction reported by depressed breastfeeding mothers, observational studies have yet to identify behavioral features of the breastfeeding dyad that differ with mothers' depressed mood. Little is known about infant behaviors of key importance to weight gain, specifically, latching on to the breast and suckling (Davis, 2008; Emond et al., 2007), that could reflect feeding difficulties as a function of mothers' psychological status. Two studies that explored maternal

behaviors focused on them as they appear at the 3-month stage. In their inquiry into whether face-to-face mother–infant play interactions of breast- and formula-feeding dyads differ with depression, Jones and associates (Jones, McFall, & Diego, 2004) observed less positive emotionality in infants of depressed (vs. nondepressed) mothers, but only among those who were formula-fed. In a similar vein, a comparison of feeding interactions by Field and associates (Field et al., 2010) reported that in comparison with formula-feeding mothers, breastfeeding mothers were less intrusive and appeared more relaxed, and this was the case even if a breastfeeding mother suffered from depression. These two reports are encouraging in that they suggest that breastfeeding represents a buffering effect, possibly with a potential to extend to infant weight gain given its dependence on maternal behavior (Lawrence & Lawrence, 2005). On the other hand, it is also possible that any buffering effect that is extended at the 3-month stage may not be apparent during the early postpartum period when breastfeeding is known to be disorganized and especially vulnerable (Riordan & Wambach, 2009). It is also a period that includes a substantially larger pool of dyads, including many who fail to establish breastfeeding and terminate breastfeeding prior to 3-months (Lawrence & Lawrence, 2005).

In sum, the present study aimed to explore depressed mood in the breastfeeding mother as it relates to infant weight gain. Upon finding distinctions, we then considered factors that might underlie feeding difficulties. In particular, we focused on infant suckling behavior and milk intake, as well as maternal breastfeeding behaviors. In light of findings of epidemiological studies and work on infant exposure to antidepressant medication in breast milk (Hendrick et al., 2003; Wright, Parkinson, & Drewett, 2006), we predicted that mothers' depressed mood would be associated with infants' lesser weight gain. On the basis of anecdotal evidence, we also speculated that depressed mood would be associated with infants' reduced milk intake and poorer quality of suckling, and diminished quality of mothers' breastfeeding behavior. Given high rates of comorbidity between depression and anxiety (Kendler, Neale, Kessler, Heath, & Eaves, 1992), the present study also sought whether child outcomes would be associated with maternal anxiety. However, limited findings in previous work on anxiety (Hill et al., 2005, 2006) precluded forming specific hypotheses. Finally, we focused on the period during the infant's second week of life, when the infant is particularly vulnerable to deleterious effects of slow weight gain as well as breastfeeding cessation (Emond et al., 2007; Lawrence & Lawrence, 2005; Riordan & Wambach, 2009).

Method

Participants

Following approval from the medical center's Internal Review Board, a community sample of women was recruited from the maternity unit of a university hospital following uncomplicated, vaginal delivery of a full-term infant. Eligibility was also based on mothers' ability to read English at the sixth-grade level, be at least 18 years of age, and having reported interest in initiating breastfeeding. Prior to hospital discharge, 196 women who met criteria expressed willingness to be contacted. One week later, 27% were no longer eligible due to reporting that during the previous 24 h breastfeeding had been supplemented with one bottle or more of formula. This rate seems compatible with epidemiological data on rates of breastfeeding cessation in the early postpartum period (Wright, Parkinson, & Scott, 2006). Another 21% could not be reached, 15% were reached but unable to schedule within the narrow time frame, nine reported illness in the infant or mother, two reported that they were no longer interested. Informed consent was administered to 50 mothers. The women were 71% Caucasian, 14% Hispanic, 10% African-American, and 5% other. Socioeconomic level, derived on the basis of income and education (Hollingshead, 1978) was middle class ($M=2.45$, $SD=1.14$). They ranged in age from 19 to 38 years ($M=27.72$; $SD=4.42$), and had 11–15 years ($M=13.62$, $SD=1.10$) of education. Seventy-six percent were married, and 64% were multiparous. The infants were born full-term ($M=3,327$, $SD=416$), and 50% male.

Procedure

When infants were 12.11 days old ($SD=1.73$, range = 9–16 days), mother–infant dyads were seen by a researcher who was a certified lactation counselor (CLC). Appointments were scheduled to occur following a period of at least 90 min during which the infant had not been fed. During the visit, measures were taken of the mother's height and weight (Seca Sensa 804), and mothers were screened for symptoms of depressed mood and anxiety. They reported on demographics and medication usage. Infants were weighed using an electronic scale (Seca 231/232). Mothers were then seated comfortably, and breastfed their infants while being videotaped. Immediately after breastfeeding, infants were weighed. Upon completion, mothers received a gift card and feedback from the researcher/CLC with respect to the infant's weight gain.

Measures

Biobehavioral Measures of Breastfeeding in Infants

Weight gain was the infant's average daily weight gain since birth, obtained by subtracting the birth weight from the infant's weight the day of the study and divided by the infant's age in days.

Milk intake was a measure of breast milk consumed during one feeding session. It was derived by subtracting the infant's prefeed from postfeed weights, obtained using an integrated electronic balance (Seca 231). With use of precise electronic scales, weights have been found accurate in determining actual milk volume to 1 gram (Arthur, Hartmann, & Smith, 1987; Casey, Neifert, Seacat, & Neville, 1986; Meier, Lysakowski, Engstrom, Kavanaugh & Mangurten, 1990).

Latch quality measured the infant's latch and breastfeeding behavior. Defined on the basis of standards in the field of lactation (Davis, 2008; Walker, 2006), this was measured globally on the first two min of the feeding session. On a 3-point scale, the infant received a score of 3 if she latched on and suckled calmly and without interruption, except for brief pauses to swallow, breathe, or rest. A score of 1 was assigned if the infant fussed, had to be repositioned several times, or came off the breast and cried.

Hunger was measured in order to index an estimation of infant hunger, and defined as number of minutes elapsed since the infant's last feeding prior to the breastfeeding session (Hendry & Kessen, 1964; Lew & Butterworth, 1995).

Exclusivity measured exposure to formula. Infants who had been breastfed exclusively since birth received a score of 2. Those whose mothers had supplemented with up to one bottle of formula per day starting before or upon hospital discharge received a score of 1.

Maternal Self-Report Measures

These pertained to mothers' depressed mood and anxiety.

Depressed mood was measured using the EPDS (Cox et al., 1987), one of the most widely used instruments for screening for postpartum depression. The instrument was found having satisfactory internal consistency (Chronbach's $\alpha > .80$; Cox et al., 1987). Unlike a psychiatric interview, it does not diagnose postpartum depression. Each of its 10 items describes a symptom of depression, e.g., *I have been so unhappy that I have been crying*, and is rated on a 4-point scale of increasing severity. A cut-off score of 9/10 has been used to identify women at risk for minor depression (Cox et al., 1987). It was used in the present study in preliminary analyses for comparing mothers with and without depressed mood on

demographic variables in order to explore potential biases. However, continuous data were used in all other analyses.

Anxiety was measured using the State Anxiety scale of the State Trait Anxiety Scale (STAI; Spielberger, Gorsuch, & Lushene, 1970) to measure currently experienced anxiety. It has excellent psychometric properties (Chronbach's α .92; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983). Its 20 items, such as, *I am worried*, are rated on 4-point scales. Higher scores have been found inversely related to breastfeeding confidence, and positively related to the introduction of formula, nonexclusive breastfeeding, and earlier termination of breastfeeding (Britton, 2007).

Maternal Behavioral Measures

Maternal breastfeeding behavior was addressed by measuring the duration of the entire session, and by coding three behaviors which were displayed during the first 9 min, plus the last 1 min of the feeding session. If a mother nursed for <10 min, data were based on the available time that she breastfed. The three coded measures, *sensitive positioning*, *frequency of touch*, and *frequency of vocalization*, were derived from the field of lactation (Walker, 2006; Davis, 2008), and coded globally on 5-point scales.

Sensitive positioning described the extent to which the infant was sensitively positioned at the breast. A score of 5 was assigned if the infant was supported so that its head was facing the mother's breast and in line with the spine which was straight. Also, the infant had to have full access to the nipple which was exposed in a manner that did not obstruct the infant's breathing or require that the infant crane forward. A score of 1 was assigned if the infant's body was in a supine position, the head was turned sideways, the shoulders and spine were not aligned with each other, the spine was bent, twisted, or arching, or access to the nipple impeded breathing or required that the infant crane forward.

Frequency of touch described the manner in which the mother touched the nursing infant. A score of 5 was assigned if the hand of the mother's cradling arm held the infant to the mother's body, while the free hand constantly stroked or patted the infant. A score of 1 was assigned if the hand of the supporting arm was flaccid or holding another object, e.g., magazine, and the free hand was not touching the infant.

Frequency of vocalization described vocal behavior directed toward the infant. Mothers who vocalized constantly by singing received a score of 5. Those who never vocalized or directed conversation elsewhere, e.g., telephone contact, received a score of 1.

Duration of feeding was the number of minutes the mother's breast was available to her infant.

Reliability

Coding was conducted by CLCs under the supervision of an International Board Certified Lactation Consultant (IBCLC), all of whom were blind with respect to the mother's depression status, and the infant's milk intake and weight gain. They were trained using training videotapes. To establish reliability of coding, behavioral measures were obtained independently by two trained coders who coded one third of the videotapes. Reliability checks were conducted frequently to prevent observer drift. Spearman's ρ for latch quality, sensitive positioning, frequency of touch, and frequency of vocalization were .77, .79, .88, .73, respectively.

Data Analysis Plan

Data analyses were conducted in three stages. First, the distributions of study variables were examined for missing values, outliers, and violations of the normality assumption. Descriptive data were then computed using *t*-tests in order to rule out biases associated with the main predictor variable, depressed mood (EPDS); and bivariate correlations were conducted to help evaluate potential problems of shared variance among predictor variables. The second stage included a univariate analysis. This was conducted on the dependent measure of prime interest, infant weight gain. The model included self-report measures of depressed mood and anxiety (STAI) as predictors, and two covariates, birth weight and infant age. In the final stage, multivariate analyses were conducted. The first was a MANCOVA in which mothers' symptoms of depressed mood and anxiety were explored in relation to infant bi-behavioral measures, including latch quality, milk intake, and four covariates, infant birth weight, age, level of hunger at time of testing, and degree of exclusivity in breastfeeding. The second was a MANOVA which explored whether mothers' symptoms of depressed mood and anxiety differed with their breastfeeding behaviors, including sensitive positioning, frequency of touch, frequency of vocalization, and duration of feeding.

Results

Preliminary Analyses

There were no missing data, and no extreme skewness (i.e., <-2 or >2) was found. One outlier was found for weight gain, but we kept the case with the extreme value (an infant whose average daily weight gain was 52 g) in the analysis because the skewness of the distribution of weight gain did not show a serious departure from the normal distribution. Using a cutoff score of 9/10 on the EPDS depression screening scale, we identified 19 women at

risk for minor depression (Cox et al., 1987). They were assigned to the depressed mood group. Using *t*-test analyses, we found that these women and their infants did not differ on demographics from mothers with scores <10 on the EPDS. All mothers in the study had been breastfeeding exclusively (no formula supplementation) since hospital discharge, except two in the depressed mood group and eight in the nondepressed mood group. One mother in each group was taking antidepressant medication. All were included after analyses revealed that their inclusion did not affect group means and distributions with respect to maternal or infant measures in their respective group. Using *t*-test analyses, we found that mothers in the depressed mood group differed from Nondepressed mothers on anxiety (Table I). Correlation analyses revealed that the measure of primary importance, infant weight gain, was inversely related to maternal depressed mood, $r = -.32$, $p < .05$; and positively associated with milk intake, $r = .33$, $p < .05$; latch quality, $r = .32$, $p < .05$; and sensitive positioning, $r = .89$, $p < .001$. Evidence of inter-relatedness among these variables called for further

analyses to help control for the number of tests being conducted. The two predictors, depressed mood and anxiety, were inter-related, $r = .46$, $p < .001$. In order to address their independent influences, both were included in subsequent ANCOVA and MANCOVA analyses. The two biobehavioral measures of infant breastfeeding, milk intake, and latch quality were inter-related, $r = .27$, $p < .05$. Therefore these outcome measures were analyzed within a multivariate analysis. Since milk intake was also associated with exclusivity, $r = .27$, $p < .05$, exclusivity was included as a covariate. Hunger, birth weight, and infant age were found unrelated to any of the outcome measures individually, but included in the model to rule out influences on the model. Correlation analyses on maternal breastfeeding behaviors revealed that duration of feeding was associated with frequency of touch, $r = .36$, $p < .01$, and frequency of vocalization, $r = .32$, $p < .05$. Therefore these outcome measures were analyzed within a multivariate model.

Infant Weight Gain

To explore maternal depressed mood and anxiety in relation to infant weight gain, an ANCOVA analysis was conducted on weight gain. The two independent variables were continuous scores for depressed mood (EPDS) and anxiety (STAI). Birth weight and infant age were entered as covariates. Significant results emerged only for depressed mood, $F(1, 44) = 7.08$, $p < .01$, $\eta^2 = .15$. This analysis revealed that when controlling for infant age and birth weight, mothers' depressed mood was associated with infant's lower weight gain.

Biobehavioral Measures of Infant Breastfeeding

To explore maternal depressed mood and anxiety in relation to infant feeding behavior, a MANCOVA was conducted on milk intake and latch quality. This analysis included depressed mood and anxiety as predictors, as well as four covariates: birth weight, infant age, hunger, and exclusivity. Neither anxiety nor any of the covariates was significant. Depressed mood was significant, $F(2, 37) = 5.29$, $p < .01$, $\eta^2 = .22$. Follow-up with univariate tests yielded significant effects of depressed mood on milk intake, $F(1, 38) = 8.32$, $p < .01$, $\eta^2 = .18$; and latch quality, $F(1, 38) = 4.7$, $p < .05$, $\eta^2 = .11$. Overall, these analyses revealed that when controlling for infant birth weight, age and level of hunger at time of testing, and degree of exclusivity in breastfeeding, mothers' greater symptoms of depressed mood were associated with infant's reduced milk intake and poorer quality of latch to the breast.

Table I. Descriptive Statistics for Infants and Mothers (SD in parentheses)

	Nondepressed	Depressed mood	<i>p</i>	η
<i>Mothers</i>				
Depressed mood ^a	4.58 (2.25)	10.93 (2.11)	<.001	.56
Anxiety ^b	27.70 (5.97)	37.72 (11.38)	<.001	.25
Age (years)	27.61 (4.57)	27.89 (4.26)		
Education (years)	13.45 (10.09)	13.89 (11.00)		
SES (Hollingshead)	2.59 (1.18)	2.22 (1.06)		
Multiparous (%)	.68	.58		
Married (%)	.71	.84		
Ethnicity (%)				
European-American	.71	.68		
Hispanic	.16	.11		
African-American	.07	.16		
Other	.06	.05		
<i>Infants</i>				
Age at test weighing (days)	12.07 (1.89)	12.17 (1.82)		
Gestational age	37.53 (.51)	37.43 (0.61)		
Male (%)	.50	.50		
Birth weight (g)	3,356 (425.03)	3,234 (386.90)		
Length (cm)	51.48 (2.11)	50.36 (2.95)		
Head circumference (cm)	34.57 (1.58)	34.07 (1.54)		

^aDepressed mood was measured using the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987).

^bAnxiety was measured using the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1970).

Maternal Breastfeeding Behavior

To explore maternal depressed mood and anxiety in relation to maternal feeding behaviors, a MANOVA was conducted. The independent variables were depressed mood and anxiety. Dependent variables were sensitive positioning, frequency of touch, frequency of vocalization, and duration of feeding. Significant results were obtained for depressed mood, $F(4, 44) = 4.63, p < .01, \eta^2 = .29$; and anxiety, $F(4, 44) = 2.61, p < .05, \eta^2 = .19$. Follow-up with univariate tests revealed that depressed mood was associated with sensitive positioning, $F(1, 49) = 5.67, p < .05, \eta^2 = .11$; and frequency of touch, $F(1, 49) = 9.65, p < .01, \eta^2 = .12$. Anxiety was associated with frequency of touch, $F(1, 49) = 5.67, p < .05, \eta^2 = .11$. In sum, these results indicated that mothers' depressed mood was associated with breastfeeding behavior marked by poorer quality of positioning. Both depressed mood and maternal anxiety were found associated with frequency of touch, but in opposing directions. While depressed mood was associated with less frequent touch, anxiety was associated with more frequent touch.

Discussion

The present study explored whether the breastfed infant is placed at risk by exposure to a mother with depressed mood. In particular, we focused on infant weight gain. In line with predictions, we found that mothers with higher scores on a depression screening instrument (EPDS) had newborn infants showing lower weight gain. This finding supports reports of lower weight gain in breastfed infants that emerged from research on infant exposure to antidepressant drugs via the depressed mother's breast milk (Hendrick et al., 2003). It also supports population-based research that reported a transient association between infant weight gain and maternal depression during the early postpartum period (Wright, Parkinson, & Drewett, 2006). The present study adds to these reports by revealing that in the breastfed infant, linkages between low weight gain and maternal depressed mood are detectable by as early as the age of 12 days.

To help shed light on factors that may underlie low weight gain in the breastfed infant of a mother with depressed mood, we examined two biobehavioral measures of breastfeeding in infants, milk intake, and quality of latch to the breast. These were examined in relation to maternal depressed mood as well as mothers' symptoms of anxiety and with controls for infant age, birth weight, level of hunger at time of testing, and degree of exclusivity in

breastfeeding. As predicted, milk intake was found lower among infants of mothers with depressed mood. In line with previous research (Hill et al., 2005, 2006), maternal anxiety did not have effects independent of those relating to maternal depression. Findings on latch quality revealed that in comparison with infants of nondepressed mothers, those of mothers with depressed mood had greater difficulty staying latched to the breast. This finding extends previous research on infant of depressed mothers who, in situations outside breastfeeding, have been found less active and showing weaker orienting to other types of stimulation (Hernandez-Reif, Field, Diego, & Ruddock, 2006).

Mothers' depressed mood and anxiety were also explored in relation to maternal breastfeeding behavior. We found that in comparison with nondepressed mothers, mothers with depressed mood touched their infants less frequently. They also positioned their infants less sensitively to the breast. At times, this resulted in situations where in order to be latched to the breast, the infant's head was twisted, or her back was arched. These findings extend previous work on depressed mothers' interactions with their infants in situations outside breastfeeding, where depressed mothers' interactions have been characterized as insensitive and disengaged (Goodman & Brand, 2009; Murray & Cooper, 1997; Tronick & Reck, 2009). However, the results on maternal breastfeeding behavior depart from findings of research on depressed mothers who were breastfeeding 3-month-olds, whose behavior did not appear to be compromised by maternal depression (Field et al., 2010; Jones et al., 2004). The disparity could be due to differences in sample characteristics. The present study's participants were in the second week following childbirth. At this point, breastfeeding interactions are known to be disorganized, and include dyads who ultimately fail to establish breastfeeding.

Analyses of maternal behavior yielded one significant finding on maternal anxiety, an association with frequency of touch. In contrast with maternal depressed mood, which was found associated with reduced touch, maternal anxiety was found associated with increased touch. Whether this level of contact represents a protective influence typically associated with touch, or risk associated with hyperarousal as has sometimes been associated with maternal anxiety (Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001; Kaitz, Maytal, Devor, Bergman, & Mankuta, 2010) is an important question for future research.

The set of interrelationships, in which infant weight gain was inversely related to maternal depression, and positively associated with sensitive positioning by mother, quality of latch to mother's breast, and milk intake, is open to a number of interpretations. One possibility is

that maternal depression triggers hormonal events that inhibit lactogenesis, which, in turn, leads to low milk output, followed by low weight gain (Lawrence & Lawrence, 2005). However, we can also speculate that as a prelude to low milk output and low weight gain, suboptimal lactogenesis could be driven by the infant, whose weak latch to the breast fails to provide stimulation that is sufficient for promoting milk production (Daly & Hartmann, 1995). This, in turn, could precipitate maternal dissatisfaction with breastfeeding, leading to depression. This scenario, in which maternal depression emerges as an outcome, rather than as a causal influence, would be compatible with findings of a small scale study which reported that newborns who frequently detached from the breast had mothers who were more likely to become depressed by 2-months (Hewat, 1998). Neither of these scenarios preclude the contribution of other driving influences, such as breast milk composition, which differs with mothers' symptomatology relating to depressed mood (Hart et al., 2004). Further research is necessary to explore various synergistic pathways toward reduced weight gain in breastfed infants of mothers with depressed mood.

Strengths of the present study lie in its attention to an issue, breastfeeding in the context of mothers' depressed mood, a topic that has received scant attention despite the prevalence of maternal depression, and risk that it poses for breastfeeding cessation (Cooper et al., 1993; Dennis & McQueen, 2009; McCarter-Spaulding & Horowitz, 2007; Taveras et al., 2003). The study benefitted too from a mixed methods approach, in which survey, observational, and biobehavioral data yielded a detailed portrait of the phenomenon. However, it also included a number of limitations. This was a small scale, cross-sectional study in which a limited number of participants were seen at only a single point in time. Although power was adequate for testing our main predictions, the results need to be substantiated through research in which a larger and more diverse sample is followed over time. Greater inclusion of non-white and low-income families is needed in order to help establish representativeness. Other limitations were methodological. Our attention to mothers' depressed mood through use of a well-validated screening instrument, the EPDS, presents clinicians with methodology that can easily be replicated in a range of settings where nursing mothers are frequently seen, and so referrals can be applied more readily and in a timely manner. Still, we recognize that our findings need to be substantiated by investigative attention to maternal depression through diagnostic procedures based on clinical interviews.

Clinical implications of the present study's findings pertain to the management of lactation so that mothers

and infants can derive the full benefits of breastfeeding. The present study's findings reveal that in the breast fed neonate, low weight gain and feeding difficulties are associated with maternal depressed mood. Thus, clinicians should regard these features as possible indicators of mothers' depressed mood, and should encourage mothers to be screened and treated for depression. Mothers should also be encouraged to seek lactation counseling for advice on feeding behaviors, especially latch, sensitive positioning, and touch. By revealing that an association between feeding difficulty and maternal depressed mood is apparent by as early as 12 days, findings of the present study call for clinicians' early involvement in screening for maternal depression and referral for lactation support. Timely intervention could help prevent deleterious outcomes associated with formula feeding (American Academy of Paediatrics, 2005), slow weight gain (Emond et al., 2007) and maternal depression (Goodman & Brand, 2009; Murray & Cooper; 1997).

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