The Association of Breastfeeding Initiation with Sensitivity, Cognitive Stimulation, and Efficacy Among Young Mothers: A Propensity Score Matching Approach

Renee C. Edwards,¹ Matthew J. Thullen,² Linda G. Henson,¹ Helen Lee,³ and Sydney L. Hans¹

Abstract

Objective: This study examined the association between breastfeeding initiation and maternal sensitivity, efficacy, and cognitive stimulation among young, low-income, African American mothers.

Subjects and Methods: Two hundred twenty-one mothers were interviewed during pregnancy, at birth, and at 4 months postpartum regarding breastfeeding and parenting. Medical records were collected after birth, and mother–infant interactions were videotaped at 4 months. Propensity score matching was used to address selection bias by matching breastfeeding and nonbreastfeeding mothers on characteristics measured prior to breastfeeding.

Results: One hundred twenty-four (56%) mothers initiated breastfeeding. After matching, mothers who initiated breastfeeding reported greater parenting efficacy (effect size, $d=0.44$) and were observed to be more sensitive with their 4-month-old infants (effect size, $d=0.42$) than nonbreastfeeding mothers. Breastfeeding was marginally associated with less maternal intrusiveness (effect size, $d=0.28$) but was not related to parenting attitudes or cognitive stimulation.

Conclusions: This study presents evidence supporting the claim that breastfeeding may enhance maternal efficacy and sensitivity. Providing breastfeeding support to young mothers may have effects that extend beyond maternal and child health outcomes to parenting and mother–child interactions.

Introduction

THE QUALITY OF THE MOTHER–INFANT relationship is an important aspect of the early caregiving environment that sets the foundation for children's development. Maternal sensitivity in response to infant cues is related to later social-emotional development,¹ and maternal verbal stimulation and encouragement are associated with both social-emotional and cognitive development.^{2,3} Positive parenting attitudes and self-efficacy with regard to parenting have also been associated with cognitive development and lower levels of behavior problems in young children.⁴

Although it is well established that there are numerous maternal and infant health benefits associated with breastfeeding,⁵ it has also been claimed that breastfeeding can provide long-term benefit for the mother–infant relationship by stimulating more sensitive maternal behaviors and attitudes^{6–8} and preventing problems, such as maternal neglect.⁹ Studies have shown that breastfeeding mothers touch their infants more frequently, experience a greater desire to hold their infants, smile and talk affectionately to their infants more

often, engage in more mutual contact, are more sensitive, and display higher levels of positive affect while playing when compared with nonbreastfeeding mothers.^{8,10–13} There is also some evidence to suggest that breastfeeding may enhance mothers' feelings of competence in their parenting role.¹⁴

Because mothers cannot be randomly assigned to breastfeed or formula feed, selection bias has remained a serious limitation in understanding whether a causal relationship may exist between breastfeeding and parenting outcomes. Differences in demographic and psychosocial characteristics between breastfeeding and nonbreastfeeding mothers may explain observed differences in their parenting behaviors and attitudes.⁶ It may be that mothers who are already more likely to show positive parenting are those who choose to breastfeed. The current study attempts to address this limitation through propensity score matching, an advanced statistical technique used to account for maternal characteristics that may confound the association between breastfeeding initiation and subsequent parenting outcomes.¹⁵ This study focuses on a sample of young, low-income, African American mothers, a population that typically has low rates of

¹School of Social Service Administration and ³Department of Comparative Human Development, The University of Chicago, Chicago, Illinois.

²School of Health Professions, University of Missouri, Columbia, Missouri.

breastfeeding^{16,17} and may experience difficulties in parenting young infants, given the stressors they face and their limited access to support and resources.^{18–21}

Based on previous research, we hypothesized that mothers who initiated breastfeeding would report more sensitive parenting attitudes and feel more efficacious in caring for their infants than nonbreastfeeding mothers. We also expected that breastfeeding initiation would be associated with observations of greater maternal sensitivity and less intrusiveness in mother–infant interactions. Because some evidence suggests that breastfeeding may enhance children's cognitive development,²² we were interested in examining whether breastfeeding may also be related to maternal stimulation of development. However, because previous research examining associations between breastfeeding and maternal support for learning is limited, we did not have a strong *a priori* hypothesis.

Subjects and Methods

Sample

Pregnant women were recruited from prenatal clinics affiliated with a major urban university hospital to participate in a study of community doula services.²³ Women were eligible if they were under the age of 22 years, less than 34 weeks of gestation, planned to deliver at the university hospital, intended to remain in the area for 2 years, planned to keep custody of the infant, and had no medical condition at the time of enrollment that would require a surgical delivery. Of 468 women who were approached, 248 agreed to participate in the study and completed the baseline (prenatal) interview. All participants were African American, 94% received Medicaid, and the majority (88%) were giving birth for the first time. At the time of enrollment (baseline), 77% of the young women resided with a parent figure, and 69% were in a partner relationship with the father of the baby. Mothers ranged in age from 14 to 21 years (mean = 18.3 years, SD = 1.7 years) at the birth. At the completion of the baseline interview, mothers were randomly assigned to receive either community doula services²³ ($n = 124$) or regular clinic and hospital medical and social services ($n = 124$). 221 mothers remained in the study at the 4-month follow-up and are the focus of the present investigation. Reasons for sample attrition included inability to locate mothers ($n = 24$), infant death ($n = 2$), and refusal to participate ($n = 1$). Sample retention was unrelated to maternal baseline characteristics or participation in doula services.²³

Procedures

Written informed consent was obtained by research staff following procedures approved by the university's Institutional Review Board before collecting data. At the baseline interview, mothers were asked questions related to their pregnancy, family background, current relationships, health, and work/school experiences. At the hospital following the birth, mothers were interviewed about their birth experiences and breastfeeding/feeding practices. After discharge, medical charts were reviewed for breastfeeding and infant admission to the neonatal intensive care unit or other special care nurseries.

Mothers and infants returned for follow-up when the infants were 4 months old. These visits took place in a research

room and included a video session of mother–infant interaction and an interview in which the mothers were asked about their parenting, experiences as a mother, infant feeding practices, and health. Mothers received a small payment for the interview sessions, were reimbursed transportation costs, and were given a copy of the videorecording.

Measures

Breastfeeding initiation. Information about breastfeeding was collected from the birth interviews with mothers at the hospital 1 day postpartum and from review of nursing notes in the mothers' medical charts. At the 4-month interview, mothers were asked about their duration of breastfeeding. For the current analysis, breastfeeding initiation is defined as breastfeeding at least through the mother's hospital stay following the birth. This operationalization has been used in prior studies examining the association between breastfeeding and sensitivity.⁶

Parenting outcomes. During the 4-month interview, the mothers' feelings of parenting efficacy were assessed using the Maternal Self-Efficacy Scale,²⁴ which includes questions about how competent the mother feels in relation to specific domains of infant care such as soothing the baby, understanding the baby's needs, and maintaining joint attention and interaction. Mothers responded to 10 items on a 4-point Likert scale ($\alpha = 0.56$). This scale has shown good internal consistency and has been related to observed maternal behavior.²⁴

Maternal attitudes about sensitive and appropriate parenting were assessed using 12 items from the Adult-Adolescent Parenting Inventory.²⁵ Three items from each of the following subscales were included based on high factor loadings in previous work and relevance to infancy: inappropriateness of developmental expectations, lack of empathic awareness of children's needs, endorsement of corporal punishment, and reversal of parent–child roles. Mothers responded to each item on a 5-point Likert scale, with higher scores indicating attitudes less sensitive to the perspective of the child ($\alpha = 0.61$).

At 4 months, mothers were asked to engage in several activities with their infants, including undressing, weighing, and redressing the infant and showing the infant a new rattle. These mother–infant interactions lasted approximately 15 minutes and were videorecorded. The interactions were coded using National Institute of Child Health and Development rating scales by two graduate student raters who were blinded to information about mother and infant.²⁶ Three 4-point global rating scales were used in the present study: maternal sensitivity to infant nondistress (e.g., engagement, responsiveness to infant signals), maternal intrusiveness (e.g., overstimulation, mother-centered vs. infant-centered interactions), and maternal stimulation of cognitive development (e.g., expanding on infant vocalizations, describing objects). Inter-rater reliability on each dimension was greater than 0.90.

Covariates. Demographic information and maternal characteristics measured at the baseline (prenatal) interview that conceptually and/or empirically may be related to both breastfeeding and parenting outcomes were considered for use as covariates in the propensity score model. These variables include maternal age, parity, whether the mother had breastfed other children, relationship with the father of the baby, plans to return to work/school, knowledge that her own mother breastfed,

depressive symptoms (CES-D Scale),²⁷ history of conduct problems, comfort in close relationships (The Relationship Orientation Inventory),²⁸ inappropriate parenting attitudes (Adult-Adolescent Parenting Inventory),²⁵ fondness of children (Childbearing Attitudes Questionnaire),²⁹ and sense of mastery (Pearlin Mastery Scale).³⁰ Mothers were also administered the Peabody Picture Vocabulary Test,³¹ in order to assess general verbal ability.

In addition, the propensity score model included whether mothers received specialized services during pregnancy and at childbirth. Roughly half ($n = 108$) of the mothers received perinatal support services from a community doula whose work focused on preparation for childbirth, labor support, healthcare practices, breastfeeding, and the mother–infant relationship.²³ Of the infants, 28% ($n = 61$) were admitted to a special care nursery at birth because of medical concerns about either the infant or the mother. Previous research has shown that mothers whose infants are admitted to the neonatal intensive care unit may be less likely to breastfeed³² and may interact with their young infants in different ways than other mothers.³³

Data analysis

Although randomized controlled trials are often considered to be the gold standard in research design, it is impossible and unethical to study some complex human behaviors using this method: mothers cannot be randomly assigned to breastfeed or not breastfeed their infants. Therefore, propensity score matching was used to statistically address the problem of selection bias.¹⁵ Propensity score methods are increasingly being applied across academic disciplines to estimate causal effects using observational data. A propensity score is the conditional probability of an individual being exposed to a treatment given a set of preexisting covariates.¹⁵ In this case, breastfeeding initiation is considered the “exposure” condition, and never breastfeeding is the “non-exposure” condition. Propensity scores were estimated for the entire sample, and mothers who initiated breastfeeding were then matched with nonbreastfeeding mothers on the basis of sharing similar propensity scores.

Estimating propensity scores first involved choosing a set of variables that theoretically and/or empirically may be predictive of both breastfeeding initiation and parenting outcomes.^{34,35} Because these covariates must be unaffected by breastfeeding or the anticipation of breastfeeding, all covariates included in the propensity score model were measured prior to breastfeeding initiation,³⁵ either at the baseline interview or, in the case of special care nursery admission, immediately following the birth.

In order to examine associations between numerous baseline covariates (see variables included in Table 1) and both breastfeeding initiation and 4-month parenting outcomes, t tests and chi-square tests of association were conducted. Three maternal characteristics were significantly associated with breastfeeding initiation ($p < 0.05$): mothers with higher verbal abilities, more sensitive parenting attitudes, and knowledge that their own mother breastfed were more likely to initiate breastfeeding (see Table 1). Additionally, mothers who received community doula services were more likely to initiate breastfeeding,³⁶ and mothers whose infants were admitted to a special care nursery were less likely to initiate breastfeeding. These three maternal

TABLE 1. BASELINE MATERNAL CHARACTERISTICS AND INFANT NEONATAL INTENSIVE CARE UNIT STATUS BEFORE AND AFTER MATCHING

Covariate	Original (unmatched) sample		Matched sample		Test statistic
	Breastfeeding ($n = 124$)	Nonbreastfeeding ($n = 97$)	Breastfeeding ($n = 77$)	Nonbreastfeeding ($n = 77$)	
Own mother breastfed [n (%)] ^a	51 (41.1%)	27 (27.8%)	28 (36.4%)	24 (31.2%)	$\chi^2(1) = 4.21^b$
Verbal ability [mean (SD)] ^a	148.18 (16.8)	142.79 (18.8)	147.48 (16.7)	145.42 (17.4)	$t = 2.23^b$
Insensitive parenting attitudes [mean (SD)] ^a	33.5 (5.3)	35.5 (5.8)	33.68 (5.3)	34.32 (5.4)	$t = -2.63^c$
Received doula services [n (%)] ^a	69 (55.7%)	39 (40.2%)	37 (48.1%)	35 (45.5%)	$\chi^2(1) = 5.19^b$
Infant NICU admission [n (%)] ^a	24 (19.4%)	37 (38.1%)	18 (23.4%)	21 (27.3%)	$\chi^2(1) = 9.62^c$
Maternal age (years) at birth [mean (SD)]	18.37 (1.6)	18.20 (1.8)	18.39 (1.7)	18.21 (1.9)	$t = 0.70$
Has other children [n (%)]	13 (10.5%)	14 (14.4%)	7 (9.1%)	11 (14.3%)	$\chi^2(1) = 0.79$
Breastfed other children [n (%)]	9 (7.3%)	6 (6.3%)	6 (7.8%)	4 (5.2%)	$\chi^2(1) = 0.09$
Plans to return to work/school [n (%)]	119 (96.0%)	93 (96.9%)	74 (96.1%)	73 (94.8%)	$\chi^2(1) = 0.12$
Partnered with father of baby [n (%)]	83 (66.9%)	69 (71.1%)	49 (63.6%)	58 (75.3%)	$\chi^2(1) = 0.45$
Depressive symptoms [mean (SD)]	16.71 (8.7)	15.9 (9.2)	16.55 (8.9)	14.32 (7.6)	$t = 0.70$
Conduct problems (yes/no) [n (%)]	67 (54.0%)	54 (55.7%)	34 (44.2%)	42 (54.5%)	$\chi^2(1) = 0.06$
Sense of mastery [mean (SD)]	11.60 (2.9)	12.12 (3.0)	11.53 (3.0)	11.92 (2.5)	$t = -1.31$
Comfort in close relationships [mean (SD)]	22.35 (5.2)	22.81 (4.4)	22.09 (5.1)	22.81 (4.6)	$t = -0.70$
Fondness of children [mean (SD)]	24.2 (4.3)	24.1 (3.7)	24.45 (4.5)	24.30 (3.6)	$t = 0.23$

^aCovariates included in the propensity score model.

^b $p < 0.05$, ^c $p < 0.01$.

NICU, neonatal intensive care unit.

characteristics, participation in doula services, and infant admission to a special care nursery were also each significantly associated with at least one of the 4-month parenting outcomes (efficacy, sensitive attitudes, sensitivity, intrusiveness, and stimulation). Therefore, these five covariates were used in the model to predict propensity scores.

Propensity scores were estimated using a logistic regression model, and good model fit was achieved [likelihood ratio $\chi^2(5)=27.44$, $p=0.001$]. After propensity scores were obtained, nearest neighbor (1-1) matching using nonreplacement and a caliper of 0.25 SD of the estimated propensity score was used to create the matched sample. In order to check for covariate balance, that is, how well the matching procedure resulted in a breastfeeding group and nonbreastfeeding group that were comparable on characteristics measured prior to breastfeeding, the standardized bias before and after matching was calculated for each covariate included in the propensity score model. The standardized bias is the difference in the sample means between the breastfeeding and nonbreastfeeding groups in terms of the pooled SD.³⁷ Additionally, t tests and chi-square tests were used to compare breastfeeding mothers and nonbreastfeeding mothers in the matched sample on all baseline characteristics considered for the model, participation in doula services, and infant special care nursery admission in order to ensure that there were no remaining significant differences between the groups.

In order to examine our hypotheses, we computed mean differences in maternal efficacy, sensitive parenting attitudes, maternal sensitivity, intrusiveness, and stimulation of cognitive development at 4 months postpartum between mothers who initiated breastfeeding and nonbreastfeeding mothers in the matched sample. Standard errors were calculated using the Abadie-Imbens method³⁸ in order to account for the fact that the propensity scores were estimated. To determine statistical significance, t statistics were used. Effect sizes (Cohen's d) were also calculated to indicate the standardized mean differences between breastfeeding and nonbreastfeeding mothers on each of these outcomes.

Results

In the original (unmatched) sample, 56% ($n=124/221$) of the mothers initiated breastfeeding. Of the mothers who initiated breastfeeding, 30% ($n=37/124$) discontinued breastfeeding in the week after hospital discharge, 40% ($n=50/124$) breastfed longer than 6 weeks, and 11% ($n=14/124$) were still breastfeeding at the 4-month postpartum interview. Propensity

score matching generated a new sample of 154 mothers ($n=77$ breastfeeding, $n=77$ nonbreastfeeding) and achieved adequate balance on all 15 covariates, including the five used in the propensity score model and the 10 additional baseline characteristics not included in the propensity score model because they were uncorrelated with breastfeeding. The mean standardized bias across the five covariates used in the propensity score model prior to matching was 0.35, but it was reduced to 0.10 after matching, and no covariate had a standardized bias greater than 0.12. Additionally, results of t tests and chi-square tests further demonstrate that there were no significant differences in any covariates between mothers in the matched sample who initiated breastfeeding and those who never breastfed (Table 1).

Mean differences in 4-month parenting outcomes between breastfeeding and nonbreastfeeding mothers in the matched sample showed that mothers who initiated breastfeeding reported significantly greater feelings of maternal efficacy (effect size, $d=0.44$) and were observed to show greater sensitivity while interacting with their infants (effect size, $d=0.42$) at 4 months of age (Table 2). There were no significant differences in sensitive parenting attitudes or observed stimulation of cognitive development between mothers who did and did not initiate breastfeeding. Breastfeeding mothers were found to be marginally less intrusive toward their infants compared with nonbreastfeeding mothers (effect size, $d=0.28$; $p<0.10$).

Discussion

This investigation presents evidence supporting the claim that breastfeeding may enhance parenting efficacy and maternal sensitivity. Although correlational studies have reported more positive maternal behaviors and attitudes among mothers who initiate breastfeeding,^{6-8,10-14} this study addresses the selection biases inherent in prior research by comparing breastfeeding and nonbreastfeeding mothers matched according to their propensity for breastfeeding measured prior to breastfeeding initiation. The results show that mothers who initiated breastfeeding reported greater efficacy in their parenting and were observed to be more sensitive when interacting with their infants at 4 months postpartum.

These results are important not only because they advance our understanding of the link between breastfeeding and other aspects of parenting but they do so within a sample of young, low-income, African American mothers. A recent national study showed that only 30% of black adolescent mothers had ever attempted breastfeeding.¹⁷ Young, "at-risk" mothers are

TABLE 2. MEAN DIFFERENCES IN PARENTING OUTCOMES BETWEEN BREASTFEEDING AND NONBREASTFEEDING MOTHERS IN UNMATCHED AND MATCHED SAMPLES

Parenting outcomes (at 4 months)	Original (unmatched) sample		Matched sample	
	Mean difference (SE) (breastfeeding versus nonbreastfeeding)	Effect size (d)	Mean difference (SE) (breastfeeding versus nonbreastfeeding)	Effect size (d)
Maternal efficacy	0.96 (0.36) ^c	0.37	1.12 (0.41) ^c	0.44
Insensitive parenting attitudes	-1.95 (0.74) ^c	0.36	-0.68 (0.81)	0.14
Observed maternal sensitivity	0.23 (0.08) ^c	0.38	0.26 (0.10) ^c	0.42
Observed maternal intrusiveness	-0.10 (0.08)	0.16	-0.17 (0.10) ^a	0.28
Observed maternal stimulation	0.22 (0.11) ^b	0.29	0.07 (0.13)	0.08

^a $p<0.10$, ^b $p<0.05$, ^c $p<0.01$.

also frequently found to display less sensitive parenting behavior and attitudes than older, more socially advantaged mothers.^{18–21} Given that large proportions of young, African American mothers never even attempt to breastfeed, the current findings provide further support for efforts to increase breastfeeding rates among these mothers, as breastfeeding may not only improve maternal and child health outcomes but also enhance the parenting experience and the mother–infant relationship through more positive maternal behaviors. Although the breastfeeding and nonbreastfeeding mothers did not differ in their general feelings of efficacy/mastery during pregnancy, mothers who initiated breastfeeding felt more confident in their abilities to understand their infants' needs, soothe their infants, and care for their infants at 4 months of age.

A variety of mechanisms may be responsible for the association between breastfeeding initiation and positive parenting outcomes. Oxytocin and other neuropeptides released during breastfeeding are known to be involved in human bonding and parenting behavior,³⁹ and some evidence suggests that breastfeeding may promote enhanced activation in brain regions that correlate with maternal sensitivity.⁴⁰ Breastfeeding mothers may spend more time with their infants early on because they are fully responsible for feedings, whereas family members and nurses can share in the feeding for formula-fed infants. Successful breastfeeding requires attention to an infant's behavioral cues and body position, and, as a result, breastfeeding mothers may become more aware of and responsive to their infant's needs. As mothers succeed in feeding, they may feel increased confidence in their abilities to care for their infants. In the hospital, young mothers who initiate breastfeeding may receive positive feedback and enhanced support from medical staff, family members, and other support figures, which in turn may increase their feelings of competency in caring for their infants. They may also receive increased support with their early parenting efforts.

The effect sizes are in the small to moderate range; however, they are comparable to those found in studies of interventions designed to enhance maternal sensitivity⁴¹ and are noteworthy given that many of the mothers in this sample breastfed for only a short duration. Young and high-risk mothers often face numerous barriers to breastfeeding, particularly when they return to their homes and communities, which makes it challenging to promote long-term breastfeeding in this population.^{42,43} Although exclusive, sustained breastfeeding should be encouraged, the findings presented here suggest some benefit even among young mothers who only initiate but are unable to sustain their efforts after returning home. Although these mothers may not experience all the health benefits associated with longer-term breastfeeding, early breastfeeding attempts may enhance their parenting and promote positive mother–infant interactions.

In this study, breastfeeding initiation was not related to parenting attitudes or maternal stimulation and was only marginally associated with less intrusiveness when analyses were conducted on the matched sample. Breastfeeding may have positive effects on specific aspects of parenting but not enhance other parenting behaviors that are also important to the mother–infant relationship and child development. Prior to matching on propensity scores, the breastfeeding mothers were observed to be more stimulating with their infants and held more sensitive parenting attitudes than the nonbreastfeeding mothers. This suggests that other maternal characteristics, such as verbal

ability or previously held parenting attitudes, likely influenced both the mother's decision to breastfeed and these parenting outcomes and accounted for the association between the two in the unmatched sample.

Strengths and limitations

There are several notable strengths and limitations of the current study. A rich set of maternal characteristics, including demographics, psychological characteristics, relationships, and feelings about parenting and children, that could potentially influence both the mother's choice to breastfeed and her parenting was considered for the model predicting propensity scores. After matching, there were no significant differences on any maternal characteristics between breastfeeding and nonbreastfeeding mothers, which provides us with reasonable confidence that the estimates of the effects are unbiased. Additionally, data were collected from multiple sources, including mothers' reports, medical charts, and observations of mother–infant interactions, which reduces potential biases associated with relying on only one source.

This study used a sample of young, low-income African American mothers, and therefore caution must be used in generalizing findings to all mothers or even to other groups of young mothers. Second, although a fairly comprehensive set of maternal characteristics was considered for inclusion in the propensity score model, it is possible that other important unmeasured variables were left out, which could have resulted in biased estimates of the effect sizes. Third, because many mothers in this sample only breastfed for a short period of time, it was not possible to examine whether duration of breastfeeding was related to parenting outcomes using a propensity score approach.

Future research using propensity score matching with larger, diverse samples could more closely examine the role of breastfeeding initiation and duration in parenting outcomes. Studies should also consider other aspects of early breastfeeding, such as timing of initiation, exclusive breastfeeding, and skin-to-skin contact during feedings, especially in light of recent work suggesting that immediate, uninterrupted, and skin-to-skin mother–infant contact following the birth may promote more gentle handling during breastfeeding in the postpartum period.⁴⁴ Finally, future work should test whether breastfeeding has sustained positive effects on mother–infant interactions beyond the first months of infancy.

Conclusions

Findings from the current study suggest that breastfeeding may enhance maternal sensitivity and parenting efficacy. Efforts to strengthen and expand programs to increase breastfeeding rates among young pregnant women should be continued. Hospital staff should be encouraged to support breastfeeding among this group of mothers given that even a very short duration of breastfeeding may promote positive parenting outcomes.

Acknowledgments

The authors would like to thank the dedicated research staff, including Nicole Gallicchio, Christine Glover Grela, Natalie Jacobson-Dunlop, Cynthia Lashley, Christine Nutter El Ouardani, Lara Perez-Longobardo, Jane Schreiber, Melissa

Singer, Lindsey Walton, and Jessica Whitham, for conducting interviews and videotaping; Laura Walton and Bianca Pullen, for medical chart abstraction; Adjoa Tetteh, for coding video-recordings; and Eric Van Lente, for creating the database. The authors would also like to thank the young mothers who participated in the study. All phases of the research study reported in this article were supported by grant R40 MC 00203 from the Maternal and Child Health Bureau Research Program, Health Resources and Services Administration, U.S. Department of Health and Human Services.

Disclosure Statement

No competing financial interests exist.

References

1. Leerkes EM, Weaver JM, O'Brien M. Differentiating maternal sensitivity to infant distress and non-distress cues. *Parent Sci Pract* 2012;12:175–184.
2. Landry SH, Smith KE, Swank PR. Responsive parenting: Establishing early foundations for social, communication, and independent problem-solving skills. *Dev Psychol* 2006; 42:627–642.
3. Shonkoff J, Phillips D. *From Neurons to Neighborhoods: The Science of Early Childhood Development*. National Academy Press, Washington, DC, 2000.
4. Coleman PK, Karraker KH. Maternal self-efficacy beliefs, competence in parenting, and toddlers' behavior and developmental status. *Infant Ment Health J* 2003;24:126–148.
5. American Academy of Pediatrics. Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics* 2012;129:e827–e841.
6. Britton JR, Britton HL, Gronwaldt V. Breastfeeding, sensitivity, and attachment. *Pediatrics* 2006;118:e1436–e1443.
7. Gutman LM, Brown J, Akerman R. *Nurturing Parenting Capability: The Early Years*. Centre for the Wider Benefits of Learning, Institute of Education, London, 2009.
8. Pearson RM, Lightman SL, Evans J. The impact of breastfeeding on mothers' attentional sensitivity towards infant distress. *Infant Behav Dev* 2011;34:200–205.
9. Strathearn L, Mamun AA, Naiman JM, et al. Does breastfeeding protect against substantiated child abuse and neglect? A 15-year cohort study. *Pediatrics* 2009;132:483–493.
10. Richards MP, Bernal JF. An observational study of mother-infant interaction. In: *Ethological Studies of Child Behaviour*. Cambridge University Press, Oxford, United Kingdom, 1972, pp. 175–197.
11. Dunn JB, Richards, MPM. Observations on the developing relationship between mother and baby in the neonatal period. In: Schaffer HR, ed. *Studies in Mother-Infant Interaction*. Academic Press, New York, 1977, pp. 427–455.
12. Kuzela AL, Stifter CA, Worobey J. Breastfeeding and mother-infant interactions. *J Reprod Infant Psychol* 1990;8: 185–194.
13. Lavelli M, Poli M. Early mother-infant interaction during breast- and bottle-feeding. *Infant Behav Dev* 1998;21:667–683.
14. Tarkka M-T. Predictors of maternal competence by first-time mothers when the child is 8 months old. *J Adv Nurs* 2003;41:233–240.
15. Rosenbaum PR, Rubin DB. The central role of the propensity score in observational studies for causal effects. *Biometrika* 1983;70:41–55.
16. Li R, Darling N, Maurice E, et al. Breastfeeding rates in the United States by characteristics of the child, mother, or family: The 2002 National Immunization Survey. *Pediatrics* 2005;115:e31–e37.
17. McDowell MM, Wang C-Y, Kennedy-Stephenson J. Breastfeeding in the United States: Findings from the National Health and Nutrition Examination Surveys, 1999–2006. *NCHS Data Brief* 2008;(5):1–8.
18. Baranowski MD, Schilmoeller GL, Higgins BD. Parenting attitudes of adolescent and older mothers. *Adolescence* 1990; 25:781–790.
19. Berlin LJ, Brady-Smith C, Brooks-Gunn J. Links between childbearing age and observed maternal behaviors with 14-month-olds in the Early Head Start Research and Evaluation Project. *Infant Ment Health J* 2002;23:104–129.
20. Pomerleau A, Scuccimarrì C, Malcuit G. Mother-infant behavioral interactions in teenage and adult mothers during the first six months postpartum: Relations with infant development. *Infant Ment Health J* 2003;24:495–509.
21. Lee Y. Early motherhood and harsh parenting: The role of human, social, and cultural capital. *Child Abuse Negl* 2009; 33:625–637.
22. McCrory C, Layte R. The effect of breastfeeding on children's educational test scores at nine years of age: Results of an Irish cohort study. *Soc Sci Med* 2011;72: 1515–1521.
23. Hans SL, Thullen M, Henson LG, et al. Promoting positive mother-infant relationships: A randomized trial of community doula support for young mothers. *Infant Ment Health J* 2013;34:446–457.
24. Teti DM, Gelfand DM. Behavioral competence among mothers of infants in the first year: The mediational role of maternal self-efficacy. *Child Dev* 1991;62:918–929.
25. Bavolet SJ. *Handbook of the AAPI*. Family Development Resources, Eau Claire, WI, 1984.
26. NICHD Early Child Care Research Network. Child care and mother-child interaction in the first 3 years of life. *Dev Psychol* 1999;35:1399–1413.
27. Radloff LS. The CES-D Scale: A self-report depression scale for research in the general population. *Appl Psychol Meas* 1977;1:385–401.
28. Simpson JA, Rholes WS, Nelligan JS. Support seeking and support giving within couples in an anxiety-provoking situation: The role of attachment styles. *J Pers Soc Psychol* 1992;62:434–446.
29. Ruble DN, Brooks-Gunn J, Fleming AS, et al. Transition to motherhood and the self: Measurement, stability, and change. *J Pers Soc Psychol* 1990;58:450–463.
30. Pearlin LI, Lieberman MA, Menaghan EG, et al. The stress process. *J Health Soc Behav* 1981;22:337–356.
31. Dunn LM, Dunn LM. *PPVT: Peabody Picture Vocabulary Test—Third Edition (PPVT-III)*. Pearson Assessments, Bloomington, MN, 1997.
32. Epsy KA, Senn, TE. Incidence and correlates of breast milk feeding in hospitalized preterm infants. *Soc Sci Med* 2003;57: 1421–1428.
33. Stern M, Karraker K, McIntosh B, et al. Prematurity stereotyping and mothers' interactions with their premature

- and full-term infants during the first year. *J Pediatr Psychol* 2006;31:597–607.
34. Austin PC, Grootendorst P, Anderson GM. A comparison of the ability of different propensity score models to balance measured variables between treated and untreated subjects: A Monte Carlo study. *Stat Med* 2006;26:734–753.
 35. Caliendo M, Kopenig S. Some practical guidance for the implementation of propensity score matching. *J Econ Surv* 2008;22:31–72.
 36. Edwards RC, Thullen MJ, Korfmacher J, et al. Breastfeeding and complementary food: Randomized trial of community doula home visiting. *Pediatrics* 2013;132(Suppl 2):S160–S166.
 37. Rosenbaum PR, Rubin DB. Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *Am Stat* 1985;39:33–38.
 38. Abadie A, Imbens G. Large sample properties of matching estimators for average treatment effects. *Econometrika* 2006;74:235–267.
 39. Heinrichs M, von Dawans B, Domes G. Oxytocin, vasopressin, and human social behavior. *Front Neuroendocrinol* 2009;30:548–557.
 40. Kim P, Feldman R, Mayes LC, et al. Breastfeeding, brain activation to own infant cry, and maternal sensitivity. *J Child Psychol Psychiatry* 2011;52:907–915.
 41. Bakermans-Kranenburg MJ, van IJzendoorn MH, Juffer F. Less is more: Meta-analyses of sensitivity and attachment interventions in early childhood. *Psychol Bull* 2003;129:195–215.
 42. Apostolakis-Kyrus K, Valentine C, DeFranco E. Factors associated with breastfeeding initiation in adolescent mothers. *J Pediatr* 2013;163:1489–1494.
 43. Furman LM, Banks EC, North AB. Breastfeeding among high-risk inner-city African American-American mothers: A risky choice? *Breastfeed Med* 2013;8:58–67.
 44. Dumas L, Lepage M, Bystrova K, et al. Influence of skin-to-skin contact and rooming-in on early mother-infant interaction: A randomized controlled trial. *Clin Nurs Res* 2013;22:310–336.

Address correspondence to:
 Renee C. Edwards, PhD
 School of Social Service Administration
 The University of Chicago
 969 East 60th Street
 Chicago, IL 60637

E-mail: rcduffy@uchicago.edu