

Potential Impact of Breastfeeding and Maternal Sensitivity during the First Year of Life: An Integrative Review of the Literature

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Abstract

Background: Poor maternal sensitivity leads to insecure infant attachment, and has been associated with negative cognitive consequences later in life. Maternal sensitivity is an indicator of the interactions between mothers and infants characterized by mutual and concurrent interchanges. The aim of the study is to review and synthesize all published studies that examine the potential effect of breastfeeding on maternal sensitivity during the first year of life.

Materials and Methods: Searches were conducted using the following databases: Medline (via PubMed), CINAHL, and SCOPUS. Inclusion criteria were as follows: published in English, and no limitation on publication date. Articles were excluded if they did not focus on the main concepts of this review, maternal sensitivity, if they focused on the physiological aspects of breastfeeding or if they included children breastfed after one year of age.

Results: Nineteen out of 60 articles met the inclusion criteria. All of the studies that were identified for this review were quantitative. Four categories emerged from these studies: Potential effects of breastfeeding on maternal sensitivity; Potential effects of breastfeeding-related environment on maternal sensitivity; Potential effects of infant's health on maternal sensitivity, and No potential effect of breastfeeding on maternal sensitivity.

Conclusion: There is strong evidence that a relationship exists between breastfeeding and maternal sensitivity. However, that relationship is not well-defined. Identification of breastfeeding as a factor to enhance maternal sensitivity for newly and multi-children mothers will or may assist health care providers and social workers to help mothers improve their interactions with their infants to an optimal level.

Key Words: Attachment, Breastfeeding, Formula Feeding, Maternal Sensitivity.

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1- INTRODUCTION

Breastfeeding is defined as the transfer of human milk from the mothers' breast to the infant. Not only is breast milk an optimal form of infant feeding, but it also supports optimum growth and development for human infants (1). However, many mothers discontinue breastfeeding before their infants are six months of age. Breastfeeding rates in the United States were reported at the highest levels in US history. According to the Centers for Disease Control and Prevention (CDC) more than 75% of new mothers initiated breastfeeding in the hospital (2), yet only 40% of breastfeeding mothers continued to breastfeed their infants for six months as recommended by the World Health Organization (1). The CDC reported that if 75% of United States mothers breastfed their children for at least three months after childbirth, it would lead to an average savings of thirteen billion dollars per year in health care costs and prevent the number of infant deaths per year (2). Despite the positive health impact of breastfeeding for infants and their mothers, the rate of breastfeeding among mothers in the US today remains below the levels recommended by WHO (3).

Much of the breastfeeding literature focuses on advantages that breastfeeding has for the infant, such as the transfer of nutrients and antibodies that help with immunity. But there is also evidence that breastfeeding has a significant role in shaping maternal sensitivity (4). Maternal sensitivity is defined as the mother's ability to recognize and respond to infant cues consistently and is critical to interactions that influence infant development (2). Mother-infant interactions are characterized by mutual and concurrent interchanges, and are often referred to as the "mother-infant dance" (6). If the mother is able to understand and respond appropriately to her infant's cues, then she can provide an appropriate and

secure base for exploration by the infant, watching over and protecting the infant when necessary (7). The mother's interaction with her baby during the infancy period has been reported as a predictor of infant mental health, cognitive abilities, and physical health later in life (3). Studies like this suggest that maternal sensitivity plays a key role in their infants' lifelong development (7, 8). However, even after decades of research, there is little evidence available to identify mothers and infants at risk of insecure attachment that cause psychological and physical health problems, mediated and enhanced by maternal sensitivity.

Also, few interventions have been identified that improve maternal sensitivity and include support from family and friends and caregiving classes during the prenatal period (9). The purpose of this paper was to review and synthesize published literature on breastfeeding and maternal sensitivity and will address the following question: What is the Potential effect of breastfeeding on maternal sensitivity during the first year of life? The first year of life is the foundation that shapes children's future health, growth, development and achievement at school and in life in general. Moreover, the first year of life is the most critical in shaping the child's brain architecture. Early experiences provide the foundation for the brain's organizational development and functioning throughout life (10).

2- MATERIALS AND METHODS

The literature search was conducted using the following electronic databases: Medline (via PubMed), CINAHL, and Scopus. The following search terms were used: "maternal sensitivity" AND "breastfeeding", "maternal responsiveness" AND "breastfeeding", "mother-infant interaction" AND "breastfeeding". The scope of the search was later expanded to include a reference list of related articles,

including dissertations, theses, conference proceedings, editorials, opinions and theoretical articles (**Figure.1**). Articles were screened with the overall goal of identifying data-based studies that focused specifically on the relationship between the two concepts: breastfeeding and maternal sensitivity. Inclusion criteria were as follows: 1) published in English, and 2) no limitation on publication date. Articles were excluded: 1) if they did not focus on the main concepts of this review (breastfeeding and maternal sensitivity), 2) if they focused only on the physiological aspects of breastfeeding and maternal sensitivity, or 3) if they included children breastfed after one year of age. Each abstract was thoroughly evaluated since the title often was insufficient to judge the relevancy of a given study for this review. If the abstract was relevant to the focus of

this review, the article was transferred to the data-management software Endnote. Out of 50 articles, 19 papers met the inclusion criteria. The table at the end of this paper provides a detailed description of the articles that are included in this literature review. A knowledge-management method using a Word table was created to extract the data from the retrieved articles. The researcher used six categories to organize the data in a summary table (researcher, aim, concept, method, sample and results). Each article was printed, and data were entered according to the variables addressed so that comparing studies across each outcome was feasible. The themes in the results section were determined according to how the results of the relationship between breastfeeding and maternal sensitivity were categorized.

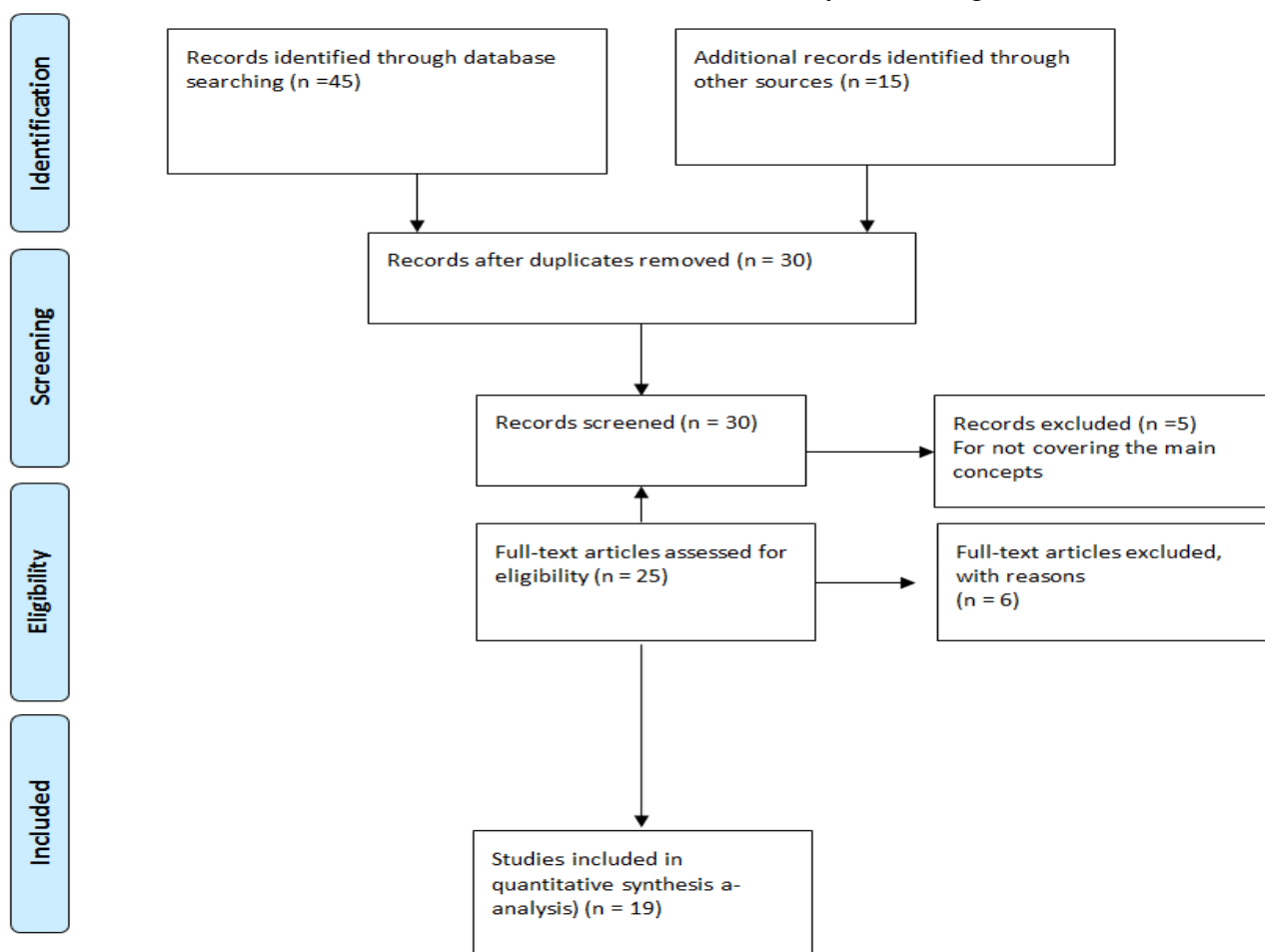


Fig.1: PRISMA flowchart of present study.

3- RESULTS

The results of the literature review are displayed in **Table.1**. The four themes are as follows: Potential effects of breastfeeding on maternal sensitivity, Potential effects of breastfeeding-related environment on sensitivity, Potential effects of infant health on maternal sensitivity, and no effect of method of infant feeding on maternal sensitivity.

3-1. Themes

3-1-1. Theme one: Potential effects of breastfeeding on maternal sensitivity

Among mothers, the physical and psychosocial changes occur during breastfeeding that positively impacts maternal sensitivity. These physical and psychosocial changes that women experience during breastfeeding were identified in over half of the studies displayed in **Table.1** (11, 12-17) (*please see the table at the end of paper*). The physiological changes that resulted from breastfeeding and that may impact maternal sensitivity include: maternal changes in the brain, heart rate, response to stimuli, and hormone levels (12).

These physiological changes occur as a result of sucking during breastfeeding and influences maternal sensitivity, through secretions in oxytocin hormone and changes in the brain that include increased activity in the frontal lobe and the inferior frontal gyrus that extends to the frontal operculum. For example, Kim reported that in a subset of 17 dyads from a larger study observing 657 mother and infant dyads, MRIs were used to measure brain changes associated with increased maternal sensitivity (12). In this study, The Ainsworth Maternal Sensitivity Scale (AMSS) was also used to measure maternal sensitivity. Mothers who breastfeed show more activity in the brain areas responsible for maternal sensitivity than bottle-feeding mothers. In another study, Nissen examined whether maternal

personality traits like anxiety, fatigue, and sensitivity were correlated with hormone changes that resulted from breastfeeding. Nissen reported that the oxytocin levels were highly correlated with the level of maternal sensitivity ($r = 0.45$) (13). Furthermore, Danvon indicated that breastfeeding mothers experience changes that related to enhance maternal sensitivity. For example, breastfeeding mothers may have been more relaxed under laboratory conditions reporting less muscle tension and an increased feeling of calm than bottle-feeding mothers did relate to secretion of oxytocin hormone.

A breastfeeding mother shows greater cardiac variability responses to their infants' stimulus than a bottle-feeding mother (15). Only one study evaluated the psychosocial changes associated with breastfeeding, Britton et al. identified that breastfeeding could be a means of increasing maternal sensitivity and improve the attachment between mother and infant. Britton study reported that breastfeeding could be a means of increasing maternal sensitivity and improve the attachment between mother and infant. Britton et al. reported that breastfeeding mothers scored higher on the NCASF than bottle-feeding mothers, and demonstrated increased security and decreased disorganization (11).

Boytsov and Tessier directly discuss the relationship between the process in breastfeeding and maternal sensitivity by discussing physiological and psychosocial changes without any confounding factors such as the presence of family support and working-related conditions. Both the physiological and psychosocial changes that occurred in the mother during the act of breastfeeding supported the Potential effect of breastfeeding on maternal sensitivity (16, 19).

3-1-2. Theme two: Potential effects of the breastfeeding-related environment on maternal sensitivity

In this review of the literature, a breastfeeding-related environment is characterized by the following: skin-to-skin contact; support from partner and family members; supportive work environment; and breastfeeding intervention programs (7, 9, 16). Findings from the physical contact studies (skin-to-skin contact) identified overwhelming positive relationships with maternal sensitivity. Encouraging skin-to-skin contact during the first two hours after childbirth affected dyadic reciprocity, mutuality and maternal sensitivity during the infancy period, and enhanced the relationship between the mother and her infant. A lack of physical contact during the first two hours negatively affected mothers and infants in the secretion of breastfeeding hormones (7, 13, 16). Social support includes support from partner and family members, the working environment, and breastfeeding intervention programs during the prenatal period. These same support factors were related to increased maternal ability to recognize infant cues in the early postpartum period (17,18) that mothers who breastfed had significantly higher maternal sensitivity scores than mothers who bottle-fed their infants.

3-1-3. Theme three: Potential effects of an infant on maternal sensitivity

There is a Potential effect of infant physical health and psychological health (temperament) on the mothers' decision to breastfeed and her expression of maternal sensitivity. A study by Tulzek reported that the health of the infant, such as suffering from health condition, may cause the mother not to breastfeed her infant and be sensitive, suggesting that maternal sensitivity is not related to breastfeeding (9). Conversely, another study examined

the effects of infant health condition on the quality of maternal sensitivity in the context of feeding using the mixed method design in 17 mother-infant dyads. The psychological status of infants such as infant temperament was reported in three studies that may cause many mothers to be less sensitive to their infant needs and discontinue breastfeeding (9). Edhborg et al. mentioned that breastfeeding did not relate significantly to mother sensitivity and mother attachment to her infant when breastfeeding is known to promote maternal sensitivity through oxytocin release (20). Tulzek et al. and Edhborg et al. both suggest that infant health and infant temperament may cause mothers to be more sensitive (9, 20). The infant's physical and psychological health (temperament) may be responsible and may cause the mother not to breastfeed the infant (21).

3-1-4. Theme four: no Potential effect of feeding method on maternal sensitivity

The only study that examined differences in maternal sensitivity between breastfeeding mothers and bottle feeding mothers, reported no significant difference (19). This finding was consistent whether using a large sample or different instruments (11). Drake et al. mentioned factors such as the presence of siblings, the mother's self-esteem, and the mother's satisfaction with life as having a significant impact on self-reported maternal sensitivity scores. This limited research suggests there may be an impact on breastfeeding and maternal activity, but more studies are needed to verify this (19).

3-2. Critique

The results of this review demonstrate that there is not, as yet, an agreed definition of maternal sensitivity in the papers studied. The maternal sensitivity concept has been defined in various terms; that include maternal responsiveness, mother-infant

interaction, mother-infant attachment, maternal attachment, and maternal bonding (20). Six of the studies in the literature included some definition of maternal sensitivity using the interchangeable terms as follows: maternal responsiveness, mother-infant interaction, maternal bonding and mother behavior (11, 12-17). Using a unified and clear definition can provide a context for people unfamiliar with the concept of maternal sensitivity. Using a well-defined theoretical framework underpinning a study guides the research question and provides an explanation of the relationship between the theoretical concepts of breastfeeding and maternal sensitivity (22). Of the seventeen studies included in this paper, only eight studies reported a theoretical framework that was integrated into their literature review of breastfeeding and maternal sensitivity.

The predominant theories used to explain the relationship between breastfeeding and maternal sensitivity were Bowlby's attachment theory (n = 3) and Ainsworth's attachment theory (n = 2), since they are focused on mother and infant interaction (11, 13-17). It is not clear why there is an absence of a theoretical framework in a developed area like breastfeeding, as a lot of research has been reported in the literature. Using an explicit theoretical framework to explain the relationship between breastfeeding and maternal sensitivity is encouraged as a more rigorous way to improve research methods and advance the science in breastfeeding and maternal sensitivity (23) and in the field. At this point, inconsistent use of frameworks to develop research studies impedes a thorough comparison of the studies and further development of the phenomena. It is hoped that future work in this area will recognize this need of a unified framework (24). Using Bowlby attachment theory for future studies would be helpful. Another gap in the literature is

using nine instruments to measure maternal sensitivity. Using many instruments will impede the ability to compare the studies. However, many of the aforementioned studies used various questionnaires which were not specifically named to measure maternal sensitivity. These studies also failed to report the psychometric properties of the instruments used (14,18). Therefore, the findings of these studies should be interpreted with caution. However, previous studies suggest that the field is maturing. Self-report (women's perceptions) and observational methods are always going to be part of studying breastfeeding and should be honored for their contributions.

Future researchers will improve the scientific understanding of maternal sensitivity through the use of well-validated specialized physiological and reported instrument in measuring the phenomenon of maternal sensitivity, such as MIRI and AMSS, since both have a high rate of reliability (19). Many studies used small sample sizes due to the financial burden of conducting large studies (12-15), which limited the generalization of the results to the larger population. A study that has a small sample size may be inconclusive or have limited application. All of the previous six studies in this review are quasi-experimental that used a subject pool that was 90% white and highly educated. The focus on white and highly educated women may limit the researchers' ability to generalize the findings to other populations and geographic areas. The researcher needs to apply the maternal sensitivity measuring tools to all type of populations to check efficacy.

4- DISCUSSION

The purpose of this review was to evaluate existing evidence on the relationship between breastfeeding and maternal sensitivity during the first year of

a child's life. The major findings from the current state of science point out the following types of relationships that exist between breastfeeding and maternal sensitivity. First, it is clear that suckling during breastfeeding improves maternal sensitivity by causing physiological and psychosocial changes in breastfeeding mothers that include increased activity in the emotional area and increased heart rate. Which means skin-to-skin contact could increase a woman's oxytocin level? But not to the same degree as breastfeeding (26). For example, Cong et al. reported that maternal oxytocin levels in skin-to-skin contact (SSC) group were significantly increased from baseline (41.25 ± 25.74 pg/mL), to during post skin-to-skin contact (P-SSC) (49.78 ± 25.39 pg/mL), and continued to maintain at a higher level during the post-30 mins of P-SSC (50.10 ± 31.50 pg/mL), $F_{(2, 36)} = 4.52$, $p < 0.05$ (25).

In contrast, Drewett et al. report that the breastfeeding mothers' plasma *oxytocin* rose from 54 pg/ml before nursing to 130 pg/ml during nursing and *oxytocin* levels changed rapidly from minute to minute. This means that suckling raises oxytocin levels more than skin-to-skin contact, which may explain why breastfeeding has the potential to be more effective in increasing maternal sensitivity levels. Increased breastfeeding education in the peri-natal postnatal period and social support after childbirth may improve maternal sensitivity by encouraging mothers to breastfeed (26). Another finding is that infant health status impacts the mother's decision to breastfeed. If the infant experiences any metabolic disease, and the mother discovers this during pregnancy or after delivery that would negatively impact her decision to breastfeed and this may positively impact her sensitivity to her child's cues (19). Finally, one study found that there is no relationship between the method of

feeding and maternal sensitivity, as the literature showed that the mother who bottle-feeds is just as sensitive to her infant's needs as the breastfeeding mother. The search was limited to the English language and research that took place in Europe, Australia, and the USA. Another limitation was the limited number of Randomized controlled trial (RCT) in these areas. These articles focused on breastfeeding-related environments and not on the breastfeeding process. The general limitations include the risk of confounding (history and number of previous children) small participant size, and the retrospective design of the examined studies. Furthermore, the studies in this review used different analytical procedures, which limit the synthesis of the studies. Moreover, the inconsistency of definitions and measurement tools limited the researcher's ability to compare the findings and applications to practice (30).

4-1. Limitation

One of the main limitations of this survey was the difference in definition of AKI between the included studies, which lead to a significant heterogeneity between the articles. Subgroup analysis was performed to minimize the effect of this cofactor on the results. Furthermore, the few number of studies with sepsis and contrast-induced nephropathy settings, lead to reaching unreliable results considering the diagnostic value of plasma/serum NGAL in these settings. All the included articles were observational studies, which increases the risk of selection bias; an entity that can affect the results of the survey.

5- CONCLUSIONS

There is strong evidence that a relationship exists between breastfeeding and maternal sensitivity. However, that relationship is not well-defined. The potential effect of breastfeeding on maternal sensitivity is likely not

directional, and it is probably not exclusive (i.e. there is also a relationship between bottle-feeding and maternal sensitivity). This synthesis also supported that the effect of breastfeeding on maternal sensitivity is clinically significant for the health and well-being of infants so we better understand the breastfeeding maternal sensitivity relationship. There were several gaps in the literature review that merit further exploration. Firstly, several different instruments were used. Secondly, definitions of maternal sensitivity were not always included in the reports. Thirdly, definitions that were sometimes included differed significantly across studies. Fourthly and finally, only a few studies focused exclusively on maternal sensitivity, but there are many studies where it was discussed. Knowledge in the field will develop if researchers in the future replicate or closely approximate the most promising and best-designed studies.

6- CONFLICT OF INTEREST

The authors declare no conflicts of interests with respect to the research, authorship, and/or publication of this article.

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Table-1: The Relationship between Breastfeeding and Maternal Sensitivity.

Name, reference, year, country	Aim	Concept/ Theory	Methods Instrument	Sample	Results
Britton et al. (11), 2006 USA II-1 BF-MS	Examine RT of BF intent, Attachment and MS.	Attachment, Bowlby's Attachment Theory ^a	Longitudinal, prospective and non-randomized study, NCAST-F ^f AMSS ^g	152 mothers with healthy singleton infants, uncomplicated VD.	Prenatal BF intent related to attachment security that resulted from maternal sensitivity ($r=0.24$). Early maternal sensitivity in BF mothers was not a predictor of the duration of exclusive BF during the infant's first year of life.
Bystrova et al.(16), 2009 Russia I BFE-MS	Examine the impact of mother-infant interaction practices on maternal sensitivity.	Concept: Mother and infant interaction. No theory	Prospective, cross sectional RCT PCERA ^h	176 MI-dyad, FT healthy baby without complications.	Women that BF demonstrated greater infant sensitivity than those who do not F (1481) =53.71 at the first few months. There is NS relationship between the duration of BF and maternal sensitivity (PCERA) at 4 months of age.
Cooklin et al. (17), 2012 Australia III BFE-MS	Investigate the association between the M-I relationship, including maternal sensitivity, duration of BF, & maternal employment status, at 10 months after childbirth.	No definition, No theory.	Longitudinal and descriptive study PAQ ^j	165 employed, pregnant women >18 years of age, English speaking.	There were no significant differences in maternal sensitivity between employed and non-employed women Chi-square=3.45.
Danvon et al. (15),1978 USA II-1 BF-MS	Examine that infant cognitive development is a function of maternal sensitivity to infant during BF.	Maternal responsiveness, Ainsworth Attachment Theory ^b	Prospective, nonrandomized and longitudinal study AMSS ^a DVP ^k HR ^l	22 mother-infant dyads.	Maternal sensitivity during BF was related to subsequent infant performance in cognitive tasks compared to bottle feeding mothers chi-square=3.21 The mother who have high score in Development of Visual Pursuit are more sensitive than mother with low scoring infants.
Drake et al. (19), 2007 USA III NFBF	Examine potential predictors on maternal sensitivity, including infant feeding.	Maternal responsiveness Care-giving Theory ^c	Cross-sectional survey design. MIRI ^m RSE ⁿ SWLS ^o	177 M-I dyads in the first 2 to 4 months after child birth.	Other factor such as satisfaction with life, self-esteem, and many children cause more maternal sensitivity scores $F = 4.176$ not BF. N/S maternal sensitivity (MIRI) in BF mothers.
Edhbory et al. (20), 2005 Sweden	Investigate associations between blues, bonding, perception of the child's temperament and depressive	Bonding	Cross-sectional correlational, (PBQ) ^w	106 couples (dads and moms) returned all questionnaires.	Fathers scored significantly higher on PBQ and its subscales two months postpartum than did mothers indicating that at this time the fathers had more

II-2 I-MS	symptoms two months postpartum in both parents.				difficulties than mothers with the emotional relationship with the child. 92% of the mothers reported that they breastfed their children at 2 months. Breastfeeding did not significantly relate to postpartum bonding in the regression equation for the mothers, breastfeeding is known to promote maternal bonding through Oxytocin release.
Ekstrom and Nissen (18), 2006 Swedian I BFE-MS	Examine the relationship between program in BF counseling during prenatal and maternal sensitivity.	No definition, No theory.	Longitudinal, prospective and RCT.	540 first-time mothers.	Those who received BF counseling expressed more maternal sensitivity to their infants (Chi-square=15.45). The mothers in the intervention group were more confident with their infant.
Else-Quest et al. (8), 2003 USA II-1 BFE-MS	Investigate the role of early BF in the development of maternal sensitivity.	Bonding, Bonding Theory ^d	Longitudinal study and non- randomized study. PCERA ^h	570 mother-infant pairs > 18, between weeks 12 & 21 of pregnancy, student or unemployed, had a telephone.	BF mothers tended to demonstrate higher levels of sensitivity than bottle feeding mothers. BF mothers felt more positively reinforced by their infants. $F(1, 495) = 3.07$ At 4 months, these results support the effect of breastfeeding on maternal sensitivity, but not at 12 months $F(2, 489) = .74$
Kim et al. (12), 2011 USA II-1 BF-MS	Investigate the relationship between BF, Maternal brain response to her infant stimuli, & maternal sensitivity after child birth.	No definition, No theory.	Prospective, longitudinal and non- randomized study. CIB ^p	17 healthy Caucasian biological mothers of healthy baby.	BF mothers showed greater activations in the areas responsible for maternal sensitivity (Amyglada and hypothalamus) while listening to their baby crying than bottle-feeding mothers ($r = .62$).
Kuzela et al. (9), 1990 USA III BF-MS	Examine the relationship of maternal sensitivity to BF outcomes at six weeks postpartum.	No definition, No theory.	Prospective, comparative descriptive Study NCAST-F ^f	42 Latina mothers in 3rd trimester of pregnancy. Primiparous, Antepartum desire to BF > 8 weeks.	Continuing BF > 6 weeks postpartum increases maternal sensitivity (NCAFS scores) more than dyads who had stopped BF by 6 weeks.
Tester-jones (27), 2015 UK II I-MS	Examine the hypothesis that maternal rumination would mediate the relationship between social support and maternal attunement when infant negative temperament was high, but not low.	Maternal attunement.	Descriptive correlational study (MIRI).	203 mothers with infants aged between nine and 14 months. Period.	Direct relationships between negative temperament, maternal depressive symptoms, lower maternal self-reported responsiveness to the infant and continue of breastfeeding.
Nissen et al. (13), 1998 Sweden	Determine whether maternal sensitivity was correlated with	No definition, No theory.	Longitudinal, prospective and	37 healthy mother dyads FT infants.	The amount of milk the infant took in during feeding increased the oxytocin level in the mothers' blood.

Breastfeeding and Maternal Sensitivity

II-1 BF-MS	hormone changes relate BF.		non-randomized KSP ^q		The amount of oxytocin level correlated with the level of maternal sensitivity (r = 0.45). N/S relationship between duration of BF and maternal sensitivity.
Tessier et al. (29),1998 Colombia I BFE-MS	To compare the maternal sensitivity of mothers who had skin-to-skin contact with early baby suckling with a more traditional care group to compare maternal sensitivity and early infant suckling between mother who did and did not have skin-to-skin contact.	Concept: Bonding is the relationship between mother and her infant. Bonding Theory ^d	Prospective, longitudinal and RCT NCAST-F ^f	488 healthy M-I dyads.	The mothers in the skin-to-skin were more sensitive to their infants. Mothers in skin to skin group more sensitive to time spent (less than 10 days) in the hospital for their infants than bottle-feeding mothers.
Tharner et al. (7), 2012 Netherland III BF-MS	Examine the relationship of BF with maternal sensitivity and M-I Attachment.	Attachment, Ainsworth Attachment Theory ^b	Longitudinal, prospective and cohort study AMSS ^g	675 M-I dyads with 2 parents and 4 grandparents.	Longer duration of BF was associated with higher maternal sensitivity (r=0.24). Duration of BF was not related to attachment problems, but longer BF predicted a lower risk of problem in sensitivity. Maternal oxytocin receptor genotype was not a significant moderator of maternal sensitivity.
Thuczek (9), 2010 USA II-2 IH-MS	Examine effects of neonatal diagnosis on the quality of maternal sensitivity in the context of feeding.	No definition, No theory.	Longitudinal and mixed-method PCERA ^h STAI ⁿ	17 mother and infant dyads 1of 4 have conditions including cystic fibrosis, congenital hypothyroidism.	Mothers of infants with metabolic disease bottle fed. Mothers (normal baby) with low task-oriented behavior (showed more sensitivity to their infants' cues (Chi-square=137). Mothers of infants with metabolic disease had significantly more anxiety and depression.
Jones (21), 2015 Canada II-2 B-MS	Examined the association between breastfeeding at three months postpartum and infant temperament at 18 months postpartum and whether this link was affected her sensitivity	No definition, No theory.	Longitudinal Correlational study. AMSS	170 breastfeeding mothers for breastfeeding postpartum.	Breastfeeding mothers at 3 months postpartum were more sensitive in their interactions with their infants at 6 months postpartum, and elevated sensitivity, in turn, predicted reduced levels of negative affectivity in infant temperament at 18 months postpartum. After controlling for confounders (effect ab = -0.0312 [0.0208], 95% CI = -0.0884 to -0.0031).
Wilkinson and Scherl (28), 2006 Australia II-2 NEBF	Test psychological health and maternal attachment in a sample of BF and formula-feeding mothers.	Attachment is the child's need to seek proximity to and comfort from his mother at times of stress. No theory.	Longitudinal and mixed method EPSD ^t MRI ^u	36 BF and 24 formula-feeding women with a child between 4and 6.	No differences in sensitivity between BF and formula-feeding mothers The secure attachment styles were related to change the feeding method to BF F (5, 54=52.41).

Wisenefield et al. (14), 1985 UK II-2 BF-MS	Examine the relationship between infant feeding method and maternal sensitivity.	Concept: Maternal responsiveness is responding of mother to her infant's signals which have been accorded a central role in affected by a host. No theory.	Nonrandomized and cross sectional study SCR.	48 healthy mothers w/o receding or following menstrual cycle.	Response of BF and bottle feeding mothers across response measures is different. Skin conductance measures using Galvanic skin response indicated that breast-feeders may have been more relaxed. cardiac response of BF mother compare to bottle feeding is different, BF mothers were more sensitive and they also expressed greater satisfaction with the feeding experience (r=.28).
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NOTE: All results are significant at P=0.05 except with when indicated by N/S (not significant).

^a(Bowlby attachment theory)(Bowlby,1978),

^m(Maternal Infant Responsiveness Instrument=MIRI) (Amankwaa, 2002),

^b(Ainsworth's Attachment Theory)(Ainsworth,1972),

ⁿ(Rosenberg Self-Esteem Scale =RSE) (Rosenberg, 1965),

^c(Care-giving Theory)(Erel,2000),

^o(Satisfaction with Life Scale =SWLS) (Diener et al., 1985),

^d(Bonding Thoery)(Klaus,1972),

^p(Coding Interactive Behavior=CIB) (Feldman, 1998),

^e(Roy Adaption Theory)(Roy and Andrew,1999),

^q(Karolinska Scales of Personality=KSP) ((Klinterberg,1986),

^f(Nursing Child Assessment Satellite Training Feeding=NCAST)(Banard,1994),

^r(Extension of Stimuli)(Bindemann, 2005),

^g(Ainsworth Maternal Sensitivity Scale)(Ainsworth,1978),

^s(Maternal Sensitivity Scaler = MSS) (Han, 2002),

^h(Parent-Child Early Relational Assessment=PCERA)(Clark,1994),

^t(Edinburgh Postnatal Depression Scale =EPDS) (Cox et al., 1987),

^l(Postnatal Attachment Questionnaire =PAQ) (Condon,1998),

^u(Maternal Attachment Inventory =MAI) (Muller, 1994),

^j(Development of Visual Pursuit &the Permanence of Objects=DVT) (Uzgisir& Hunt, 1975),

^l(Recording heart-rate of mothers)(Graham and Clifton, 1966),

^v(Postpartum Bonding Questionnaire=PBQ) (Brockington et al., 2006),

Duration of breastfeeding is the time mother continue breastfeeding in weeks,

Themes of the relationship between breastfeeding and maternal sensitivity,

BF-MS= Potential effect of maternal sensitivity on breastfeeding, NEFB= No effect of breastfeeding on maternal sensitivity,

BFE-MS= Potential effect of maternal sensitivity environment on breastfeeding, I-MS= Potential effect of infant on maternal sensitivity.