

Breastfeeding Behavior and Related Factors in Low-Income and Ethnically Diverse  
Mother-Infant Dyads

by

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DISSERTATION

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by  
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## ABSTRACT

Breastfeeding (BF) is a health-promoting behavior and exclusive BF has proven economic and ecologic benefits to individuals and societies. Yet Healthy People 2010 BF objectives for exclusive BF remain unmet and prevalence is lowest for low-income populations. The purpose of this descriptive longitudinal study of 126 predominantly low income and ethnically diverse mother-infant dyads was to compare maternal and infant factors associated with nighttime BF behavior between exclusive BF dyads and supplemented dyads. Descriptive statistics, repeated measures ANOVA, independent t-tests, and Chi-square tests were used for analysis. BF behavior was categorized as either 1) *exclusive BF*, defined as 100% BF or breastmilk feeding on all three nights, or 2) *supplementation*, defined as any formula during any of the three nights.

Compared to women in supplementation (n=59), women in exclusive BF (n=67) were older, more likely Caucasian, working at 36 weeks pregnant but not working at 1 month postpartum, in a relationship, and getting less help with baby at night. There was no group difference in objective sleep at the last month of pregnancy assessment. At one month postpartum, women in the supplementation group averaged 30 minutes less night sleep compared to women in the exclusive BF group.

Compared to infants who were supplemented (n=54), infants who were exclusively breastfed (n=66) were significantly more likely to room-in with mothers in hospital and receive a home visit. They were statistically larger at birth, although the difference in size may not be clinically relevant.

Assessment of sleep in new mothers is important for BF maintenance and more effort is needed to promote exclusive BF among younger women, African Americans and women of Asian descent. Rooming-in practice in the hospital after birth should be encouraged, as it was significantly associated with exclusive BF behavior at one month postpartum in this diverse sample of new families. Future research using a qualitative approach would be ideal to discover how nighttime feeding for new mothers evolves over time, their motivation for BF, and their network of influence in support of BF behavior. Findings from qualitative research will be useful in developing an effective intervention for BF maintenance.

Approved:



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## CHAPTER ONE

BF (BF) has been proven to be highly beneficial for the health and well-being of infants, mothers, families, and society at large. Among the prominent benefits for infants, breast milk protects against infection and illness (Coovadia et al., 2007; Heinig, 2001; Silverdal, Ekholm, & Bodin, 2007), decreases risk of obesity (Araujo, Victora, Hallal, & Gigante, 2006), reduces risk of childhood leukemia (Bener, Hoffmann, Afify, Rasul, & Tewfik, 2008), and optimizes cognitive development in infancy and childhood (Tanaka, Kon, Ohkawa, Yoshikawa, & Shimizu, 2008) as well as early adulthood (Mortensen, Michaelsen, Sanders, & Reinisch, 2002). For mothers, short-term benefits of BF include more rapid postpartum recovery (Labbok, 2001) and weight homeostasis (Jelliffe & Jelliffe, 1978). Associated with increased duration of lactation, long-term benefits for women include decreased risks for certain types of breast cancer (Collaborative Group on Hormonal Factors in Breast Cancer, 2002; Lord et al., 2008), and decreased risk for cardiovascular disease (Schwarz et al., 2009). BF is important to public health and the economy (Bonuck et al., 2002) since its duration for the first six months of life is commensurate with annual savings in the United States (US) of \$3.6 billion in health care costs (Gartner et al., 2005).

To achieve optimal benefits, it is recommended that all infants be exclusively breastfed in the first six months of life, with the gradual introduction of complementary food and continued BF thereafter for at least one year (American Academy of Pediatrics, 2005) or longer (WHO, 2001), as long as both mother and child desire. The original BF objectives of *Healthy People 2010* (HP2010) were to increase the proportion of mothers who breastfeed their babies to 75% in the early postpartum period, 50% at 6 months, and

25% at one year. However, BF behavior (*exclusive* or *any* BF) was not specified. Thus in 2007, HP2010 BF objectives were updated to specify exclusivity at 60% for infants born in the US through age 3 months and 25% through age 6 months [objectives 16-19d and 16-19e] (US Department of Health and Human Services, 2007). Currently, objectives for exclusive BF remain unmet with an exclusive BF rate of 30.5% at 3 months and 11.3% at 6 months postpartum among US infants born between 2005 and 2006 (CDC, 2008).

BF initiation and duration is shown to be less prevalent in low-income and ethnically diverse populations (CDC, 2006; Celi, Rich-Edwards, Richardson, Kleinman, & Gillman, 2005). BF behaviors exhibited in these families include early introduction of breast milk substitutes such as infant formula and other solids and subsequent early weaning (Ertem, Votto, & Leventhal, 2001; Tender et al., 2009) with an overall low prevalence of exclusive BF (CDC, 2007; Tender et al., 2009). However, other than non-modifiable sociodemographic characteristics, the reasons why women from lower income and ethnically diverse backgrounds have lower rates of EBF are not well documented.

I am interested in studying factors related to mother and infant that may affect BF outcome, especially exclusive BF, among low-income and ethnically diverse women. Lactation, the establishment and maintenance of a full milk supply, is considered the physiological completion of gestation (Lawrence & Lawrence, 2005). The completion of gestation includes not only healthy postpartum recovery for the mother but also healthy transition for her infant by BF or the provision of breast milk. BF has been viewed as an invaluable continuum for the transition of a fetus to a healthy human being (Bostock, 1962). BF is also a preventive health behavior (Dodgson, Duckett, Garwick, & Graham,

2002) since the causes of certain health problems, particularly eating disorders, can be traced back to infancy and are usually related to early infant feeding.

This dissertation research examined the following questions:

- 1) What happens in the first three months postpartum that may affect such a profound drop in BF rate for low-income women?
- 2) Why are certain undesirable BF behavior, such as early use of supplementation, exhibited more in women from lower income and ethnically diverse backgrounds than from women in higher income status?
- 3) What interventions have been tested and how effective are they in helping women to continue to breastfeed after the first three months of life?
- 4) When would be the most appropriate time to intervene to promote exclusive BF for low-income and ethnically diverse women?

### Purpose

The purpose of this dissertation is to add to current knowledge in human lactation about factors associated with the mother and infant affecting BF behavior, particularly when these dyads are predominantly low-income and ethnically diverse. The first chapter includes a description of various theoretical approaches used in human lactation studies and the role of theory, a conceptualization and definition of *BF maintenance*, and a critique of the Social Contextual Model by Sorensen and colleagues (2003). This chapter concludes with a description of a new conceptual model for BF maintenance.

Based on this model, the second chapter presents a review of the literature on BF intervention categorized by factors (e.g., individual, interpersonal, and organizational) that

influence BF behavior in low-income populations and will be submitted as a manuscript. The third chapter is a manuscript in review that describes maternal factors that affect BF behavior and compares these factors between mothers who exclusively breastfeed and mothers who use formula supplementation during the night. The fourth chapter is a manuscript describing infant factors that affect night-time infant feeding method and compares infants who receive exclusive breast milk to infants who get formula supplementation during the night. The fifth chapter provides a synthesis of findings, implications for nursing practice, and direction for future research.

### Theoretical Approaches in Human Lactation

Various theoretical frameworks have been used in human lactation studies to address different aspects of BF. Of the more abstract theories, the Freudian Theory of Body Ego has been used to study the metapsychological and neurophysiological aspects of BF (Lehtonen et al., 2006). Attachment Theory (Bowlby, 1969; Schore, 2005) has been used to study maternal responsiveness or maternal-infant bonding in full-term infants (Drake, Humenick, Amankwaa, Younger, & Roux, 2007; Pridham, Schroeder, Brown, & Clark, 2001), premature infants undergoing Kangaroo care (Tessier et al., 1998), and effects of early skin-to-skin care on BF behavior/outcome, and psychological adaptation in healthy mother-newborn dyads (Moore, Anderson, & Bergman, 2007).

The Theory of Planned Behavior (Aizen, 2006; Ajzen, 1985) has been used to study young people's attitudes toward BF (Giles et al., 2007), factors influencing BF initiation (DiGirolamo, Thompson, Martorell, Fein, & Grummer-Strawn, 2005; Khoury, Moazzem, Jarjoura, Carothers, & Hinton, 2005) and BF continuation (Carrere et al., 2005; Dodgson,

Duckett, Garwick, & Graham, 2002; Dodgson, Henly, Duckett, & Tarrant, 2003; Rempel, 2004; Wambach, 1997). Social Cognitive Theory (Bandura, 1977) has been used to develop instruments to assess self-efficacy for BF during pregnancy (Noel-Weiss, Bassett, & Cragg, 2006) and postpartum (Creedy et al., 2003; Dai & Dennis, 2003). Theory of Reasoned Action (Ajzen & Fisbein, 1980) has been used to study nurses' attitudes toward BF support (Bernaix, 2000). Organizational theories have been used in the establishment of BF accommodation in the work place (Beyer & Trice, 1978; Heinig, 2007; Huberman & Miles, 1984).

Grounded theory approaches have been utilized in qualitative studies about BF and “becoming a mother” (Flacking, Ewald, Nyqvist, & Starrin, 2006), and pain associated with BF problem (Kvist, Larsson, & Hall-Lord, 2006). Psychoanalytic theory as well as phenomenology have been employed to explore the meaning of BF experience (Friedman, 1996; Locklin, 1995). Table 1 contains a summary of theories frequently used in human lactation research and the time frame for childbearing women.

To examine BF maintenance, the conceptual model proposed by Sorensen et al. (2003) was selected for its ability to guide intervention research for health behavior change. Theory of Reasoned Action and Social Cognitive Theory (Ajzen & Fisbein, 1980; Bandura, 1977) are embedded in the model, but to better understand BF maintenance, an integration of a bio-cultural understanding of lactation within a socio-contextual approach to the mother-infant dyad is also required. BF maintenance depends on lactation establishment as much as social context of the dyad. Since human lactation is fundamentally a physiologic interaction or process, it is necessary to include physiologic

theory in the model so that it could be adapted effectively to study BF maintenance. In the next section, the role and components of theory in the context of BF is presented.

### The Role of Theory

Meleis (2005) noted that “theory is the goal of all scientific work, theorizing is a central process in all scientific endeavors, and theoretical thinking is essential to all professional undertakings” (page 8). Theory helps to identify the focus, means, and goals of practice. Theory and conceptual models have been used synonymously since they both contain a set of interrelated concepts and propositions that are employed as guiding frameworks to describe, explain, and predict phenomena. Concepts and propositions are developed in the process of theorizing. Theoretical thinking involves identifying and defining phenomena important to the nursing discipline as well as society at large, evaluating theories or conceptual models to describe phenomena and guide research, and interpreting research findings in relationship to the selected theory. Based on these findings, suggestions to further refine, modify or extend theory are considered.

### Components of Theory

Theories consist of assumptions, concepts, descriptions, propositions, and exemplars (Meleis, 2005). *Assumptions* are “statements that describe concepts or connect two concepts that are factual, accepted as truth, and represent values, belief, or goals” (Meleis, 2005, page 12). Assumptions connect aspects of knowledge that are usually derived from empirical evidence, observation, and experience. When assumptions are founded on philosophy, they may or may not represent the shared belief of the discipline (Meleis, 2005). For example, the assumption that BF is an invaluable continuum for the

transition of a fetus to a healthy human being may not represent the shared belief of the nursing discipline for several reasons. The assumption may be based on philosophy and Aristotle's inductive-deductive method (all mammals suckle their young, all humans are mammals therefore infants are suckled by their mothers), or an evolutionary approach (BF is the true completion of gestation). In addition, the term *BF* is not without controversy. Therefore, unless supported by empirical data, assumptions remain vulnerable to criticism. For instance, women who cannot breastfeed because of medical, psychological or psychiatric problems, and infants who suffer from rare medical conditions, may be part of the dyad for which mother's milk is not advised. When assumptions are challenged, they become testable propositions.

According to Meleis *propositions* are "the crux of a theory" where questions that guide exploration and research emerge (Meleis, 2005) (page 250). Considering the questions posed for this dissertation, the first question inquires about a phenomenon (i.e., a profound drop in rate of BF) as well as its temporality (i.e., period between first and sixth month), the second question inquires further by addressing specifically BF behaviors of low-income and ethnically diverse women compared to women with higher income, the third question follows with inquiry about what has been done to address the concerns in the first two questions, and the fourth question inquires about the most appropriate time for intervention. The next logical step would be to describe the phenomenon or concept from which operational definitions derive to determine what variables should be included and how they are best examined.

Concept is a term that describes a particular phenomenon or a group of phenomena. A concept provides a more concise and efficient way of communicating an idea related to



the phenomenon and facilitates further analysis and development of the phenomenon (Meleis, 2005). For example, the concept of “sleep deprivation” describes the phenomenon of what happens to people who are not getting enough sleep on a continual basis by detailing their sleep disturbances, changes in mood, and changes in behavior or interactions. For lactating mothers, sleep deprivation is also associated with a drop in prolactin secretion that may have an effect on milk production after birth (Bowen, 2003). Yet milk production, whether abundant or insufficient, does not guarantee that a mother will continue to breastfeed under all circumstances. Although it is receiving more attention on a national level (CDC, 2007), what exactly constitutes BF maintenance as a concept has not been clearly delineated in the literature.

#### Conceptualization of BF Maintenance

For centuries, and especially since the successful commercialization of artificial breast milk (i.e., infant formula), BF has been viewed with controversy (Lapham, 1987). The controversy has evolved into a conundrum, particularly in the speculation of BF as crucial for human species survival or simply a means of nutrient provision for infants. To address this conundrum, a careful examination of the concept “breast” and the concept “feed” for their definitions and meanings in society will be presented.

#### *Breast*

The word *breast* has many definitions. Breast is defined anatomically as “either of the pair of mammae occurring on the chest in humans and having a discrete areola around the nipple, ... enlarged and softened by hormonally influenced mammary-gland development and fat deposition and which secrete milk after the birth of a child: the breasts of males normally remain rudimentary”(breast, n.d.). Breast can be both noun

and verb. As a noun, breast is defined as “a source of nourishment” and “the center of affection and emotion.” As a verb, breast is defined as an “encounter or advance against resolutely,” “confront boldly,” “contend with,” and “overcome or succeed against” (breast, n.d.; The American Heritage dictionary of the English language, 2006), page 228). Thus, based on these descriptions, breast connotes a food source, a center of affection, and a way of overcoming or succeeding against adversity.

### *Feed*

The word *feed* is used as a verb or noun. As a verb, feed is defined as “to give food to,” “serve as food for,” “to provide the necessary material for development, maintenance, or operation,” “to gratify,” or simply “to eat” and “to be nourished or supported.” As a noun, feed is defined as “food,” “an allowance, portion, or supply of such food,” and “the act of eating” (feed, n.d.; The American Heritage dictionary of the English language, 2006), page 647). Therefore, feed means giving as well as receiving nourishment.

### *Breastfeeding*

Based on the above definitions as well as current knowledge of human lactation, BF henceforth can be defined as: 1) A woman’s act of overcoming or succeeding against certain conditions to provide nourishment, which she produces from her breast or center of affection, for her infant’s growth and development; and 2) an infant’s act of being nourished and supported by receiving food coming from mother’s breast (breast, n.d.; feed, n.d.; Lawrence & Lawrence, 2005; The American Heritage dictionary of the English language, 2006), pp 228 & 647). As such, BF can be conceptualized as an interaction between mother and baby during which mother gives, and infant receives, food produced by the maternal body from her center of affection and emotion. The

concept of giving and receiving within the dyad is important in BF, for one cannot be completed without the other. Therefore, in the context of BF, the mother-infant dyad should be operationalized as the unit of analysis.

### *Breastfeeding Maintenance*

To maintain is defined as “to keep in existence or continuance,” “to support by aid, influence, protection.” (maintain, n.d.) From these definitions, maintaining BF is synonymous with supporting by aid, influence, and protection. As a concept, BF maintenance is comprised of three crucial components: 1) early BF success associated with physiological interaction between mother and infant, 2) BF support associated with social context, and 3) temporality or the time frame determined as crucial for BF continuation. The temporal aspect of BF maintenance will be discussed as part of lactation physiology. For the purpose of this dissertation research, the outcome of BF maintenance is dependent on exclusive BF behavior during the first three months.

The following section includes description and evaluation of the selected conceptual model for its fit and potential to contribute to studying BF maintenance in low income and ethnically diverse populations.

#### Evaluation of Social Contextual Model for BF Maintenance

Sorensen and colleagues (2003) proposed a conceptual framework for addressing social contextual factors in health behavior interventions for working-class, multiethnic populations based on two assumptions: 1) Health behaviors are significant determinants of patterns of risk, and 2) Both patterns of health behaviors and patterns of risk differ by race/ethnicity and social class (Sorensen et al., 2003). BF maintenance can be considered a health behavior and thus this model holds potential to support this scientific inquiry.

*Paradigmatic Origin*

Sorensen et al. (2003) borrowed from the rich tradition of behavioral research and theories in creating this conceptual framework to address the social context of health behaviors (Sorensen et al., 2003). In predicting behavior change, the authors applied the individual psychosocial factors embedded in Cognitive Theory (Bandura, 1977), Theory of Reasoned Action (Ajzen & Fisbein, 1980), and Transtheoretical Model of Behavior Change (Prochaska & DiClemente, 1983). From these theories, concepts such as self-efficacy, attitudes and beliefs, and beliefs about the benefits and costs of behavior performance were extracted and employed in the model as individual factors which comprise the mediating variables. Self-efficacy, defined as a person's confidence in his/her perceived ability to perform a specific task or behavior (Bandura, 1977), has been demonstrated to be a prominent influence on health behavior change (Dennis, 1999). Attitudes toward a behavior have been theoretically linked to intention to perform that behavior by a reasoned action approach that assumes behavior follows from beliefs, attitudes and intentions, and beliefs are a strong determinant of performing a specific behavior (Ajzen & Fisbein, 2005).

In explicating the pathway by which income and race may influence health outcomes and risk-related behaviors, the authors used insight from social epidemiology (Sorensen et al., 2003). They used a social ecological framework from their previous research (Peterson et al., 2002) to conceptualize social contextual modifiers and mediators that cut across multiple levels of influence (Figure 1).

## Model Description

The conceptual framework has been used by Sorensen and colleagues (Sorensen, Barbeau, Hunt, & Emmons, 2004; Sorensen et al., 2003; Sorensen et al., 2007) to guide the development of survey research and intervention research. Based on a social ecological model, this framework defines the overarching role of social context in behavior change that could be used to develop other interventions involving health behavior. In fact, interventions developed from the conceptual model have been utilized in research to address dietary and activity patterns of low-income postpartum women (Peterson et al., 2002) and to evaluate cancer prevention intervention aimed at increasing fruit and vegetable consumption of working-class multiethnic populations (Sorensen et al., 2007). The framework serves to illuminate the social contextual pathways by which race/ethnicity and social class may affect health behaviors (Sorensen et al., 2003). The diagram links sociodemographic characteristics, modifying conditions, mediating factors, health behaviors, and health outcomes.

### *Sociodemographic Characteristics*

Sociodemographic characteristics are mainly social class, income, and race/ethnicity. Within the conceptual framework, social class is defined as “social relationship premised on people’s structural location within the economy” (Sorensen 2003, p. 189). Social class can exert control over a person’s outlook on life, access to educational and economic resources, and exposure to life stressors. Thus, social class can have a profound effect on health such that low-income populations exhibit not only increased health behavioral risks (e.g., smoking, obesity) but also less access to healthy

food (e.g., fresh fruits and vegetables) and medical care (Sorensen et al., 2007; U.S. Department of Health and Human Services, 2000).

Race and ethnicity are not only major determinants of social class, but have important implications for health outcomes (Sorensen et al., 2003). Race and ethnicity become a social contextual factor that shapes cultural norms, patterns of resource utilization, patterns of interpersonal interactions and expectations for individual behaviors. In turn, these patterns affect availability of social resources, culturally sensitive facilitators, and assets that can improve health outcomes (Sorensen et al., 2003).

#### *Modifying Conditions*

A moderator is an independent variable that affects the strength or direction of the relationship between a predictor variable and an outcome variable (Rose, Holmbeck, Coakley, & Franks, 2004). Also known as modifying factors, moderators are situated along the pathway between intervention and outcome. Modifying conditions comprise of modifying factors that independently impact an outcome, but are not likely to be influenced by intervention (Sorensen et al., 2007).

#### *Mediating Mechanisms*

Mediating mechanisms are defined as factors along the causal pathway between intervention and outcome (Sorensen et al., 2003). Mediating variables can be manipulated by intervention to affect outcome. Often a mediator variable is conceptualized as the mechanism through which one variable (predictor) influences another variable (outcome) (Rose, Holmbeck, Coakley, & Franks, 2004). In the model, mediating mechanisms are psychosocial factors conceptualized from behavioral theories and demonstrated by empirical evidence to influence intention to change behavior (Sorensen et al., 2003).

### *Modifying versus Mediating*

In the conceptual framework, modifying conditions are listed within the social context of the study participant and consist of individual, interpersonal, organizational, neighborhood/community, and societal factors (Figure 1). Of these factors, social context includes life experiences (e.g., daily hassles, material circumstances), social relationships (e.g., social ties, friendship patterns, family roles and responsibilities), organizational structures (e.g., job strain), and societal influences (e.g., discrimination). These factors can act as either modifying conditions or mediating mechanisms depending on the location within (mediating) or outside (modifying) the causal pathway between the intervention and outcomes (Sorensen et al., 2003; Sorensen et al., 2007). For example, organizational factors such as job strain could be a modifying condition because job strain has been linked to health behaviors (e.g., tobacco smoking) and the work culture associated with health behaviors as well as effective communication with health care provider (Sorensen et al., 2003). However, workplace factors such as provisions for worker's health and safety can function as mediating mechanisms (Sorensen et al., 1998).

In summary, mediator and moderator variables provide useful information about how, why, or when a phenomenon occurs. The same variable can serve as either a mediator or moderator or both, depending on the research question (Rose, Holmbeck, Coakley, & Franks, 2004). Thus, consideration of a mediator or moderator allows a more valid description of the relationship between independent and outcome variables (Bennett, 2000; Sorensen et al., 2007).

### *Health Behaviors & Health Outcomes*

The social contextual model of health behavior change has been used to develop interventions for multiple risk-related behaviors in low income, multiethnic populations (Sorensen et al., 2007). Using psychosocial factors (i.e., self-efficacy, attitudes and beliefs) from social and behavioral theories as mediating mechanisms, the model needs modification for health behaviors that have been understudied. Utilizing this model, interventions were designed for such health behaviors as fruit and vegetable consumption (Sorensen et al., 2007), tobacco smoking (Sorensen, Barbeau, Hunt, & Emmons, 2004), physical activity (Peterson et al., 2002), red meat consumption, and multivitamin use (Sorensen et al., 2003).

### *Culture*

Kroeber and Kluckhorn (1963) delineated the concept *culture* as: “Patterns of and for behavior acquired and transmitted by symbols, constituting the distinctive achievements of human groups, including their embodiment in artifacts; the essential core of culture consists of traditional [= historically derived and selected] ideas and especially their attached values” (page 66). In short, culture is defined as “what remains of man’s past working on his present to shape his future” (Montagu, 1961), page 15). Culture is depicted in the model as permeating multiple domains within the conceptual framework (Kroeber & Kluckhohn, 1963; Sorensen et al., 2003).

### Critique of Social Contextual Model

Using criteria suggested by Meleis (2005), a critical examination of the model includes the relationships between structure and function, diagram of theory, circle of contagiousness, usefulness, and external components. Relationships between structure and



function include clarity, consistency, simplicity, and tautology/teleology. A diagram of theory is analyzed for visual and graphic presentation, logical representation, and clarity. The circle of contagiousness explains the geographical origin and spread as well as influence of theorist versus theory. Usefulness, the *raison d'être* of theory, encompasses four areas: practice, research, education, and administration. Finally, external components are assessed for personal, professional, and social values as well as social significance (Meleis, 2005). A summary of this critique is in Table 2.

To adapt this model for BF, there are two major assumptions that must be addressed within sociodemographic issues. First, in the case of BF, the unit of analysis is not an individual but the mother-infant dyad. Second, each mother-infant dyad would come into the model with interactional processes involving lactation physiology. Both of these assumptions would act as antecedents to the Sorensen model before modifiers and mediators of health outcome can be evaluated for the desired health behavior of exclusive BF and health outcome of BF maintenance for the first three months of life.

Since BF is fundamentally a physiological process, the pathway between intervention and BF outcome inevitably includes modifying as well as mediating factors that relate to lactation physiology. For example, the modifying individual factors no longer pertain to just a person; instead, they are now factors related to mother, baby, and the dyad. Mediating mechanisms would also be an issue for lactation physiology. Again, the differentiation between mediating mechanisms and modifying conditions is their location on the pathway. Figure 2 diagrams the conceptual model with a moderator effect and Figure 3 depicts a mediator effect. Lactation physiology will be discussed in the next section.

## Lactation Physiology Theory

In physiological terms, it is posited that: 1) stress response and sleep deprivation of a new mother during the first postpartum months can have a negative effect on the release of prolactin, which in turn decreases milk supply; 2) adequate suckling or mechanical milk removal from breasts is important to induce synthesis and release of the oxytocin and prolactin hormones essential for milk ejection and milk production; and 3) maintenance of established milk supply depends on the success of BF during the first three months postpartum. The timing of BF maintenance has been referred to as the fourth trimester which will be discussed following the discussion of these physiologic assumptions.

Lactation or the process of milk production is controlled by the pituitary hormones prolactin and oxytocin. Lactation is divided into two main stages: 1) lactogenesis or the initiation of milk secretion, and 2) galactopoiesis or the maintenance of established milk supply.

### *Lactogenesis*

Lactogenesis is entirely hormonally dependent, and is divided into two stages. Stage I occurs during pregnancy and involves increased plasma concentrations of lactose and alpha-lactalbumin. Colostrum can be extracted from the breast but its secretion is restrained by high circulating plasma concentration of progesterone and possibly estrogen (Neville, Morton, and Umemura, 2001).

Lactogenesis stage II, marked by a copious milk secretion, takes place after the delivery of the placenta and during the first 4-10 days after birth (Lawrence & Lawrence, 2005). The most important factors in starting the cascade of changes that constitute

lactogenesis II are the results of a prepared mammary epithelium, progesterone withdrawal, maintained plasma prolactin, and removal of milk from the breast within an undefined interval after birth (McManaman and Neville, 2003). “Undefined” means anytime or as soon as possible after the fourth day after birth because during the first four days, prolactin levels are the same for lactating and non-lactating mothers.

### *Galactopoiesis*

Defined as the maintenance of established milk supply, galactopoiesis is now called *lactogenesis stage III*, or simply *lactation* (Lawrence & Lawrence, 2005, p.79).

Continuing secretion of milk is mainly related to sufficient production of prolactin during the first few postpartum weeks. In established lactation, which takes place by 10-12 weeks after birth, suppression of prolactin release does not significantly affect milk yield (Mephram, 1987, p.126). Lack of suckling or inadequate milk removal from the breast, as well as maternal stress and sleep deprivation can interfere with this process (Tennekoon, Arulambalam, Karunanayake, & Seneviratne, 1994).

### *The Role of Hormones*

Two pituitary hormones, *oxytocin* and *prolactin*, are widely recognized to be responsible for milk ejection and milk secretion. Oxytocin is a powerful galactokinetic hormone that acts on receptors in myoepithelial cells to contract and eject milk into the milk ducts. Essential for the milk ejection or “let-down” reflex, oxytocin is also credited with “producing increased responsiveness to receptivity, closeness, openness to relationships, and nurturing” (Lawrence & Lawrence, 2005, p.79). Most women experience “let-down” with release of oxytocin minutes before they begin BF (McNeilly, Robinson, Houston, & Howie, 1983). Conditional stimuli for this reflex include

preparation to feed as well as any combination of sight, sound, and smell of baby. Sympathetic vasoconstriction in stress is known to inhibit oxytocin effect on myoepithelium (Jelliffe & Jelliffe, 1978). Thus, care must be taken to protect mothers from stress, not only at the time of suckling but also immediately before BF when conditioned release of oxytocin occur.

While oxytocin release from the posterior pituitary is a conditioned reflex response, *prolactin* release from the anterior pituitary depends on stimulation of sensory nerves in the breast (Hill, Chatterton, & Aldag, 1999). In milk synthesis, prolactin acts together with cortisol and insulin to stimulate transcription of the genes that encode milk protein (Bowen, 2003). Prolactin is secreted in response to suckling by the infant (Neville & Berga, 1983). Normally, prolactin secretion occurs in 7 to 20 episodes per day with peaks of up to 75 minutes in duration and is associated with eating meals. The prolactin peaks seem to be superimposed upon a continuous low basal level of secretion. Basal prolactin secretion has a circadian rhythm with a night time increase related to sleep rather than time of day (Neville, 1983). However, release of prolactin can be attenuated by prolactin-inhibitory factor (PIF) which was identified chemically as the catecholamine *L-dopamine* (Lapham, 1987). Release of prolactin can be enhanced by prolactin-releasing factors that include thyroid-releasing hormone, gonadotropin-releasing hormone and vasoactive intestinal peptide (Bowen, 2003). See Figure 4 for hormonal preparation of breast for lactation.

Suckling plays the most important role in milk production after delivery of the placenta. In the conceptual model, suckling is placed with individual factors and modifying conditions because it is contingent on individual circumstance of mother and

infant and their dyadic interaction. For example, if the mother has very inverted nipples, sedation during delivery, large blood loss or complications with childbirth, effective suckling is less likely to happen. Likewise, if the infant has poor reflexes (i.e., rooting, sucking, and swallowing), is too sleepy, suffered birth trauma, was born premature or had other neonatal conditions, effective suckling is unlikely. When everything is normal for mother and newborn, suckling may still be affected simply because the dyad must integrate into a dyadic unit by learning from each other. This process takes time and its temporality is described next.

#### The Clinical Importance of the Fourth Trimester

BF maintenance can be considered in physiological, psychosocial, and temporal aspects founded on three assumptions: 1) adequate suckling during the first few weeks postpartum is important to promote BF success, 2) transitioning from early BF success to BF maintenance requires support, and 3) the first three months postpartum is considered a crucial time frame for lactation establishment. In this chapter, the three months following birth will be referred to hereafter as the *fourth trimester*.

The term fourth trimester was introduced by two Nurse Midwives who redefined the postpartum period as the first three months instead of the traditional six-week evaluation of uterine involution, and emphasized the importance of caring for mother, father, and newborn during this time (Jennings & Edmundson, 1980). The authors argued that pregnancy care should be 12 months instead of 9 months, and while the mother is the primary focus, optimal outcomes of pregnancy require that care be given to her entire family to address new relationships, roles, and responsibilities. While aspects of infant care were discussed, BF was not included in their description of care.

From a scientific and evolutionary approach, Bostock (1962) postulated that human gestation should be 540 days or 18 months instead of 9 months (Bostock, 1962). For survival of the species, the human fetus must be delivered by the end of the 9<sup>th</sup> month and not much later so that it still fits through the mother's fixed pelvic girdle; otherwise both mother and child would perish. Drawing upon previous work in anthropology (Montagu, 1961), Bostock (1962) reaffirmed that an infant at birth was indeed an "exterogestate" fetus whose needs are just as great as the fetus in utero with regard to maternal warmth and food. This viewpoint supports the concept of a fourth trimester and the importance of BF during this period.

While a definition of the postpartum period crucial for BF maintenance has been vague in the human lactation literature, a prominent reason for BF cessation is reported to be breast milk insufficiency (Amir, 2006; Colin & Scott, 2002; Hill, Aldag, Zinaman, & Chatterton, 2007; Lewallen et al., 2006). Although galactopoeisis starts as early as 14 days after birth (Lawrence & Lawrence, 2005), lactation is not fully established until 90 to 100 days postpartum (Neville, Allen, & Watters, 1983) and fits with the time frame for the fourth trimester.

Therefore, a major priority and goal for BF maintenance is a successful passage beyond the fourth trimester. Lactation support during this period can provide tremendous short-term and long-term benefits to mother, baby, and family. Conversely, BF in the fourth trimester is vulnerable to discontinuation if the mother-infant dyad is not well attended to, or if something or someone interferes with lactation effort (i.e., formula supplementation, lack of support from partner). As such, BF is an invaluable continuum of pregnancy. It must be afforded a status similar to that of prenatal care.

The following section presents a modification of the Sorensen et al (2007/2003) model to address BF maintenance in low income and diverse populations (Figure 5). Modification of the model as it applies to the social context for BF maintenance will be discussed next.

#### Proposed Conceptual Model for BF Maintenance

Compared to the original model, changes introduced for an emerging model of BF maintenance occur in modifying conditions, mediating mechanisms, health behaviors, health outcomes, and the effect of culture to tailor interventions to meet BF needs.

##### *Modifying Conditions*

Individual factors are redefined as factors related to the mother-infant dyad comprised of the unique anatomy and physiology (A&P) of mother and infant which contribute to a myriad of potential BF problems related to the dyad interaction crucial for successful milk transfer. For example, nipple size and nipple shape affect the suckling process. Pain and discomfort can be caused by anatomical variations in maternal breasts and nipples (i.e., flat or inverted nipples). Usually during the first couple of weeks postpartum, breast and nipple pain of varying degree is universal to nursing mothers, and is most indicative of early termination of BF (Blair, Cadwell, Turner-Maffei, & Brimdyr, 2003; Morland-Schultz & Hill, 2005). However, most breast and nipple pain is caused by improper latch and positioning, which in turn has a negative impact on milk supply. Improper latch often results in inadequate suckling, while poor positioning causes maternal stress and fatigue (Lewallen et al., 2006; Marasco, Marmet, & Shell, 2000; Wallace et al., 2006).

A prominent part of BF depends on the infant's ability to grasp and suck at mother's breast. For infant, BF is more a suckling process where negative pressure suction (from sucking) is less important than compression of the nipple and areola between the tongue and hard palate to effectively remove milk from mother's breast.

Three neonatal reflexes are necessary for this process: *rooting* (baby's instinctive ability to turn, open and close the mouth in response to pressure on the cheek or circumoral area, or in response to the smell of mother's breast), *sucking* or *suckling*, and *swallowing*.

These feeding reflexes are affected by gestational age, birth weight, method of delivery, and various neonatal conditions such as congenital anomalies, severe jaundice, septicemia, or neurological damage (Jelliffe & Jelliffe, 1978). Feeding reflexes are weak or even absent in a premature neonate. The suckling reflex is not fully mature until the 32<sup>nd</sup> to 37<sup>th</sup> week of gestation and is impaired by congenital anomalies like severe cleft palate. In addition, delayed suckling reflex in the first few days after birth has been related to epidural anesthesia and labor analgesia (Nystedt, Edvardsson, & Willman, 2004; Ransjo-Arvidson, Matthiesen, & Lilja, 2001; Riordan, Gross, Angeron, Krumwiede, & Melin, 2000) and cesarian delivery (Dewey, Nommsen-Rivers, Heinig, & Cohen, 2003). Other newborn conditions, such as extremely recessive chin or tight frenulum, can also interfere with BF.

BF can be summed up as a physiologic, psychosocial and emotional interaction between mother and baby in which important mutual benefits occur (Gartner et al., 2005; Lawrence & Lawrence, 2005). The *dyad interaction* is critical since BF requires coordination as well as cooperation between mother and baby. Method of delivery can



also affect the mother's postpartum recovery and energy for wound healing. Needs for special care of the low birth weight neonate can interrupt the dyad's interactions.

Interpersonal factors highlight relationships that the lactating mother forms with her partner and her health care providers. Relationship with partner plays a vital role in either promoting or sabotaging BF maintenance. It has been shown that when a mother is in a supportive relationship, she is more likely to continue BF (Ekstrom, Widstrom, & Nissen, 2003; Giugliani, Caiaffa, Vogelhut, Witter, & Perman, 1994; Lewallen et al., 2006). BF can in turn deepen existing relationship with her partner and strengthen attachment with her infant. Conversely, when conflict arises with her partner about BF (i.e., partner thinks breast milk is not enough), supplementation or weaning is more likely to occur (Ekstrom, Widstrom, & Nissen, 2003). Similarly, it has been demonstrated that health care providers can influence a woman's decision about BF maintenance (Graffy & Taylor, 2005; Labarere et al., 2005).

Organizational factors salient to BF maintenance include birth settings and community programs. These factors can also function as mediating mechanisms related to BF support. Birth settings that are certified Baby-Friendly have established infrastructure to promote, protect, and support BF (UNICEF/ WHO, 2004). Therefore, women who give birth in a Baby-Friendly facility have better outcomes for BF initiation than women who delivered elsewhere (Merten, Dratva, & Ackermann-Liebrich, 2005). Likewise, community programs (e.g., La Leche League, Nursing Mothers Council) that offer home visit and case management services to new mothers and families are proven effective for BF promotion (Gribble, 2001; Milligan, Pugh, Bronner, Spatz, & Brown, 2000).

### *Mediating Mechanisms*

Within the realm of social context, BF support as mentioned above, affects the outcome of BF behavior and maintenance. For individual factors, changes are made in regard to mother and infant as separate but interconnected individuals. Mother factors to be addressed include her disrupted sleep patterns, her desire and confidence in ability to breast feed, and her emotional status.

Sleep deprivation and sleep fragmentation represent the typical experience of mothers of infants (Lee et al., 2000). Sleep deprivation could result in maternal fatigue, stress, and postpartum depression (Gay, Lee, & Lee, 2004; Goyal, Gay, & Lee, 2007; Graef et al., 1988; McCoy, Beal, Shipman, Payton, & Watson, 2006) which are the contributing factors to cessation of BF (Groer et al., 2005; Mezzacappa, Kelsey, & Katkin, 2005; Wambach, 1998) Sleep is intricately involved in the physiology of lactation as it affects production of prolactin and therefore milk production (Lawrence & Lawrence, 2005). Likewise, mother's desire or motivation to breastfeed, and her confidence in her own ability to do so can influence her BF behavior (Dennis, 1999). Finally, her emotional status and her stress perception can influence lactation physiology and hormonal responses, and is linked not only to undesirable BF behaviors like supplementation or weaning, but also to interpersonal relationships (Stuchbery, Matthey, & Barnett, 1998).

In addition to mother's emotional status, infant temperament may also affect BF behavior. Infant temperament refers to biologically rooted individual differences in behavior tendencies that are present early in life and are relatively stable over context and across time (Bates, 1989). Early in life, inconsolable crying could cause added confusion

and stress for parents who are still learning to cope with parenthood. Infants who cry after BF in the evening or during the night are often supplemented with formula because mothers infer from the infant's behavior that breast milk is insufficient (Sachdev & Mehrotra, 1995).

Infant factors are dependent in part on developmental stage and in part on temperament. Sleeping and feeding patterns evolve slowly during the first three months of life. From the initial feeding and sleeping patterns that alternate every two to three hours, it is not until four months of age (and this also varies by the individual) that an infant's feeding interval extends to 4-5 hours during the night to allow for a mother's uninterrupted sleep. In addition, the mother-infant dyad's sleeping arrangement may also influence BF behavior, particularly their proximity or distance apart during the night. These factors can be both modifying and mediating depending on the research question and intended study outcome.

### *Culture*

Culture is extended in the model to include BF behaviors and outcomes because BF is deeply rooted in traditions, beliefs and expectations shared by people in the same culture. An overview of postpartum cultural traditions is included to illustrate the importance of shared beliefs and expectations in the relationship between social context and BF maintenance.

The importance of acculturation in BF relates to the social context within an underlying culture. Acculturation is defined as "the process whereby the attitudes and/or behaviors of people from one culture are modified as a result of contact with a different culture" (acculturation, 2009). The level of acculturation differs among immigrants and

also depends on one's social class in the country of origin. Recent immigration, minimal social and financial resources, in addition to childbirth and BF beliefs and rituals, can be influencing factors for BF maintenance. There is also the loss of beneficial postpartum traditions to be considered in the cultural context. The degree of acculturation can lead to conflict because the immigrant women who are considered more acculturated or more able to obtain education and employment, are shown to be least likely to continue BF beyond the first three months (Celi, Rich-Edwards, Richardson, Kleinman, & Gillman, 2005; Singh, Kogan, & Dee, 2007). Conflict between generations can also be a factor with profound effects on BF behavior in the more acculturated generation (Ekstrom, Widstrom, & Nissen, 2003; Spear, 2006).

Cultural phenomena in BF revolve around traditions during postpartum recovery, usually known as the confinement period. Across cultures, this time period is intended to restore maternal health after pregnancy and childbirth and promote maternal-infant bonding, health and well-being for the dyad. Interestingly, the duration of confinement, ranging between 40 and 100 days following birth, is within the time frame of the fourth trimester. Volumes can be written about this fascinating period, for its peculiar customs often distinguish one culture from another or a subculture within a dominant one. In essence, the principles are to provide complete rest for postpartum women by freeing them from all mundane activities including self-care as well as child care. Infant care during this period, except for BF, is the responsibility of others in the family or community.

Confinement practices are deeply embedded in cultural as well as religious beliefs, and reflect practices that may appear bizarre to some and highly acceptable to others. For

instance, total rest for Chinese women means they cannot touch water; thus bathing and hair shampoos are avoided for 30 days to prevent “heat” loss, hair loss and weakness in old age (Teh, nd). Malaysian women receive daily massage with herbal oils to get rid of impurities and tone abdominal muscles. Perhaps one of the most visible and colorful postpartum care rituals is the tradition in South Asia, North Africa, and the Middle East, where henna is applied in beautiful patterns to the new mother’s feet to deter “malevolent spirits that cause health problems and poor bonding with her infant” (Cartwright Jones, 2002). In summary, the culturally-defined confinement period may vary, but it is critical to mother-infant postnatal care protocols. Large components of these protocols consist of maternal dietary restrictions that can affect breast milk production and the infant’s health and well-being. Galactogogues (food or drink believed to increase mother’s milk supply) range from exotic food (pig feet cooked in special vinegar) consumed by Chinese Singaporeans (SHL Confinement Cares, 2005) to *Atole* (hot drink made thick with corn) for Latinas, or beer for populations of European descent (Mallory & University of Wisconsin Integrative Medicine, 2008)

Postnatal dietary regimens are designed to restore energy because childbirth puts the mother in a state of extreme vulnerability. Across Asian cultures, the balance of two elements “hot” (*yang*) and “cold” (*yin*) is important to restore health and prevent illness (Ludman & Newman, 1984). In birth, women lose “vital breath, blood, and heat” and become vulnerable to “cold” and “wind”(Mathews & Manderson, 1980). The postnatal dietary practices vary in content and are dictated specifically by cultural traditions. For example in the Vietnamese tradition, hot and tonic foods such as black pepper, ginger, alcohol, coffee, and protein-rich foods are given to the mother to replenish “heat” loss

(Fishman, Evans, & Jenks, 1988; Nguyen et al., 2004). Although the humoral “hot/cold” belief is thought to pertain to people of Asian descent, it is also shared by citizens of Africa and Latin America. Nigerian women have a confinement period called *inu nmili oku*, (meaning “drinking hot water” ), during which time they consume a thin peppery soup made with smoked fish and herbs to cleanse the womb, enrich the blood, and restore energy (Amadiume, 1988). Women from Central and South America avoid eating beans and other “wind” food to prevent colic in their breastfed infants.

At times, maternal food intake can interfere with exclusive BF. For example, a majority of Southeast Asians would infer from newborn rash, common during the first few months of life, that mother’s milk contains too much “heat” and this would necessitate temporarily feeding the infant with formula until mother’s milk can “cool” off. Most often, basic recommendations for milk production such as drinking water and eating vegetables are considered too “cold” for the mother and therefore omitted from her diet. Practices such as giving *manzanilla* (chamomile tea) to Latina newborns to prevent colic and withholding BF when mother has a cold are widely in use in most Hispanic cultures.

In addition, despite its proven benefits, colostrum is given with discretion by Vietnamese who consider it “raw milk” that can upset the newborn’s stomach. They prefer instead to give babies some formula or sugar water during the first few days until their milk comes in. This practice can lead to early supplementation among Southeast Asians. Another practice that seems puzzling is the avoidance of skin-to-skin contact with newborn by some Asian families who consider the body of the new mother to be “unclean” while the baby, especially a boy, is not. While skin-to-skin contact within the

first few hours after birth has been shown to enhance bonding as well as milk supply (Moore & Anderson, 2007), a mother's worry that she may "contaminate" her baby with her "unclean" and "cold" body is a very legitimate cultural concern.

The influence of culture on BF behavior and maintenance must be recognized, as it spans the breadth of the conceptual model. Culture is omnipresent in the variables (social class, ethnicity/race, language, place of birth) comprising sociodemographic characteristics. Culture pervades the social context of BF in both modifying conditions (interpersonal factors) and mediating mechanisms (social norms, social support, BF support). Subsequently, culture affects BF behaviors and thus BF outcomes. For example, exclusive BF in the early postpartum period may not be observed by mothers who are reluctant to give colostrum due to their cultural belief that it is not fit for newborns. Interventions such as skin-to-skin contact would cause undue stress for a mother who thinks she might contaminate her baby with her "unclean" body. While it may not be feasible to develop one intervention that works for every BF mother, understanding cultural differences is important in working with women from ethnically diverse backgrounds and can help explain variations in the effectiveness of any intervention.

### Summary

This chapter addresses factors implicated in the low prevalence of BF maintenance, especially in low-income and ethnically diverse populations. To understand the phenomenon, an overview of theoretical approaches in human lactation and a description of the role and components of theory were provided. BF maintenance, as the identified outcome of interest, was described as a concept since it has not been adequately

addressed in the literature. The emerging concept of BF maintenance contains three crucial components: 1) early BF success is associated with physiological interaction between mother and infant, 2) ongoing BF support is associated with social context, and 3) the first three months postpartum (fourth trimester) is a crucial time frame for lactation establishment.

To study a new concept, a careful selection of the theoretical or conceptual framework is necessary. The conceptual model is used to guide the literature review and select relevant and valid measures, as seen in the next three chapters. The social contextual model for behavior change by Sorensen et al. (2003) was selected and evaluated for its potential utility in BF maintenance research. Since BF is fundamentally physiological in nature, lactation physiology was added to the model to address the current understanding of the physiological basis for BF. In explicating the modified model, an emphasis is placed on cultural factors because low-income women from diverse race/ethnicity backgrounds are less likely to be educated about Western theories of physiology and more likely to rely on cultural traditions and expectations from past generations as well as support within their family and community. Various postpartum traditions were briefly discussed to gain perspective on BF behavior. It is important to extend the model to reflect cultural effects that permeate all concepts presented in the framework for BF maintenance. The emerging conceptual model for BF maintenance (Figure 5) guides the literature review presented in Chapter 2 as well as the research results presented in Chapter 3 and Chapter 4.



## CHAPTER TWO

### INTERVENTIONS FOR BF MAINTENANCE

#### Abstract

**Objective:** To review the literature on BF interventions and synthesize the data on effective strategies for promoting exclusive BF in the first three months postpartum.

**Data Sources:** Computerized searches of PubMed, CINAHL, and the Cochrane database for studies published between 2001 and 2009.

**Study Selection:** To limit the search, studies were selected if they involved any type of behavioral intervention targeting exclusive BF duration as the outcome, and if they included low-income and ethnically diverse populations. From an initial sample of 89 studies obtained from the search, 21 met criteria for inclusion in this review.

**Data Extraction:** Data were extracted from each study and presented within the social context of the mother-infant dyad and the individual, interpersonal, and organizational factors that represent modifying conditions of BF behavior.

**Conclusions:** To promote BF initiation and duration, prenatal health education for pregnant women and their partners was effective. Effective interventions addressing the individual or mother-infant dyad included skin-to-skin care, breast and nipple pain management, and infant sleep location. At the interpersonal level, support from a peer counselor, health professional (midwife, lactation consultant), partner, and baby's grandmother were effective. At the organizational level, Baby-Friendly Hospital Initiative training programs for hospital staff and peer counselors offering BF support for pregnant and lactating women, and corporate lactation programs providing BF education and lactation consultant support for mothers and partners were effective. All of these

interventions were effective for BF initiation; however, there was no difference in the rate of exclusive BF by the third month postpartum.

**Keywords:** BF maintenance, conceptual model, fourth trimester, individual, interpersonal, organizational.

Healthy People 2010 objectives for the United States (US) were revised in 2007 to attain the goal of 60% exclusive BF through 3 months and 25% through 6 months of age (U.S. Department of Health and Human Services, 2007). BF prevalence has been shown to be lower in initiation, exclusivity and duration among women from low-income and ethnically diverse backgrounds (Centers for Diseases and Prevention, 2008; Li & Grummer-Strawn, 2002). Why women from disadvantaged backgrounds are less likely to maintain BF compared to women from middle and upper socioeconomic status is not well understood. The goal of this review is to critically evaluate the literature on interventions implemented to help women, especially those from low-income and ethnically diverse populations, maintain BF during the first three months postpartum.

In addition to sociodemographic characteristics such as ethnicity and income, there are modifying conditions that can affect behavior. These conditions are categorized as individual factors, interpersonal factors, and organizational factors in most conceptual models of behavioral change. A social contextual model was developed for BF maintenance based on prior behavioral theory (Sorensen 2003/2007) and used to guide this literature review (Figure 5). Table 3 lists the 21 studies categorized as interventions involving three categories of factors: 1) individual factors for the mother, infant, and the dyad; 2) interventions involving interpersonal factors such as support and interactions with health care providers; and 3) interventions that relate to organizational factors such as the workplace setting or delivery services for lactation programs in the home or hospital setting.

The concept of BF maintenance must consider three crucial components: 1) early BF success associated with physiological interaction between mother and infant, 2) BF

support associated with the dyad's social context, and 3) a time frame determined to be crucial for BF maintenance. This time frame has been delineated as the three months after birth, or the fourth trimester (Jennings & Edmundson, 1980). Based on anthropology (Montagu, 1961), evolutionary approach to infant care (Bostock, 1962) and lactation physiology (Lawrence & Lawrence, 2005; Neville, 1983), the clinical significance of the fourth trimester has been described elsewhere (Doan, 2009). The focus of this review is to critically evaluate BF interventions that take place in either the antepartum or postpartum period. This review addresses four central questions:

- 1) What antepartum interventions have been tested to increase the likelihood of BF initiation and maintenance?
- 2) What postpartum interventions have been tested to increase the likelihood of BF maintenance for a minimum of three months postpartum?
- 3) Which of these interventions are most effective for exclusive BF initiation and maintenance?
- 4) How do these BF interventions incorporate a woman's social context?

BF maintenance through the fourth trimester forms a strong foundation for both mother and infant in lactation establishment (Lawrence & Lawrence, 2005) and maternal-infant attachment (Schoore, 2005). Physiologically, BF maintenance depends on early BF success and key factors include physiologic function as well as technical and emotional forms of social support.

During the first weeks postpartum, sufficient nipple stimulation in addition to complete removal of milk from the breasts facilitates development of prolactin receptor sites (Neville & Berga, 1983) and thus increases milk production capacity (Lapham,

1987). While interventions are aimed at increasing the rate for BF initiation, it is duration of BF that is associated with numerous health benefits for both the mother and infant (Gartner et al., 2005; Heinig, 2001; Kramer & Kakuma, 2004). To understand the complexity of BF maintenance, it is essential to review and synthesize the science regarding early BF success and support for mother-infant dyads during the first three months after birth.

The purpose of this review is to critically analyze and synthesize the literature on clinical trials designed to help women maintain BF through the fourth trimester. A pathway permeated in cultural context provides the outline for modifying factors and mediating mechanisms leading to BF behaviors and outcomes (Figure 5). Each study in the review will be analyzed from this perspective.

## The State of the Science on BF Maintenance

### *Search Strategy*

PubMed, CINAHL, and the Cochrane Database of Systematic Reviews searches were from January 2001 to December 2008. The past eight years of research is most relevant to the evolution in human lactation research resulting from World Health Organization (WHO) recommendations published in 2001 (WHO, 2001). Both MeSH terms and keywords were used: *BF* (or *breast feeding*, or *infant feeding*), *intervention\** (any intervention), *initiation*, *duration*, *culture*, *attitudes*, *behavior*. The search was limited to English language and to human studies with uncomplicated deliveries and healthy full-term infants.

## *Results*

All articles resulting from the search were scanned for relevance and appropriateness for BF maintenance. Selection criteria included type of study, racial and ethnic characteristics of the sample, and fit with the conceptual model as well as studies that specifically targeted BF behavior. The focus was on clinical trials with interventions for exclusive BF in low-income and ethnically diverse women since this population is most at risk for low BF rates. The final selection consisted of 21 studies (see Table 3), the majority of which were randomized controlled trials (RCT). In addition to three Cochrane reviews (Abdulwadud & Snow, 2007; Britton, McCormick, Renfrew, Wade, & King, 2007; Dyson, McCormick, & Renfrew, 2005) there were 18 intervention studies organized by whether the intervention was focused on the individual mother, baby, or dyad, focused on interpersonal factors, or focused on organizational factors. Appendix A provides a summary of all 21 studies.

## *Organization of the Review*

The organization of the review is based on the modifying and mediating factors that influence behavior change in the conceptual model (Figure 5). This conceptual model was developed to evaluate how studies addressed individual, interpersonal and organizational factors within the social context of breast feeding behavior in the US. Studies are discussed in three sections as presented in Table 3 and presented in chronological order from earlier to most recent research findings to represent the progress of intervention research on this topic over time.

### Individual Factors and Early BF Success

One of the Cochrane reviews is included in this section, along with six other studies that used interventions to address *individual factors* including mother-infant dyad interaction (Carfoot, Williamson, & Dickson, 2005; Moore, Anderson, & Bergman, 2007), mother-related problems such as nipple and breast discomfort/pain (Kvist, Hall-Lord, Rydhstroem, & Larsson, 2007; Manizheh et al., 2007), and infant-related factors such as the use of artificial nipples (Howard et al., 2003) or sleep location in hospital after birth (Ball, Ward-Platt, Heslop, Leech, & Brown, 2006).

Reasoning that women and families around the world encounter promotion of artificial feeding more than promotion of BF (WHO, 1996), Dyson and colleagues (Dyson, McCormick, & Renfrew, 2005) conducted a systematic review of RCTs to evaluate the effectiveness of interventions in increasing the rate of BF initiation. The sample included women of various ethnicities and mixed income levels who were either pregnant, BF or considering BF in the future. Criteria for inclusion were studies with interventions that occurred before the first breastfeed to promote BF initiation. Results from this meta-analysis were based on a sample of seven RCTs with a total of 1388 women. When the effect of health education was evaluated, there was a significant increase in BF initiation ( $RR = 1.53$ ; 95%  $CI$ : 1.25, 1.88) among low-income women in the United States (US). Health education interventions included routine BF education compared with one-to-one education, self-help manuals, or lecture and leaflet). The positive effect of prenatal health education on BF initiation has important implications for research. However, the definition of “first breastfeed” in this Cochrane review was not

clearly indicated, and first breastfeed is controversial as a determinant of BF initiation (Nils Bergman, personal communication, October 5, 2007).

### *Dyad Interventions*

Success of the first breastfeed among full-term infants has been examined in relation to early mother-infant interaction by researchers in the United Kingdom and the US. Carfoot, Williamson & Dickson (2005) conducted an RCT in England to examine the effect of skin-to-skin care on initiation and duration of BF in early postpartum with a sample of primiparous and multiparous mother-infant dyads. During the second stage of labor, women were randomized to either routine care (n = 102) where mother-baby contact was interrupted for usual newborn and mother care after delivery, or to skin-to-skin care (n = 102) where babies were placed naked in a prone position against mother's skin between the breasts right after birth for a minimum of 45 minutes uninterrupted time. BF outcomes included success of baby's first breastfeed as well as *partial* or *exclusive* BF at four months. The success of the first breastfeed was determined by a priori score of 8 or higher on the Breast Feeding Assessment Tool (BAT) modified from the Infant Breast Feeding Assessment Tool (Matthews, 1993) to include a *latching-on* component. BF at four months was determined from maternal self-report. More babies in the intervention group (91%) had a successful first feed at breast compared to controls (83%) but this difference was not significant. BF rate at four months postpartum was also not significant at 43% for intervention and 40% for controls.

As the sole instrument to measure success at first breast feed in this study, the BAT did not assess whether milk transfer occurred. BF experts would agree that without milk transfer, there is no feed. In addition, rate of BF at four months did not differentiate



between exclusive and partial, which may contribute to lack of statistically significant differences between the two groups.

A similar intervention was used in Moore and Anderson's RCT (2007) conducted in the US (Tennessee) with a sample of 20 first-time mothers (Moore, Anderson, & Bergman, 2007). In this study, BF outcomes included successful first breastfeed and exclusive BF at one month postpartum. Women were recruited in active labor and randomly assigned to either intervention ( $n=10$ ) where the mother-infant dyads remained skin-to-skin from the first minute after birth until the end of the first breastfeed, or to controls ( $n=10$ ) where dyads were separated after delivery for newborn and mother assessments. Success of the first breastfeed was evaluated as infant sucking competence using the mother's score on Matthews' Infant Breast Feeding Assessment Tool. Exclusive BF status at one month postpartum was also determined by self-report. During the first breastfeed, intervention infants had significantly ( $p < .02$ ) higher sucking competency ( $8.7 \pm 2.1$ ) compared to controls ( $6.3 \pm 2.6$ ) and achieved significantly ( $p < .04$ ) faster time from birth to effective BF ( $15.6 \pm 12.0$  hours versus  $28.9 \pm 16.7$  hours). BF exclusivity at one month did not differ between groups.

This study was limited by its small sample size which may contribute to lack of significance at one month postpartum. Although there was a significantly faster time to effective BF for the intervention group, this analysis was not done by intent-to-treat. There was no report of inter-rater reliability (mother vs. researcher) for the measurement tool, and this tool did not assess milk transfer although, in this study, mothers would know when it happened.

The above studies had homogeneous sample of mostly White, educated, and middle class women, which limits the generalizability of their results to population with similar settings and sociodemographic characteristics. The findings, nevertheless, demonstrated the physiologic impact of early skin-to-skin contact for full-term mother-baby dyads on BF initiation. Their combined results showed that early skin-to-skin intervention had a moderate effect ( $d = .6$ ) on BF initiation and a weak effect ( $d = .2$ ) on BF maintenance.

*Maternal Factors: Interventions for Breast and Nipple Pain*

To maintain BF, maternal breast and nipple discomfort needs prompt attention to avoid further complications of mastitis and intolerable pain for women (WHO, 2000). Pain is a common reason reported by women who do not want to start or continue to breastfeed (Tait, 2000). The next two RCTs employed interventions to address breast inflammatory symptoms (Kvist, Hall-Lord, Rydhstroem, & Larsson, 2007 & Larsson, 2007) and nipple pain (Manizheh et al., 2007).

In a midwife-run BF clinic in Sweden, Kvist and colleagues (Wynn et al.) conducted a non-blinded RCT to examine the effect of acupuncture treatment and other care interventions on breast pain and satisfaction with BF for 210 mothers with breast inflammatory symptoms (i.e., erythema, tenderness, and pain). Participants were randomly assigned to one of three treatment groups ( $n=70$  per group). All women were given “essential care” that included advice about proper emptying of the breasts. Group 1 received essential care and oxytocin nasal spray; Group 2 received acupuncture treatment at two points for a circulatory and relaxation effects on the thoracic region; Group 3 received Group 2 intervention and an additional acupuncture treatment at a third point for an oxytocin-like effect. Treatments were given at liberty by midwives with various levels

of expertise in acupuncture for as many days as both midwife and mother deemed necessary. Pain was assessed using a visual analog scale of 0 to 10 (with 0= no pain and 10= worst possible pain). Satisfaction with BF was assessed using a 4-point Likert scale (with 0 = has decided to wean and 10 = very satisfied). Women in Group 1 who did not receive any acupuncture treatment reported significantly higher pain on day 3 ( $p = .01$ ) and day 4 ( $p < .01$ ) than women in both acupuncture groups. Maternal satisfaction with BF on days 3, 4, and 5 did not differ among the groups.

In this study, women who refused participation were those who were afraid of needles and who did not speak Swedish, suggesting a selection bias. The lack of a placebo control or sham acupuncture group, and the fact that all participants had symptoms, limited the interpretation of results. Since acupuncture treatment was given by different midwives whose skills varied, provider skill may also affect treatment outcome.

Breast and nipple pain of various degrees is a prominent complaint of lactating mothers and, in addition to low milk supply, is most indicative of early termination of BF (Blair, Cadwell, Turner-Maffei, & Brimdyr, 2003 & Brimdyr, 2003). The degree of discomfort ranges from mild soreness to the most excruciating pain ever endured by women (Huml, 1999). Sore nipples are also associated with high level of emotional distress in lactating mothers (Amir, Dennerstein, Garland, Fisher, & Farish, 1996 Fisher, & Farish, 1996) and remain a major deterrent to establishing successful BF.

To address nipple pain, Manizheh and colleagues (2007) conducted a double-blind RCT to test the effect of peppermint gel compared to lanolin and placebo on prevention of nipple/areola crack and pain in 163 first-time Iranian mothers with healthy term infants. Infants were excluded if they received formula supplementation, had oral infection or an

abnormally short frenulum. Mothers were randomly assigned to receive lanolin (n=58), peppermint gel (n=52), or placebo gel (n=53) with instructions to rub the assigned preparation on the nipples/areola between feedings and not use soap to wash nipples before feeding. Outcome measures included occurrence of cracked nipples in the first two weeks, pain, and BF status at six weeks postpartum. Pain was rated by mothers using an unspecified scale. Nipple/areola damage was defined by width (1–2 mm, *mild*; 3–9 mm, *moderate*; >10 mm, *severe*) using criteria described by Amir et al (2004). Although there was no significant difference in report of cracked nipples in the first two weeks between the three groups, peppermint gel was associated with less nipple cracking ( $p = .01$ ) compared to lanolin and placebo gel. There was no significant difference in pain or BF rate at six weeks postpartum, although more women in placebo group (27%,  $n = 12$ ) used infant formula compared to women in the lanolin (13%,  $n = 6$ ) or peppermint (5.6%,  $n = 3$ ) group.

Use of peppermint gel for nipple pain is an innovative intervention since it has not been used in the US to prevent or treat nipple pain. Using an unspecified pain scale, however, limits comparability of these findings with other studies addressing nipple pain intervention.

#### *Infant Factors: Artificial Nipples and Sleep Location*

To prevent mastitis and nipple pain caused by improper latch, the WHO discourages pacifiers and bottle-feeding in the first few months after birth while lactation is being established (WHO, 2000). Howard and colleagues (2003) conducted an RCT in a US hospital to examine the effects of cup versus bottle-feeding and early versus late pacifier use on BF outcomes. The final sample consisted of 700 breastfed newborns

randomly assigned to bottle/early pacifier ( $n=169$ ), bottle/late pacifier ( $n= 167$ ), cup/early (2 to 5 days) pacifier ( $n =185$ ), or cup/late (>4 weeks) pacifier ( $n=179$ ). For the pacifier intervention, infants were randomly assigned to early (2–5 days) or late (>4 weeks) introduction. Although all infants were randomized to either a bottle or cup feeding group, supplemental feedings were only given upon maternal request or if medically indicated. All supplemental feedings were given by the nursing staff. Outcome was duration of overall, full, and exclusive BF up to one year postpartum measured as time to cessation.

The most significant predictor of shorter duration for all types of BF was in-hospital supplemental feedings ( $p \leq .001$ ). There was no significant difference in BF duration between cup and bottle feeding groups. In the pacifier intervention group, exclusive BF at 4 weeks was less likely among infants exposed to early pacifiers ( $OR = 1.5$ ; 95%  $CI$ : 1.0, 2.0) but the confidence intervals include 1, so the difference was not statistically significant. Early pacifier use shortened overall duration compared to late pacifier use, but did not affect exclusive BF or full BF duration. For women who delivered by cesarean, cup feeding prolonged exclusive BF by about ten days ( $p = .04$ ), full BF by five weeks ( $p = .02$ ), and overall BF by ten weeks ( $p = .04$ ). For first-time mothers, early pacifier use had a significant ( $p=.004$ ) negative impact on exclusive BF.

Although this study was the third RCT to examine the effects of supplemental feeding on BF, it was the first to demonstrate an impact and thus contributed substantively to promotion of early BF success and subsequent duration. For social context, the sample was mostly White and well-educated married women. There is some concern regarding instructions given to mothers in the *early* pacifier group. Although

imposed by the study protocol, telling a woman (especially a first-time mother) to use a pacifier as soon as possible to comfort the infant and knowing the likely negative outcomes on BF can create an ethical dilemma for nurses caring for the mother-infant dyad. This advice is also incongruent with effort to become a Baby-Friendly institution.

In addition to supplemental feeding as an infant-related factor, the effect of infant sleep location on BF initiation in the hospital postpartum unit was examined in an RCT by researchers in the UK (Ball, Ward-Platt, Heslop, Leech, & Brown, 2006; Leech, & Brown, 2006). Participants were 64 mother-baby dyads randomly assigned to one of three sleep interventions: 1) baby in mother's bed; 2) baby in crib attached to mother's bed; and 3) baby in stand-alone bed adjacent to mother's bed. Mothers were told to keep their baby in the allocated sleep location for sleep. Outcomes were BF frequency and maternal and infant sleep duration. Both outcomes were measured using night-time video recordings on two consecutive nights. Feeding effort was calculated by adding frequency per hour of unsuccessful and successful feeding attempts. There was a significant ( $p < .01$ ) difference in mean night-time BF frequency such that newborns sleeping in mother's bed or in crib attached to mother's bed breastfed more frequently than those sleeping in a stand-alone bed. There were no differences in duration of maternal or infant sleep among the groups. Sleep averaged 64.5% (11.8–99.8%) for mothers and 65.9% (6.5–99.8%) for infants.

The above two studies used interventions on infants and their findings have important implications for BF in the early postpartum period. Both in-hospital supplementation and infant sleep location (in stand-alone bed) had a negative effect on

suckling frequency, a well-known predictor of early BF success (Merten, Dratva, & Ackermann-Liebrich, 2005 2005).

### Interpersonal Factors and Support for BF Maintenance

Early BF success is but the first step toward BF maintenance. Maintaining exclusive BF necessitates not only the collaboration of the mother-infant dyad but also the technical and emotional support of others. This section focuses on a Cochrane review and six other studies describing and testing interventions related to interpersonal factors that support BF. Among the seven studies, there were two qualitative studies about perception of mothers (Memmott & Bonuck, 2006) and fathers (Fagerskiold, 2008). BF behavior and duration outcomes varied in each study and the seven studies were examined by type of support for BF. Support included peer counselor support (Anderson, Damio, Young, Chapman, & Perez-Escamilla, 2005; Britton, McCormick, Renfrew, Wade, & King, 2007), health care professional support (Bonuck, Trombley, Freeman, & McKee, 2005; Fallon et al., 2005; Wallace et al., 2006), and family support (Fagerskiold, 2008), representing both the informal social and professional network members. This section starts with the Cochrane systematic review of BF support interventions aimed at helping mothers to continue BF (Britton, McCormick, Renfrew, Wade, & King, 2007).

In response to a need to determine what might be effective in helping women continue to breastfeed, Britton and colleagues (2007) conducted a systematic review of RCTs and quasi-RCTs to analyze the impact of interventions that offered extra BF support for mothers during BF maintenance. Inclusion criteria were studies with intervention occurred in the postpartum period or also with a prenatal component. Studies

were excluded if their intervention took place only during pregnancy or if intervention involved only education. The main outcome was the effect of intervention on duration of any BF to specified points in time (recorded as stopping BF before four to six weeks and 2, 3, 4, 6, 9 and 12 months). The review included 34 trials with a total of 29,385 mother-infant pairs from 14 countries. Population subgroups included women intending to breastfeed, women who identified themselves as unsupported, low-income women, women less than 18 years of age, mothers of sick infants, and parents of very low birth weight infants. BF support was categorized as “lay,” “professional”, and “lay and professional.” Professional support was provided by a variety of medical, nursing, and allied professionals (e.g., nutritionist, lactation consultants). Lay support was either voluntary or paid.

Overall, intervention with any form of support had a beneficial effect on the duration of *any* BF up to six months postpartum (relative risk (*RR*) .91, 95% confidence interval (*CI*).86 to .96). This overall effect was significant (*RR* .92, 95% *CI* .85 to .98) in trials conducted with moderate (60%-80%) BF initiation rates whereas there was no significant effect in areas with high (greater than 80%) or low (less than 40%) BF initiation rates. The effect of any support for exclusive BF was greater than for women continuing *any* BF, such that women who received support were less likely to give up exclusive BF before five months (*RR* .81, 95%*CI* .74 to .89).

Professional support also had a beneficial effect on maintaining exclusive BF (*RR* .91, 95% *CI* .84 to .98) in the first three months. Beyond this time, additional professional support was effective in prolonging *any* BF but its effect on exclusive BF was not evident. Within the first three months, lay support had a significant reduction in



cessation of exclusive BF (*RR* .86, 95% CI .76 to .98). Professional support, lay support and combinations of lay and professional support did not differ in their effect on *any* BF maintenance. For maintenance of exclusive BF, lay support and combinations of lay and professional support were more effective than professional support alone, but the difference was not statistically significant. Exclusive BF was significantly prolonged with the use of World Health Organization/United Nations Children's Fund (WHO/UNICEF) training for the supporters (*RR* 0.69, 95% CI 0.52 to 0.91). Of the 34 studies, there was only one study from the UK reporting the effects of support as an intervention for different social groups. The support intervention had a significant ( $p=.01$ ) effect on BF rates at four weeks for women in social class IV and V (women with partners in manual or unskilled occupations = 86% rate) compared to controls (58%) from the same social classes. The findings suggested the need for further trials to investigate appropriate strategies to support women to maintain BF for longer than two months. The non-significant findings about overall effect of a support intervention on BF duration in trials conducted in areas with low BF initiation rates could be related to social context.

The following five studies were not included in the systematic review by Britton and colleagues (2007) and tested BF support interventions for predominantly low-income women.

#### *Peer Support*

An RCT conducted by Anderson and colleagues (2005) examined the effect of peer counseling support intervention on exclusive BF in a sample of 162 low-income and predominantly Latina mother-infant dyads. The setting was a certified Baby-Friendly hospital and peer counseling was provided by two women who had successfully breastfed

for at least six months and completed the 40-hour WHO/UNICEF BF counseling training course. All participants received Baby-Friendly care. Compared to controls (n=63), women in the intervention group (n=72) received additional support from a peer counselor that included three prenatal home visits, daily hospital visits after delivery, and nine postpartum home visits with unlimited telephone support. The outcome variable was exclusive BF status (yes/no), defined as whether anything besides breastmilk was given to the infant during the 24 hour-period before the interview, at hospital discharge, and at 1 and 2 months postpartum.

Women who had the prenatal intention to breastfeed exclusively were more likely to do so regardless of group assignment (53% vs. 25% for controls; 74% vs. 48% for intervention,  $p < .05$ ). Women whose mothers lived in the US were less likely to engage in exclusive BF at hospital discharge (0 vs. 20% for controls; 30% vs. 46% for intervention,  $p \leq .01$ ). At 2 months postpartum, intervention group mothers who were breastfed as children were more likely to engage in exclusive BF (42 % vs. 10%,  $p \leq .01$ ). While the outcome was exclusive BF, results indicated a significant difference in the proportion of *non-exclusive* BF at three months (98.6% for controls and 79.4% for intervention group) but no difference in BF cessation rate at three months postpartum.

Considering the social context of this study, the intervention had a greater effect on BF outcome for Hispanics other than Puerto Ricans ( $OR = 6.40$ ; 95%  $CI: 1.45, 28.33$ ). Because the two peer counselors in their study were both Puerto Rican, the finding failed to support the belief that minority women would respond better to interventions delivered by counselors of the same ethnicity. This suggests the need to explore the influence of culture and acculturation in support intervention trials.

In addition to peer counseling support, it has been shown that women value the opinion and especially support from their health care providers in order to maintain BF. The following studies examine this effect.

### *Professional Support*

Wallace and colleagues (2006) conducted an RCT in Scotland to examine the effect of postnatal hands-off care by midwives compared to routine care on BF duration of 370 mother-baby dyads (188 intervention and 182 controls). There were 108 midwives for the intervention and 109 midwives for the controls. Both mothers and midwives were randomly allocated. Mothers were randomized to receive either intervention or routine care at the first breastfeed; care at subsequent feeding events was not controlled. Intervention included verbal-only advice about baby initiation of feeding (baby-led feed time and duration), positioning (sitting upright and supported), and attachment (latch onto breast rather than nipple). Routine care did not include any of these aspects. Main outcome measures were BF status (exclusive or any) and duration of exclusive BF up to 17 weeks. BF was assessed from infant feeding diary and interviews. The results indicated no group difference in BF outcome at either time point. Both groups had similar cessation rates of *any* BF and exclusive BF at 6 weeks and at 17 weeks.

This study addressed a hands-off approach to BF support in the early postpartum period. Although the study had a larger sample and more rigorous design compared to two previous studies (Fletcher & Harris, 2000; Ingram, Johnson, & Greenwood, 2002), their collective findings did not provide sufficient evidence to either confirm or refute the benefit of this type of hands-off support intervention.

Two next studies examined the effect of lactation consultant's support on BF duration at three months (Fallon et al., 2005) and up to one year postpartum (Bonuck, Freeman, & Trombley, 2006). These two studies differed in study method, mode of delivery of intervention, and timing of intervention. Fallon and colleagues (2005) conducted a prospective cohort study ( $n=696$  pre-intervention and 625 who received intervention) using a telephone-based lactation consultant support intervention during the postpartum period. Bonuck and colleagues (2006) conducted an RCT ( $n=145$  intervention and 159 control) using telephone and face-to-face lactation consultant intervention in both antepartum and postpartum periods.

Considering the social context for the sample, Fallon included women in both private and public hospitals and found that support had no effect on BF outcome at any time point for women from the public hospital setting. Women from the private hospital setting who received the intervention were more likely ( $RR$  1.4, 95%  $CI$  1.0 to 2.0) to breastfeed exclusively at one month postpartum than controls but the difference was not statistically significant, and there was no effect at three months postpartum.

Bonuck (2005) incorporated several best-practice BF interventions (i.e., professional, one-on-one, skills-based, prenatal and postnatal education and support) to promote BF in low-income, primarily Hispanic and Black women. There was no effect on exclusive BF rate, which was low and did not differ between women who received support intervention and controls. For the social context of their study, US-born women in the control group were five times more likely to give formula supplementation at 12 weeks ( $OR$  5.2, 95%  $CI$  2.4 to 11.2) and 52 weeks ( $OR$  5.3, 95%  $CI$  2.4 to 11.3) compared to women who were foreign-born in both groups. Together, these two studies suggest

beneficial effects on duration of *any* BF when lactation consultants provide BF support, but there were no significant effects on BF behavior at one month, three months, or one year postpartum.

Another effect of BF support intervention is the impact on the intended receivers as they perceive or experience the support. The following two qualitative studies explored perception of mothers who received BF support intervention (Memmott & Bonuck, 2006) and perception of first-time fathers (Fagerskiold, 2008).

#### *Perception of Mothers and Fathers*

Memmott and Bonuck (2006) conducted exit interviews with 21 women (11 intervention and 10 control) who participated in a BF support intervention study (Bonuck, Trombley, Freeman, & McKee, 2005) to explore women's perception and experience of being in the study and how participation affected their infant feeding choices. Women in the intervention group perceived lactation consultant support as a positive influence in their decision to initiate and maintain BF. They credited the lactation consultant's communication skills and positive reinforcement with their confidence and perseverance to breastfeed. Lactation consultants were seen as a source of support and confidence for women as mothers and also helped in ways unrelated to BF (e.g., how to make a bottle of formula, listening to women's problems and concerns and offering general encouragement and support). Several of the women in the control group stated that the post-partum study interview was a source of support and made them more conscious of how they fed their infant. The success of the intervention was attributed to technical assistance from a trained lactation consultant within the context of a relationship built on encouragement, guidance and support.

Fagerskiold (2008) used grounded theory to explore experiences of 20 first-time fathers and perception of fatherhood during (Of note, Sweden is one of the developed countries with the most benevolent parental leave consisting of ten days paid leave for childbirth and up to 480 days with 80% paid for the first 390 days and then negotiable pay) The emergent theme “changing life” included becoming a father, alternating between work and home, changing relationship (partner) and developing new relationship (Infante-Rivard, Amre, Gautrin, & Malo). On becoming a father, men reported satisfaction in participating with infant care including infant feeding of which, BF was viewed with ambivalence because fathers wanted the best food (mother’s milk) for the infant but also felt insignificant since only mothers could breastfeed. One father acknowledged the advantage of formula feeding, stating he felt “lucky” being able to prepare and feed his baby during the night and when they went out. Alternating between work and home made men feel they were not the main parent.

### Organizational Factors and BF Maintenance

This section reviews studies with interventions aimed at the organizational level, such as employment settings and home visit programs that may have an impact on BF behavior. The third Cochrane review and four other intervention studies in this section relate to organizational factors (see Table 3). As background for these factors, two distinctive organizational movements will be discussed that have important contributions to BF, especially for low-income and ethnically diverse populations: the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) and the United

Nations Children's Fund/World Health Organization (UNICEF/WHO) Baby Friendly Hospital Initiative (BFHI).

*Baby-Friendly Hospital Initiative*

The BFHI is a global program sponsored by WHO and UNICEF to encourage and give special recognition to hospitals and birth centers offering optimal care for lactation. The BFHI assists hospitals to establish infrastructure that fosters BF by giving mothers information, confidence and skill to successfully initiate and continue BF. Baby-Friendly USA is the national authority for BFHI in the US. The mission of Baby-Friendly USA is to foster "an American culture that values the enduring benefits of BF and human milk for mothers, babies, and society" (BFHI USA, 2004). Results of a national survey of US Baby-Friendly hospitals indicated that BFHI improves BF initiation and exclusivity rates regardless of sociodemographic factors (Merewood, Mehta, Chamberlain, Philipp, & Bauchner, 2005).

*Special Supplemental Nutrition Program for Women, Infants and Children (WIC)*

Established as a pilot program in 1972, WIC became permanent in 1974 and is administered by the Food and Nutrition Services of the US Department of Agriculture. Eligibility is based on participant income, which must be at or below 215% of the US Poverty Income Guidelines or about \$36 thousand for a family of four (USDA, 2006). WIC's mission is "to safeguard the health of low-income women, infants, and children up to age 5 who are at nutrition risk by providing nutritious foods to supplement diets, information on healthy eating, and referrals to health care"(Food & Nutrition Service/USDA, 2008).

Since a prominent goal of the WIC program is to improve nutritional status of infants, WIC has historically promoted BF as the optimal infant feeding choice. At WIC, BF promotion and support programs include prenatal counseling and BF education, follow-up support by peer counselors (if program in-place), electric breast pump loans, free hand pumps, free breast shells, and nursing supplementers. Interestingly, while BFHI had positive effects on the BF behavior of low-income and underprivileged women, WIC had almost the reverse effect. WIC participants have lower rates of BF initiation, exclusivity, and duration than non-WIC participants in many studies (Caulfield et al., 1998; Chatterji & Brooks-Gunn, 2004; Petrova, Hegyi, & Mehta, 2007). Anecdotally, this effect is attributed largely to the fact that WIC also provides free infant formula, which inadvertently facilitates supplementation of infants especially during the early postpartum period when mothers may struggle to breastfeed. .

In addition to WIC and BFIC national programs, there are local and individualized organizational factors, such as maternal employment and maternity leave policy, which can negatively affect BF behavior and duration. BF duration and exclusivity have been shown to be influenced by maternal employment and early return to work (Ryan, Zhou, & Arensberg, 2006; Shealy, Li, Benton-Davis, & Grummer-Strawn, 2005).

The results of the Cochrane review identified no clinical trials evaluating the effectiveness of workplace interventions to encourage, assist or support BF for postpartum women returning to work. Likewise, the impact of such interventions on outcomes related to employers, mothers and infants is also unknown (Abdulwadud & Snow, 2007). However, there were several descriptive studies addressing these specific issues. For example, one study reported a favorable effect of employer-sponsored



lactation program and duration of BF by providing the service of a lactation specialist and enabling mothers employed outside the home to pump while at work during their breaks (Ortiz, McGilligan, & Kelly, 2004). Another study described the “Fathering Program,” an innovative corporate lactation program offering BF education and lactation counseling for male employees and their partners as well as breast pumps for partners to use at home or at work (Cohen, Lange, & Slusser, 2002). This program demonstrated a 69% BF rate at six months postpartum. In addition to limitations imposed by the study design, results may not be generalizable to other populations of postpartum women who lack access to such lactation programs or whose work does not allow for a rest period to be able to pump their breasts.

Escobar and colleagues (2001) examined the effect of home visits versus hospital-based group follow-up visits after early postpartum discharge in 1014 mother-infant pairs (506 control and 508 intervention) and found no association between these two strategies and continuation of BF. BF outcome was determined by the discontinuation rate at two weeks after discharge from hospital. Offering a one-hour home visit by a registered nurse, especially one trained in lactation support, within 48 hours of hospital discharge can be beneficial for BF behavior since the first week after birth is a vulnerable time for the mother-infant dyad.

Ickovics and colleagues (2007) conducted an RCT to compare the perinatal outcomes of group prenatal care versus traditional care in a sample of 1,047 low-income and ethnically diverse mothers between 14 and 25 years of age (Ickovics et al., 2007). They reported significantly higher BF initiation rates for mothers in group care compared to traditional care. However, BF behavior was not specified and BF was determined by

self-report. Given the components of group care that have definite potential to foster BF practice, a replication of the study with stronger emphasis on exclusive BF behavior may add even more to the economic, health, and psychosocial outcomes of group care.

Coutinho and colleagues (2008) conducted an RCT to examine the effect of BFHI hospital-based intervention and a combined BFHI hospital-based and community-based intervention on rate of exclusive BF from birth to six months in a sample of 350 low-income Brazilian mother-infant dyads (Coutinho, de Lira, de Carvalho Lima, & Ashworth, 2005). Women were randomly assigned to extra support with ten postpartum home visits (n=175) or standard BFHI hospital care (n=175). Home visits were performed by peers who received the same 20 hours of WHO/UNICEF training as hospital staff plus five days of more intensive training. The BFHI hospital-based intervention improved BF rate in hospital to about 70%, but this rate dropped to 30% by the tenth day and 15% at one month postpartum. Mean exclusive BF for days 10–180 differed significantly ( $p < .0001$ ) between women who received extra support (45%) compared to those without home visit (13%). Findings suggest that using BFHI as the only strategy for BF promotion should be reassessed since a combination of promotional systems (hospital-based and community) was more effective.

The last study addressing organizational factors is an RCT examining the effect of combined antepartum education with postpartum lactation consultant support to promote BF for 104 WIC participants who were low-income and predominantly Latina (Petrova, Ayers, Stechna, Gerling, & Mehta, 2008). The intervention included one-on-one BF education and postpartum telephone follow-up by a lactation consultant. There was no significant effect of the intervention on exclusive BF at three months postpartum. The

findings echo results of other studies demonstrating no significant effect of extra BF education or support on BF rate of low-income women. Since the study was conducted with WIC participants, the effect of receiving free formula vouchers should be examined.

## Discussion

The goal of this review was to critically evaluate the literature focusing on interventions to address BF maintenance starting with early BF success followed by support for mother-infant dyads as related to the sample's social context. Using the conceptual model of BF maintenance (Figure 5), studies were presented in reference to the social context according to individual, interpersonal, and organizational factors representing the modifying conditions of BF behaviors. The review also addressed four central questions as discussed below: 1) what antepartum interventions have been tested to increase the likelihood of BF initiation and maintenance; 2) what postpartum interventions have been tested to increase the likelihood of BF maintenance for a minimum of three months postpartum; 3) which of these interventions are most effective for exclusive BF initiation and maintenance; and 4) how do these BF interventions incorporate a woman's social context.

In response to the first question, interventions administered in the antepartum period had a significant effect on increasing the likelihood of BF initiation and duration. These interventions included prenatal health education for pregnant women (Abdulwadud & Snow, 2007) and partners (Cohen, Lange, & Slusser, 2002), as well as support by peer counselors (Anderson, Damio, Young, Chapman, & Perez-Escamilla, 2005) and lactation

consultants (Bonuck, Freeman, & Trombley, 2006; Coutinho, de Lira, de Carvalho Lima, & Ashworth, 2005).

For the second question, interventions in the postpartum period that have been tested to increase the likelihood of BF maintenance for a minimum of three months included support by peers (Anderson, Damio, Young, Chapman, & Perez-Escamilla, 2005; Petrova, Ayers, Stechna, Gerling, & Mehta, 2009) and professional support by a nurse or lactation consultant (Bonuck, Trombley, Freeman, & McKee, 2005; Coutinho, de Lira, de Carvalho Lima, & Ashworth, 2005; Escobar et al., 2001; Fallon et al., 2005).

For the third question, interventions that had significant effect on increasing exclusive BF initiation or during the first four to six weeks had no effect on exclusive BF beyond the third month postpartum (Britton, McCormick, Renfrew, Wade, & King, 2007). The fourth question about BF intervention that incorporate a woman's social context is best addressed in terms of the modifying conditions that include individual, interpersonal, and organizational factors.

Presented within the social context of BF behavior that includes the individual factors related to the mother-infant dyads, interventions administered in hospital after childbirth such as skin-to-skin (Carfoot, Williamson, & Dickson, 2005; E. R. Moore & Anderson, 2007) and proximity of infant sleep location (Howard et al., 2003) had a significant effect on success of BF initiation but no effect on exclusive BF. Acupuncture was effective in helping mothers with relieving breast pain from inflammatory symptoms but had no effect on maternal satisfaction with BF (Kvist, Hall-Lord, Rydhstroem, & Larsson, 2007). The use of peppermint gel compared favorably with lanolin and placebo in preventing nipple cracks and treating nipple pain in the first two weeks postpartum but

had no effect on BF behavior at six week postpartum (Manizheh et al., 2007). Infant sleep proximity to mother in the hospital had a significant effect on BF frequency while not affecting the mother's sleep (Ball, Ward-Platt, Heslop, Leech, & Brown, 2006). The use of artificial nipples, especially for supplemental feeding in hospital after birth significantly predict shorter duration of BF (Howard et al., 2003).

Within the social context of BF behavior that includes interpersonal factors, BF initiation was improved by interventions that offered extra BF support for mothers using peer support (Anderson, Damio, Young, Chapman, & Perez-Escamilla, 2005), professional support (Bonuck, Trombley, Freeman, & McKee, 2005; Fallon et al., 2005; Wallace et al., 2006), and a combination of peer and professional support (Britton, McCormick, Renfrew, Wade, & King, 2007). However, there was no effect from support-related interventions on exclusive BF by three months postpartum. Mothers who received lactation consultant support intervention perceived the experience positively and attributed their BF confidence to technical assistance from a trained lactation consultant within the context of a relationship built on encouragement, guidance and support (Memmott & Bonuck, 2006). Fathers viewed BF with ambivalence as they wanted their infants to be given the best food (mother's milk) but also felt less important since only mothers could breastfeed (Fagerskiold, 2008).

Within the social context of BF behavior that includes organizational factors, there was no RCT for workplace interventions to help women maintain BF. Thus the impact of such intervention on BF outcomes for employers, mothers, and infants is unknown (Abdulwadud & Snow, 2007). There are, however, corporate sponsored programs, such as the Fathering program and Corporate Lactation program, offered to

male employees and their partners (Cohen, Lange, & Slusser, 2002) or female employees (Ortiz, McGilligan, & Kelly, 2004) in which BF education, breast pumps, and lactation consultant support was effective in promoting BF duration, although there was no effect on rates for exclusive BF. At the hospital level, BFHI WHO/UNICEF training for hospital personnel had a significant impact on increasing exclusive initiation. However, to maintain exclusive BF beyond ten days, a combination of home visits by well-trained peers and BFHI hospital care had a significant effect on BF maintenance up to six months postpartum for a sample of Brazilian women (Coutinho, de Lira, de Carvalho Lima, & Ashworth, 2005). Also at the hospital level, home visits by a registered nurse compared to hospital-based follow-up, and group prenatal care compared to standard prenatal care, were associated with higher maternal satisfaction with care but had no effect on BF maintenance (Escobar et al., 2001; Ickovics et al., 2007). For low-income WIC participants, receiving prenatal and postnatal BF education and support had a significant impact on rate of exclusive BF during the first week postpartum but had no effect when assessed again at three months postpartum (Petrova, Ayers, Stechna, Gerling, & Mehta, 2008).

In reviewing the state of the science, BF maintenance remains without a clear definition.

There is a lack of consensus as well as consideration for what exactly constitutes BF maintenance. BF in general is described in the literature by phase (i.e., initiation, maintenance, and cessation), intensity (i.e., length of time or duration, percentage of all feedings that is breastfeed) and behaviors (i.e., exclusive, any or partial, token or non-BF). BF maintenance, considered the most important goal of BF promotion programs based on the empirical evidence, has not been specified as the outcome of interest in any study.

Thus, it would be helpful to have a standard definition of BF maintenance placed within the social context of a model for BF behavior in developing and testing interventions to increase BF exclusivity during the first three months postpartum.

## CHAPTER THREE

### BF BEHAVIOR AND SLEEP OF NEW MOTHERS

#### Abstract

Sleep deprivation and fragmented sleep episodes represent the typical experience of a new mother. Using objective and subjective measures of sleep, this study described and compared sleep of women who breastfed exclusively to women who gave formula supplementation at night in a predominantly low-income and ethnically diverse sample. There was no difference in sleep time between the groups in the last month of pregnancy and no differences in daytime sleep at any time point. At one month postpartum, there were significant differences ( $t = 2.30, p = .023$ ) in objective nocturnal sleep (9p-9a) for women BF exclusively (N=67) compared to those who gave formula supplementation (N=59) at night. Nighttime sleep was  $385 \pm 66$  minutes for exclusive BF mothers and  $358 \pm 66$  minutes for the supplementation group. There was no group difference in subjective sleep. Exclusive BF women averaged half an hour more sleep between 2100 and 0859 hrs than women who used formula supplementation. Findings support a previous study of middle-class first-time mothers and extend the conclusions to more of the population of women in the United States. New mothers should be encouraged to breastfeed exclusively to obtain more nighttime sleep during postpartum recovery.

**Keywords:** Actigraph, BF behavior, sleep, social support



## Introduction

Recent reports from the Centers for Disease Control and Prevention (CDC) reveal that the proportion of breastfed infants who consume infant formula before 2 days, 3 months, and 6 months of age are about 25%, 38%, and 46%, respectively. Supplementation of breastfed infants remains a popular practice, especially at bed time, and it has been shown to be related to maternal fatigue and depression.(Hatton et al., 2005; Henderson, Evans, Straton, Priest, & Hagan, 2003)

Sleep deprivation and fragmented sleep represents the typical experience of a new mother caring for her infant(K. Lee, 2000). Sleep deprivation has been linked to maternal fatigue (Gay, Lee, & Lee, 2004; M. Groer et al., 2005; Hill, Aldag, Chatterton, & Zinaman, 2005), stress(M. W. Groer, 2005), and postpartum depression(Dennis & Ross, 2005; Goyal, Gay, & Lee, 2007) and may be a contributing factor for BF cessation(Mezzacappa, Kelsey, & Katkin, 2005; Wambach, 1998). In the early months of postpartum recovery, lactation is largely controlled by the pituitary hormones oxytocin and prolactin. Prolactin promotes milk production and synthesis while oxytocin is responsible for milk ejection(Lawrence & Lawrence, 2005). Lack of suckling or inadequate milk removal from the breast, as well as maternal stress(Theorell, 1992) and sleep deprivation, can interfere with this process(Tennekoon, Arulambalam, Karunanayake, & Seneviratne, 1994). It has been posited that sleep deprivation and other stressors have a negative effect on release of prolactin(Abou-Saleh, Ghubash, Karim, Krymski, & Bhai, 1998; Tennekoon, Arulambalam, Karunanayake, & Seneviratne, 1994; Theorell, 1992), which in turn would decrease milk supply(M. W. Groer, 2005; Weichert, 1980). The secretion of prolactin occurs during sleep at night and is associated with

promoting deep sleep stages in all adults(Blyton, Sullivan, & Edwards, 2002). Yet the association between maternal sleep and BF behavior is rarely examined.

Our previous study examined formula supplementation at bedtime and sleep in new parents at three months postpartum. In that sample of 133 couples expecting their first child, mothers had a mean age of 32 years, and 82% were exclusively BF at one month postpartum while 67% remained exclusively BF at three months postpartum. Results indicated that at three months postpartum, exclusively BF mothers and their partners slept an average of 40-45 minutes more than parents who used formula supplementation at night(Doan, Gardiner, Gay, & Lee, 2007). That sample consisted of relatively older, more educated and affluent couples compared to the general population of first time parents living in the United States (US), which limits generalizability of those findings. In addition, the high rate of exclusive BF at one month postpartum precluded any opportunity to compare sleep of mothers by feeding type at that time point.

Therefore, the purpose of this study was to replicate the prior study in a sample of predominantly low-income and ethnically diverse first-time mothers. This study describes sociodemographic characteristics of first-time mothers and compares the sleep of women who breastfed exclusively to those who used formula supplementation at night in the first month postpartum. There were three null hypotheses: 1) there will be no difference in sociodemographic characteristics between mothers who breastfed exclusively and mothers who gave formula supplementation at night; 2) there will be no difference in objective sleep as measured by wrist actigraphy between mothers who breastfed exclusively and mothers who gave formula supplementation at night; and 3) there will be

no difference in perception of sleep disturbance between mothers who breastfed exclusively and mothers who gave formula supplementation at night.

## **Methods**

### *Participants & Design*

This study was approved by the Committee on Human Research at the University of California, San Francisco. As part of a randomized clinical trial to minimize sleep disruption and stress for new mothers, pregnant women in their third trimester were recruited from free childbirth preparation classes and prenatal clinics serving primarily low-income women. Inclusion criteria were (a) English-speaking women expecting their first child, (b) at least 18 years of age, (c) not working the night-shift, (d) not taking medications that alter sleep, and (e) no history of diagnosed sleep disorder or affective disorder. After eligible women consented and baseline measures of sleep were collected in the last month of pregnancy, the sample was then randomly assigned to an experimental group and given a sleep hygiene education program to help them feel more prepared for infant care during the night and to feel more competent in their new role. The control group received nutritional information and comparable time with the researcher. Follow-up assessments of sleep and well-being occurred at 1, 2, and 3 months postpartum. Each assessment took place in the participant's home.

### *Measures*

#### **BF Behavior**

BF behavior was determined from the infant sleep and feeding diary completed by each mother for three days and nights. To facilitate recording, each day was divided into

12-hour time periods from 09:00 to 20:59 for daytime recording and from 21:00 to 08:59 for nighttime recording. Each hour was further divided into 15-minute sections. For each feeding session, mothers were instructed to mark start times and type of feeding. For descriptive purposes, BF behavior was initially classified into categories congruent with standard definitions: a) *exclusive BF*, or 100% BF or breastmilk feeding; b) *partial BF*, or any combination of BF, breastmilk and formula supplementation; and c) *formula-feeding* or 100% formula feeding. Any time during the 72-hour study period, women in the supplementation group might have also breastfed or given breast milk in addition to formula. To analyze the effect of infant feeding method on maternal sleep at night (from 21:00 to 08:59), BF behavior was categorized as either 1) *exclusive BF*, defined as 100% BF or breastmilk feeding on all three nights, or 2) *supplementation*, defined as any formula supplementation at night on any of the three nights.

#### Sociodemographic Characteristics

Sociodemographic characteristics were obtained at recruitment when women were screened for eligibility and included: 1) age (years); 2) education (completed college or not); 3) employment status (working for pay outside of the home); 4) income (categorized into 4 levels - less than \$1000, between \$1000 and \$1999, between \$2000 and \$2999, \$3000 or more); 5) number of people in the household; 6) marital status (single or unmarried, married, divorced or widowed); and 7) relationship status (currently in intimate relationship with someone). Women who were eligible to participate in the study were asked about their BF intention (yes or no) and, if yes, how long they planned to breastfeed (months). At one month postpartum, participants were asked again about their employment status. To assess support women received or perceived at this time,

women were also asked whether they had help with the baby, and from whom, each night during the 72-hour study period.

### Objective Measures of Sleep

To estimate sleep time during the day (0900 hrs to 2059 hrs) and during the night (2100 hrs to 0859 hrs), each participant was asked to wear a wrist actigraph (Ambulatory Monitoring, Inc., Ardsley, NY) for 72 hours at all assessment points. This device weighs about 2 ounces and provides continuous motion activity data using a battery-operated wristwatch-size microprocessor that senses motion with a piezoelectric linear accelerometer. Actigraphy data were analyzed using Action4 software (Ambulatory Monitoring, Inc., Ardsley, NY), with an autoscoring program for sleep that provides three sleep-related variables: 1) *total sleep time at night (TST-night)* or average minutes of sleep between 21:00 and 08:59 over three nights, 2) *total sleep time during the day (TST-day)* or average minutes of sleep between 9:00 and 20:59 over three days, and 3) *wake after sleep onset (WASO)*, calculated by dividing the minutes awake by minutes in bed after falling asleep and presented as a percentage of TST. Although polysomnography (electroencephalogram, electro-oculogram, and electromyogram recordings from the scalp and face) is considered the gold standard for measuring these sleep variables, it is cumbersome, more invasive, and cannot run continuously for 72 hours to get an estimate of both daytime and nighttime sleep. Assessment of sleep in healthy young adults showed strong correlations between polysomnographic measures and actigraphy measures ( $r = 0.93$  to  $0.99$ ) (Ancoli-Israel et al., 2003; Jean-Louis et al., 1996; Walsh et al., 1991) and 88% agreement between the 2 methodologies (Cole, Kripke, Gruen, Mullaney, & Gillin, 1992).

## Subjective Measures of Sleep

To facilitate interpretation of the mother's sleep from the actigraphy data, mothers completed a 72-hour sleep diary. During the first assessment, women recorded information about their bed times, wake times, naps, and sleep locations. At 1, 2, and 3 months postpartum, the diary added infant sleep and feeding information (including specific time and type of each feed, infant sleep and wake times, and infant sleep locations). Mothers also completed the 21-item General Sleep Disturbance Scale (GSDS)(K. A. Lee, 1992) at each time point. The GSDS is used to assess frequency of specific sleep problems experienced during the past week. Each item is rated on a scale from 0 (*not at all*) to 7 (*every day*); the total score ranges between 0 and 147 with a higher score indicative of increased frequency of sleep disturbance. The GSDS was originally developed and tested in a sample of shift-working nurses (Lee, 1992) and further tested in other samples of pregnant and postpartum women (Doan, Gardiner, Gay, & Lee, 2007; Gay, Lee, & Lee, 2004; Goyal, Gay, & Lee, 2007). Cronbach alpha reliability coefficients for this sample were .80 at the last month of pregnancy and .78 at one month postpartum.

## Data Analysis

Actigraphy, diary, and self-report (GSDS) data were processed and reduced to descriptive means and standard deviations (SD). Objective sleep from actigraphy was analyzed by activity counts to determine sleep and wake episodes on the basis of Webster et al. (1982) criteria: after 4 minutes scored as wake, the next 1 minute of sleep is scored

as wake; and 6 or fewer minutes of sleep surrounded by 10 minutes of wake before and after is scored as wake (Webster, Kripke, Messin, Mullaney, & Wyborney, 1982).

Women were grouped by their infant feeding method at night (21:00 to 08:59) for analysis. Women in the exclusive BF group who were either exclusively BF or feeding breastmilk to the infant ( $n = 67$ ) were compared to women in the supplementation group ( $n=59$ ) who used any formula for supplementation at night. The group assignment as part of the randomized clinical trial was unrelated to maternal sleep outcomes at one month postpartum and unrelated to type of feeding.

Repeated measures analysis of variance (RMANOVA) was used to test for mean group differences in sleep variables in the last month of pregnancy and at one month postpartum. The design had 1 between-subjects factor (Collaborative Group on Hormonal Factors in Breast Cancer) with 2 levels (exclusive BF and supplementation) and 1 within subjects factor (time) with 2 levels (last month of pregnancy and 1 month postpartum). This design allowed for testing of the main effect of group, the main effect of time, and the interaction of group by time. To evaluate potential demographic factors associated with BF, continuous variables were tested with independent group t-tests, ordinal categorical and nonparametric variables were tested with Mann Whitney U-tests, and categorical variables were tested with Chi-square tests. Data were analyzed using a two-tailed statistical significance level of  $\alpha = .05$  with 95% confidence intervals (95% CI) using SPSS version 14.0 software for Windows (SPSS for Windows, 2005).

## Results

Of the 198 women screened for inclusion, 152 women were eligible, willing to participate, and enrolled in the study. There were no differences in sociodemographic characteristics (e.g., age, marital status, education, employment status, income level, and race) between women who were ineligible and those who were eligible for the study. The final sample consisted of 126 women with complete sleep measures and BF diary data at one month postpartum.

### *BF Behavior*

The exclusive BF rate was 50% across the three days and nights of diary measures at one month postpartum; partial BF was 29%, and exclusive formula feeding was 21%. For nighttime feedings only (21:00 - 08:59), 67 (53%) were exclusive BF for all three nights and 59 (47%) reported some supplementation.

### *Sample Description*

Table 4 provides sample characteristics for the two feeding groups. The mean age of 26.6 years for this sample is similar to the US population of 25 years for first time mothers(Mathews & Hamilton, 2002; Sutton & Mathews, 2004). The sample was predominantly low-income with 77 women (64%) reporting household income 100% below the Federal Poverty Level(US Department of Health and Human Services, 2009). There was a significant difference in age between the two feeding groups. There were no differences in marital status, education, or income level. The two groups differed significantly by race ( $\chi^2(4) = 11.29, p = .02$ ). The majority of African American and Asian women were supplementing and the majority of Caucasians and Latinas were exclusively BF. There was significant difference in prenatal intention to breastfeed ( $\chi^2(1) = 4.69, p = .03$ ) between the two feeding groups. Of 126 women, only 4 (7%) stated no intention to



breastfeed; these 4 women were African American and also in the supplementation group. Of the 122 women who intended to breastfeed, the planned duration did not differ between the feeding groups.

Most (70%) of the women in each group indicated they were single or unmarried, and 90% of the exclusive BF group were currently in a relationship compared to only 75% of the supplementation group (see Table 4). About 20% of the exclusive BF group worked for pay during the third trimester and none had returned to work by one month postpartum. This differed significantly from the supplementation group in which only five women (8%) worked during pregnancy and at one month postpartum (Table 4). In addition, having help with the baby had a significant effect ( $\chi^2(1) = 5.57, p = .018$ ) on nighttime BF behavior; those with help during the three nights were more likely to be in the supplementation group.

### *Objective Sleep*

The two feeding groups did not differ on nocturnal total sleep time (TST-night), at their initial assessment in the last month of pregnancy. However, there was a significant difference ( $t = 2.30, p = .023$ ) at one month postpartum for TST-night between the exclusive BF and supplementation group. When sleep was examined across time and by group, there was a significant time effect ( $F(122) = 26.17, p < .001, \eta^2 = .193$ ) and a significant time by group effect ( $F(122) = 5.64, p = .019, \eta^2 = .044$ ). While mothers in both groups slept less in the first month postpartum compared to their third trimester measure, the decreased TST-night from pregnancy to the first month postpartum was about 23 minutes (95% CI: 18, 28) for women in the exclusive BF group, compared to 58 minutes (95% CI: 54, 63) for women in the supplementation group. Figure 6 depicts the change in

sleep by time and group. As seen in Table 5, there were no significant differences in the other objective sleep measures (WASO or TST-day).

### *Perception of Sleep*

Perception of sleep disturbance on the GSDS did not differ between the two groups at either time point. When examined perception of sleep disturbance over time from the last month of pregnancy to one month postpartum, GSDS scores for exclusive BF mothers improved slightly (from  $47.1 \pm 16.0$  to  $43.2 \pm 17.3$ ) indicating they perceived less sleep disturbance at one month postpartum than in their last month of pregnancy, but the effect size was small (.233 SD units). In contrast, scores increased for the supplement group (from  $49.2 \pm 15.8$  to  $51.5 \pm 15.3$ ) for the supplement group but the effect size was also small (.147 SD units). The relationship between GSDS scores and nocturnal sleep or TST-night (2100 to 0859 hrs) as well as WASO at both time points was investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity. At the last month of pregnancy, there was a weak, negative correlation ( $r = -0.13$ ) between GSDS scores and TST-night. Interestingly at one month postpartum, there was a weak positive correlation ( $r = .10$ ) between these two variables with higher perception of sleep disturbance associated with slightly more night sleep. There was a weak, positive correlation between GSDS scores and WASO, ( $r = .11$ ), at both time points.

## Discussion

In this study, objective nocturnal sleep time at one month postpartum was significantly greater for women who breastfed exclusively compared to those who supplemented at night. These results further support the findings from our previous study of more affluent first-time mothers (Doan, Gardiner, Gay, & Lee, 2007) indicating a significant association between sleep and nighttime BF behavior. Since the greatest decline in exclusive BF rate occurs during the first month postpartum (Labarere et al., 2005), the association between nocturnal sleep and BF behavior at this time point is relevant to BF promotion. The first month after childbirth is a critical time for postpartum recovery as well as establishing successful BF. Lack of sleep at night during this time not only affects a mother's physical and emotional health but also interferes with her milk supply because nocturnal sleep is related to the production and release of prolactin, the main hormone responsible for milk production.

It is often assumed that new mothers get less sleep because of their new roles and responsibilities. While women in both groups slept less at night in the first month postpartum compared to their last month of pregnancy, results indicate that the amount of sleep loss (about one hour) for mothers who supplemented at night was almost three times the amount (23 minutes) of sleep loss experienced by exclusive BF women. Since women usually sleep less as they get older and women who supplemented were about 5 years younger than women who breastfed exclusively, the positive association we found in this study between BF behavior and nocturnal sleep adds yet another benefit to exclusive BF. Exclusive BF mothers in our sample got more nocturnal sleep by objective measure, but there was no significant difference in perception of sleep. Since the

correlation between subjective and objective sleep in this sample was weak ( $r = .10$ ), future research should include more objective measures of sleep in this population.

By sociodemographic characteristics, our current sample is more representative of the US population of first time mothers than our previous sample (Doan, Gardiner, Gay, & Lee, 2007). The higher exclusive BF rate of the previous sample (82%) compared to this sample (50%) at one month postpartum is congruent with the literature documenting better BF outcomes with higher socioeconomic status compared to low-income and ethnically diverse samples. Consistent with other studies that found younger women having shorter BF duration and less exclusivity compared to older women (Merewood et al., 2007; Scott & Binns, 1999), the formula feeding women were two years younger than BF women in our sample. Being employed and having a non-flexible work schedule may be a factor that should be explored in future studies, since employment was associated with nighttime supplementation at one month postpartum.

Social support has been associated with BF behavior in low-income and culturally diverse population (Dungy, McInnes, Tappin, Wallis, & Oprescu, 2008; Petrova, Hegyi, & Mehta, 2007). Social support is a broad term and can include support from any person in the professional and social network of a lactating woman. Despite marital status, women who were in relationship with someone were significantly more likely to still be BF exclusively at one month postpartum. Another aspect of social support we examined was whether women reported that they had help with baby care during the night. Women who had help during the night were more likely to supplement their baby during the night. Perhaps the help was intended to allow new mothers more sleep, but findings

demonstrate the contrary, since women who breastfed exclusively not only had less help, but they also slept more compared to women who supplemented at night.

The rate of exclusive BF in our sample at one month postpartum was 53%. In the US, the rate drops to 31% by 3 months postpartum while the Healthy People 2010 goal is 60% BF at 3 months(CDC, 2008). Formula supplementation in the first few months postpartum can lead to early BF cessation(Amir, 2006; Beck & Watson, 2008; Hill, Aldag, Zinaman, & Chatterton, 2007). Moreover, formula feeding has both short and long term health, economic, and ecologic consequences. The early introduction of formula may increase risk of childhood asthma or obesity(Oddy & Sherriff, 2003), infection and illnesses(Heinig, 2001; Roth, Caulfield, Ezzati, & Black, 2008), and decrease cognitive functioning later in life (Kramer et al., 2008). All of these issues have an impact on higher health care costs(Gartner et al., 2005) loss of work days for parents(Cohen, Lange, & Slusser, 2002; Cohen & Mrtek, 1994),and substantial loss of productivity for industry and society. Ecologically, there is increasing evidence that exposure to bisphenol A (BPA), a substance found in most plastic baby bottles, causes irreversible neurological damage in animal studies(Healthy Child Healthy World, 2008; vom Saal & Hughes, 2005). Nonetheless, these known and other unknown risks of formula-feeding fail to deter women from using infant formula.

Physiologically, pain and insufficient milk supply are the most common reasons reported by women who use formula supplementation(Amir, 2006; Binns & Scott, 2002; Lewallen et al., 2006). Milk production in the first few months postpartum relies on adequate release and synthesis of prolactin, a hormone secreted at night during deep sleep (Blyton, Sullivan, & Edwards, 2002). More than 30 minutes lost sleep at night can affect

prolactin release and milk supply as well as women's health and well being over time. Perhaps knowing that they are likely to get more sleep at night when they breastfeed may provide additional incentive to deter women from supplementing with formula.

For new mothers, maintaining exclusive BF is multifaceted and involves an integration of many factors ranging from her physiology to her social context. For lactating women in this study, nocturnal sleep was associated with nighttime feeding method and it is important for lactation consultants and other health care professionals to understand the importance of sleep in promoting exclusive BF while continuing to provide lactation support for new mothers during postpartum recovery.

Due to this study design, it remains unknown whether women were supplementing with formula at night because they were experiencing postpartum sleep loss or whether supplementing with formula resulted in the sleep loss. In fact, both sleep loss and supplementing could be affected by other factors such as maternal stress and anxiety, and maternal perception of support (inadequate) or infant temperament. We do not know about the infant's in-hospital feeding patterns (i.e., whether infant received formula or artificial nipple was used during postpartum hospital stay) and the feeding modality in the first two weeks at home. We also do not know to what extent infant sleep and sleeping location or birth outcomes impact maternal sleep and BF. Future research should address factors related to the characteristics of the infant in order to illuminate the relationship between mother's sleep and infant feeding method.

## CHAPTER FOUR

### Infant Factors Associated with Nighttime Feeding Behavior

#### ABSTRACT

**Background:** While maternal factors such as pain and complaint of low milk supply are known to affect BF, less is known about infant factors, such as type of delivery, birth weight, temperament and sleeping location. The objective of this study was to identify infant factors associated with feeding method and compare infants who were breastfed exclusively to those who received formula supplementation during the night (21:00 to 08:59).

**Methods:** Recruitment took place between May 2005 and February 2008 at clinics and free childbirth classes in the San Francisco Bay Area. Infant feeding data from 120 mother-infant dyads was examined at one month postpartum from feeding and sleep logs kept by each mother over a 72-hour study period.

**Results:** The results indicated significant differences in frequency of room-sharing in hospital after birth, birth weight and birth length of infants between the night-time feeding groups at one month postpartum. Infants who were rooming-in with mother during hospitalization were more likely to be breastfed exclusively during the night were significantly more likely to have rooming-in while in the hospital ( $\chi^2=9.73$ ,  $p=.04$ ) and infants who received home visits as part of their hospital's discharge planning program had the highest rate (68%) of exclusive BF at one month postpartum.

**Conclusion:** A trend of supplementing at night was observed in this study suggesting more care should be directed toward rooming-in hospital practices and helping mothers after hospital discharge to breastfeed exclusively during the first month of life.

**Keywords:** infant factor, night-time infant feeding, birth weight.



For millennia, mother's milk has been the best nourishment for infants (Jelliffe & Jelliffe, 1978). The World Health Organization (WHO) and the American Academy of Pediatrics recommend feeding infants from 0-6 months exclusively with breast milk, starting complementary food after the sixth month, and continuing BF for at least one year or as long as both mother and child desire (American Academy of Pediatrics, 2005; WHO, 2003). Receiving breast milk exclusively in the first six months of life is beneficial to the health and well-being of infants. Among the prominent benefits, breast milk protects infants against infection and illness ("Caring for the near-term infant", 2005; Coovadia et al., 2007; Heinig, 2001; Silverdal, Ekholm, & Bodin, 2007), decreases risk of obesity (Araujo, Victora, Hallal, & Gigante, 2006), and optimizes cognitive development in infancy and childhood (Tanaka, Kon, Ohkawa, Yoshikawa, & Shimizu, 2008) as well as early adulthood (Mortensen, Michaelsen, Sanders, & Reinisch, 2002). Healthy People 2010 objective of 25% exclusive BF at 6 months (US Department of Health and Human Services, 2007) remains unmet; only 12% of infants born in the United States between 1999 and 2005 received breast milk exclusively to 6 months of age (Centers for Diseases and Prevention, 2008). Prevalence of exclusive BF is also much lower for women who are younger, less educated, of lower income, and ethnically diverse compared to older, college educated, higher income, and Caucasian women (Centers for Diseases and Prevention, 2008). The greatest decline in exclusive BF rate occurs during the first month after birth (Labarere et al., 2005) and is related to early use of formula supplementation (CDC, 2008).

BF is a physiologic and emotional interaction which relies on how well the mother and her infant work together. Hence, BF problems derive from both mother and

infant. Maternal problems can be physiologic such as pain (Graef et al., 1988; Tait, 2000), low milk supply (Amir, 2006; Binns & Scott, 2002; Hill, Aldag, Zinaman, & Chatterton, 2007), fatigue (Groer et al., 2005; Wambach, 1998), and stress (Mezzacappa, Kelsey, & Katkin, 2005; O'Brien, Buikstra, Fallon, & Hegney, 2008), and can be psychosocial such as perceived lack of support from either her social network (Ingram & Johnson, 2004; Johnston & Esposito, 2007; Rossiter & Yam, 2000) or professional network (Labarere et al., 2005; Lewallen et al., 2006; Rossiter & Yam, 2000; Sikorski, Renfrew, Pindoria, & Wade, 2003) or employment issues and schedules (Fein, Mandal, & Roe, 2008; Kimbro, 2006). These maternal factors have been well documented to be associated with supplementation and early weaning.

Compared to maternal factors, infant factors are not as well known and are often documented in relation to maternal problems. For example, ankyloglossia (tongue-tied or tight frenulum) is often indicated as the main reason for maternal nipple pain and a probable cause for delay onset of lactation because infants with short frenulum exert more compression on the nipple (Geddes et al., 2008). Other infant factors associated with BF problems include birth-related outcomes. Cesarean section, pain medication and anesthesia (epidural, general) used during labor and delivery have been reported to be related to poor newborn sucking reflex (Riordan, Gross, Angeron, Krumwiede, & Melin, 2000; Wittels et al., 1997).

Infant temperament, described as “unsettled” (Binns & Scott, 2002) or frequent crying (Karacam, 2008), has been reported in relation to maternal anxiety over lack of milk. Supplementation tends to occur at nighttime for infants who cry after BF because mothers infer from the infant’s behavior that breast milk alone is not enough (Sachdev &

Mehrotra, 1995). More than crying behavior, infant temperament refers to biologically rooted individual differences in behavior tendencies that are present early in life and are relatively stable over context and across time (Bates, 1989). For an infant, temperament is usually measured by the mother's perception and has been associated with feeding outcomes during the first two years of life (Blissett & Farrow, 2007).

Linked to fatigue resulting from frequent infant feedings during the night, a prominent concern of new mothers is sleep deprivation (Cadwell & Turner-Maffei, 2006; Funkquist, Carlsson, & Nyqvist, 2005). In one cross-sectional study of 37 first-time mothers and infants between four and ten weeks of age, Thomas and Foreman (2005) found that increased number of infant feedings resulted in more fragmented sleep for mothers (Thomas & Foreman, 2005). In a sample of 253 new mothers in the United Kingdom, Ball (2003) examined the relationship between BF, infant sleep location, and infant sleep in the first 4 months of life and found an association between bed-sharing and BF at night (Ball, 2003). In both of these studies, sleep was measured subjectively by self-report diaries and there was no differentiation between exclusive and partial BF with nighttime supplementation. Using night-time video recording, Ball and colleagues (2006) examined the effect of infant sleep location in the hospital postpartum unit on BF initiation of 64 mother-newborn dyads and found that dyad sleep proximity affected BF frequency, suggesting that newborns sleeping in mother's bed or bedside crib breastfed more frequently than infants sleeping in stand-alone cots (Ball, Ward-Platt, Heslop, Leech, & Brown, 2006).

Little is known about BF behavior during the first month for term infants who have had an uneventful birth. The first month is a crucial time for new mothers to adjust

to new relationship, role, and responsibilities. Therefore, the purpose of this study was to explore infant factors that may contribute to nighttime supplementation in the first month postpartum in a sample of predominantly low-income and ethnically diverse women. The specific aims of the study were to 1) describe infant factors associated with night-time feeding behavior (exclusive BF, formula supplementation), and 2) compare infant factors between exclusive BF and supplementation dyads.

## Method

### *Procedure*

This study was approved by the University of California at San Francisco committee on human research. As part of a randomized clinical trial to minimize sleep disruption and stress for new mothers, pregnant women in their third trimester were recruited from childbirth preparation classes and prenatal clinics serving primarily low-income women. Recruitment and enrollment took place between May 2005 and February 2008 at a clinic associated with a county hospital undergoing the process of Baby-Friendly certification (BFUSA, 2004) and two clinic sites associated with hospitals that were not Baby-Friendly. Inclusion criteria were (a) English-speaking women expecting their first child, (b) at least 18 years of age, (c) not working the night-shift, (d) not taking medications that alter sleep, and (e) no history of diagnosed sleep disorder or affective disorder. Upon enrollment, women were randomly assigned to an experimental or control group. Women in the experimental group were given sleep hygiene intervention allowing them to feel more prepared and competent in their new role. The placebo/attention control group received nutritional information.

The first assessment took place during the last month of pregnancy (at 36 weeks gestation or later). A follow up telephone call about two weeks after delivery was made to each participant to obtain labor and birth information. Follow up assessments were carried out at one, two, and three months after delivery. At these three postpartum assessments, each mother completed a sleep and infant feeding diary for a 72-hour period. All assessments occurred in the participant's home.

### *Measures*

#### Infant Feeding

Infant feeding was determined from the mother's entry in the 72-hour diary. Feeding types were coded as BF, breast milk, and formula feeding. The diary contained information about infant sleep and infant feeding information such as specific time and type of each feed, infant sleep and wake times, and infant sleep locations. Nighttime infant feeding was coded as one of two categories from the mother's feeding log entries between 21:00 p.m. and 08:59 a.m.: 1) *exclusive BF*, defined as 100% BF or breastmilk feeding, and 2) *formula supplementation*, defined as any formula feeding.

#### Birth Outcomes

Birth outcome data were obtained either by telephone call to mother at about two weeks postpartum or during the one-month postpartum assessment. Birth outcome variables included anthropometric measures such as birth weight (kilogram) and birth length (centimeters), and related measures such as delivery providers (midwife, physician), method of delivery (cesarean, instrument assisted vaginal delivery, spontaneous vaginal delivery), labor complication (yes/no), labor induction (yes/no), and any newborn complication.

## Infant Temperament

Infant temperament was measured subjectively by maternal reports that included scores from a 12-item Infant Temperament Questionnaire designed for the primary study. Using a scale of 0 (*not at all*) to 10 (*very*), the Infant Temperament Questionnaire asked mother to indicate what the baby was like, during the past 7 days, on the following behaviors: *quiet, cuddly, easy to soothe, happy, good, fussy, restless, temperamental, unpredictable, easily upset, awake all the time, and asleep all the time*. Cronbach alpha was 0.78 for the sample at one month postpartum.

## Infant Sleep

Infant sleep variables included infant sleep location and maternal perception of infant sleep quality. Infant sleep location was examined in hospital after birth and at home. For sleep location in hospital, the frequency of “rooming-in” or room sharing with mother was coded as *always* (infant stayed with mother in the same room for the duration of hospitalization), *most of the time* (infant taken from mother’s room only for assessment or procedure), *half of the time* (infant may spend the night in the nursery), and *occasional* or *never* (for whatever reason, infant was only occasionally or never in mother’s room). For location at home, infant sleep was categorized as *in bed with mom* or *separate bed*. Infant sleep quality was categorized as *very good, fairly good, fairly bad, and very bad* by mother’s report.

## Statistical Analysis

To evaluate the effect of infant factors on night-time infant feeding method, independent group t-tests were used to compare quantitative variables such as birth weight, birth length, infant age at assessment, and temperament scores between the

exclusive BF and formula supplementation group. Chi-square tests were used to test categorical variables such as method of delivery, labor complication, labor induction, family income level, maternal employment, and prenatal BF intention. Data were analyzed using a two-tailed statistical significance level of  $\alpha \leq .05$ , with 95% confidence intervals (95% CI) using SPSS version 14.0 software for Windows (SPSS for Windows, 2005).

### Results

Of 198 women recruited and screened, 152 met eligibility criteria for the original clinical trial study design. There were no differences in sociodemographic characteristics between the participants and the women who were not eligible. Since the intervention group of mothers participated in a randomized clinical trial to test a behavioral intervention that included a bedside bassinet for the infant, group assignment was examined and there was no difference at one month postpartum between feeding groups: 41 (51%) of the exclusive breastfed infants and 40 (49%) of the night supplement infants were in the intervention group.

#### *Sample Description*

Of 152 participants, 126 had complete data for sleep and infant feeding at one month postpartum. Of the 126, six infants had extended length of stay in hospital (> 7 days) due to complications after birth and were excluded from analysis because this report focused on normal full-term infants. The final sample for this analysis consisted of 120 mother-infant dyads with completed feeding and sleep diary at one month postpartum. This sample of first-time mothers was predominantly low-income and racially diverse. There were 67(56%) boys and 53 (44%) girls in the sample. The

average birth weight in kilograms (kg) was  $3.36 \pm 0.49$  (range 2.10 to 4.99 kg) and the average birth length in centimeters (cm) was  $50.6 \pm 2.77$  (range 38.1 to 55.9 cm). Most (88%) of the delivery providers were physicians (obstetrician, family practice) and 10% were midwives. Seventy two (60%) infants were spontaneous vaginal delivery, 11 (9%) were instrument assisted vaginal delivery with forceps or vacuum extraction, and 37 (31%) were cesarean. Of the infants born by cesarean, only 2 (5%) were scheduled and the others were emergency cesarean deliveries.

Forty nine (41%) of the infants were born at the Baby Friendly hospital. Labor was induced for 68 (57%) of mothers and an epidural was administered to 93 (77%). The average length of labor was  $18.3 \pm 12.70$  hours (range 5.5 to 36.0 hours). There were 36 (30%) infants whose mothers reported some newborn complication, with jaundice as the most prominent problem. The average hospital stay was  $2.9 \pm 1.23$  days for mothers and  $3.0 \pm 1.28$  for infants. During hospital stay, 67 (56%) infants were always rooming-in with mothers, 38 (32%) spent most of the time with the mother, 7 (6%) spent half of the time with mother, and 8 (6%) were occasionally or never together in mother's hospital room. The average age of infant at the one-month assessment was  $27.5 \pm 5.17$  days (range 21 to 37 days). At one month postpartum, night-time (2100 to 0859 hrs) feeding groups were comprised of 66 (55%) infants who were breastfed exclusively and 54 (45%) who received formula supplementation. Table 6 provides mother sociodemographic as well as labor and BF characteristics by infant feeding group. Table 7 provides comparison of infant factors by feeding groups.



*Infant Factors Associated with Night-time Feeding Methods*

The results indicated significant differences in birth weight, and birth length of infants between the night-time feeding groups at one month postpartum. Infants who were breastfed exclusively during the night (2100 to 0859 hrs) were longer ( $t=2.26$ ,  $p=.03$ ) and weighed more at birth ( $t=2.04$ ,  $p=.04$ ) but the differences were not clinically meaningful (Table 7). There was no difference in other birth related measures such as length of labor, delivery method, labor induction, labor epidural or analgesia, or maternal or newborn complication between infants were breastfed exclusively at night and those who received formula supplementation at night at one-month postpartum assessment.

When the two feeding groups were compared by the extent of their hospital rooming-in practice, there was a significant group difference ( $\chi^2=9.73$ ,  $p=.04$ ) between the night feeding groups as infants in the formula supplementation group were significantly less likely to room-in with mothers (Table 7). Further analysis was performed to examine the proportion of rooming-in practice and BF behavior at one month between the infants who were born in the Baby Friendly hospital compared to the other hospitals. While there were more babies rooming-in with mother (mother and baby always together) in the Baby Friendly hospital compared to those who were born in other hospitals, the proportion of exclusive BF between hospitals did not differ by one month postpartum. There was no group difference by infant sleep location at home. About one third of infants from both groups slept in the same bed with mothers while the other two thirds were in a separate bed at night.

There was no difference in maternal perception of the infant's temperament between infants who were breastfed exclusively at night and those who received formula

supplementation at night. Maternal perception of infant sleep was rated as either *very good* (48%) or *fairly good* (48%) for mothers who breastfed exclusively at night. For mothers who used formula supplementation at night, maternal perception of infant sleep was *fairly good* (61%) or *very good* (34%). Two women from each night-time feeding groups perceived their infant sleep as *fairly bad* and one woman from each group perceived it as *very bad* (Table 7).

### Discussion

The findings indicating a statistically significant difference between birth size and infant feeding method at night at one month postpartum is interesting but clinically, within the normal parameters for birth weight and length of full-term infants, a difference of 100 grams in weight or one centimeter in length is not very meaningful.

Supplementation advice from lactation professionals and guidelines from La Leche League International suggested that supplements may be recommended if a baby has not regained birth weight within 10 to 14 days after birth, or when baby's weight gain is less than 5 ounces per week (or 1 pound per month) in the first three months (LACTNET Archives, 2009). However, this guideline has been viewed with controversy by BF experts as "we now know that the breastfed baby is getting *less* than we previously thought, much less than the formula fed baby" (Newman, 2009). Since we do not have data on infant's weight at any of those time points, we could not relate night-time supplementation to professional advice received by the mothers.

To get more sleep, women may choose to use formula supplementation at night as a coping strategy (Ball, 2003). Mother's sleep is shown to be associated with infant sleep

(Thomas & Foreman, 2005), infant sleep location and infant feeding (Ball, 2003; Ball, Ward-Platt, Heslop, Leech, & Brown, 2006). Our findings indicate a significant association between in-hospital rooming-in practice and night-time infant feeding methods at one month postpartum. Regardless of type of hospital where the delivery occurred, infants who were kept in the mother's room most and all of the time were significantly likely to be breastfed exclusively at night at the one-month postpartum assessment. Conversely, infants who were occasionally or never in the mother's hospital room were likely to be in the night-time formula supplementation group at one month postpartum. This finding echoes results from recent research indicating that hospital practices can make a difference in early BF success of mothers who intend to exclusively breastfeed (Declercq, Labbok, Sakala, & O'Hara, 2009).

Compared to findings from other studies supporting the positive association between co-sleeping or bed-sharing and BF (Ball, 2003; McKenna, Ball, & Gettler, 2007), infant sleep location at home had no association with night-time infant feeding method at one month postpartum. Co-sleeping and bed-sharing, although often used interchangeably, are not exactly the same. According to the Academy of BF Medicine, bed-sharing is "only a form of co-sleeping" while co-sleeping "refers to the diverse way in which infants sleep in close social and/or physical contact with a caregiver (usually mother)" (Academy of Breastfeeding Medicine Protocol Committee, 2008). Our operational definition of infant sleep arrangement at home (bed sharing, room sharing) differs from that of other studies (Ball, 2003; McKenna, Ball, & Gettler, 2007). Because most participants in our sample lived in tight quarters where mother and infant shared one room, any room sharing infant who slept in separate bed at night was also in proximity

with mother. It was thus possible that any room sharing infant might have spent part of the night sleeping in the same bed with the mother.

Due to the study design, we lack BF information in hospital and during the first two weeks at home. BF behavior during the first few days after birth, whether formula supplementation or artificial nipple was used, whether feeding was on-demand, and whether mothers got help with BF during this period could be confounding factors in BF maintenance by one month of age. We were unable to examine the effect of BF initiation on BF behavior at one month. When examined by type of hospital (Baby-Friendly versus other hospitals), our results indicated no difference in exclusive BF at one month between infants born at the Baby-Friendly hospital (55.1%) and those who were born in other hospitals (54.5%). In fact, one university hospital with a postpartum home visit and lactation support had the highest exclusive BF rate (68%) at one month among all the hospitals sites. This may reflect the need for lactation support for the mother-infant dyad after discharge from all types of settings, including Baby-Friendly hospitals.

Further study should take into consideration all of these variables in addition to infant sleep time, preferably by objective measures, to better evaluate BF behavior during the first month postpartum. Having knowledge of factors associated with BF behavior during this critical time will be beneficial for developing effective interventions to help low-income women maintain exclusive BF over a longer period of time. Exclusive BF needs to be addressed during the first month, and every month thereafter to reach the six-month goal. Regardless of income or ethnicity, exclusive BF in the first six months of life would provide every child with optimal nutrition, immunity, and the necessary foundation for developing into a healthy adult. Hence, exclusive BF in the first six

months of life of every child boldly becomes the first step toward eliminating health care disparities in the United States.

## CHAPTER FIVE

This dissertation study stemmed from observations of formula supplementation of the breastfed infants during the first three months postpartum, the association between BF (BF) behavior and social context, and the recognition that research was needed. As part of this dissertation, three manuscripts were prepared for publication: a review of the literature (chapter two) and two papers reporting study results (chapter three and chapter four). This chapter synthesizes key findings from the three papers, the resulting changes to the conceptual model proposed in the first chapter, clinical implications, and directions for future research.

The aims of this doctoral research were to examine the following questions:

- 1) What happens in the first three months postpartum that may affect such a profound drop in BF rate for low-income women?
- 2) Why are certain undesirable BF behaviors, such as early use of supplementation, exhibited more in women from lower income and ethnically diverse backgrounds than from women in higher income status?
- 3) What interventions have been tested and how effective are they in helping women to continue to breastfeed after the first three months of life?
- 4) When would be the most appropriate time to intervene to promote exclusive BF for low-income and ethnically diverse women?

The study addressed factors implicated in the low prevalence of BF maintenance, especially for low-income and ethnically diverse populations. To understand the phenomenon, the first chapter provided an overview of theoretical approaches in human lactation and a description of the role and components of theory. BF maintenance, as the

desired outcome, was described as a concept since it has not been clearly defined in the literature. The emerging concept of BF maintenance contained three crucial components: 1) early BF success is associated with physiological interaction between mother and infant, 2) ongoing BF support is associated with social context, and 3) the first three months postpartum (fourth trimester) is a crucial timeframe for lactation establishment. Lactation physiology and the extension of culture to both modifying and mediating conditions were added to a health behavior model (Sorensen et al., 2003; Sorensen et al., 2007) to examine BF behavior within the social context of lactating women. This model was used to guide the review of the literature in the first publishable paper (Chapter 2).

The purpose of the first paper was to review the literature on BF interventions and synthesize the data on effective strategies for promoting exclusive BF in the first three months postpartum. Twenty one studies were selected and presented within the social context of the mother-infant dyad and the individual, interpersonal, and organizational factors that represent modifying conditions of BF behavior (Table 3). Effective interventions addressing the individual or mother-infant dyad included skin-to-skin care, breast and nipple pain management, and infant sleep location. At the interpersonal level, support from peer counselors, health professionals (midwife, lactation consultant), partner, or baby's grandmother was effective. At the organizational level, Baby-Friendly Hospital Initiatives training programs for hospital staff, peer counselors offering BF support for pregnant and lactating women, and corporate lactation programs providing BF education and lactation consultant support for mothers and partners were effective in BF initiation behaviors. All of these interventions evaluated in this paper, however, made no difference in the rate of exclusive BF by the third month postpartum. Furthermore,

data presented in Chapter 4 would indicate that Baby-Friendly protocols and support do increase the rate of BF initiation, but have no effect on the rate of BF maintenance when assessed as early as one month postpartum.

In addition, the comparability between research findings were somewhat complicated by inconsistent definitions of BF duration (range between two weeks and one year postpartum) and BF behavior (exclusive or partial BF) as outcomes. Based on empirical evidence for numerous benefits associated with duration and exclusivity of BF, maintenance is considered the most important goal of any BF promotion program. Yet, interestingly, maintenance was not a specified outcome in any of the 21 studies reviewed. In reviewing the state of the science, BF maintenance remains without a clear definition as to exactly what constitutes duration and BF behavior. As a result, the paper in Chapter 2 suggests the need for a standard definition of BF maintenance that would be useful for effectively develop and test interventions to help women breastfeed exclusively during the first three months postpartum. The standard definition of BF maintenance would also facilitate the comparability between studies and the collective findings will enhance evidence-based care for the promotion of exclusive BF behavior.

The second paper (Chapter 3) reported on BF behavior and sleep of new mothers in a sample of 126 predominantly low-income and ethnically diverse mother-infant dyads. Using objective and subjective measures of sleep, this study compared sleep of women who breastfed exclusively to women who gave formula supplementation at night (9 pm to 9 am). The initial assessment took place during the last month of pregnancy (at 36 week or later), followed by assessment at one, two, and three months postpartum. This paper reported on data obtained during the last month of pregnancy and at one month



postpartum. There was no difference in sleep time between the exclusive BF group and supplement group in the last month of pregnancy and no difference in daytime sleep at any time point. At one month postpartum, there were significant differences ( $t = 2.30, p = .023$ ) in objective nocturnal sleep for the 67 women BF exclusively compared to the 59 women who gave formula supplementation at night. Nighttime sleep was  $385 \pm 66$  minutes ( $6.43 \pm 1.10$  hours) for exclusive BF mothers and  $358 \pm 66$  minutes ( $5.98 \pm 1.10$  hours) for the supplementation group. There was no group difference in subjective sleep. Exclusive BF women averaged half an hour more sleep by actigraphy measures between 21:00 and 08:59 than women who used formula supplementation. Findings support a previous study of middle-class and older first-time mothers (Doan, Gardiner, Gay, & Lee, 2007) and extend the conclusions to more of the general population of childbearing women in the United States. The findings suggested that new mothers should be encouraged to breastfeed exclusively to obtain more nighttime sleep during postpartum recovery.

The third paper (Chapter 4) explored infant-related factors that, according to the theoretical model, might affect night-time feeding behavior. Infant factors are not as well understood and are often documented in relation to maternal problems. This study examined night-time feeding behavior associated with infant sleep location (in hospital after birth and at home), maternal perception of infant sleep, birth-related variables (anthropocentric measures, method of delivery, type of provider, maternal labor/delivery anesthesia or analgesia, newborn complication), and infant temperament as assessed by the mother at one month of age. After six infants were excluded due to neonatal complications that required prolonged hospitalization after birth, the final sample

consisted of 120 mother-infant dyads who were home by one week postpartum and who had complete sleep and feeding data at one month postpartum.

For analysis, infants were divided into two groups by night-time (21:00 to 08:59 hours) feeding behavior at one month postpartum. By that time, there were sufficient numbers to have an exclusive BF (N=66) group and a formula supplementation (N=54) group. The results indicated a significant association between hospital rooming-in practice and night-time infant feeding method at one month postpartum. During their hospital stay, infants who were kept in mom's room most or all the time were significantly more likely ( $\chi^2=9.73, p=.04$ ) to BF exclusively at night at the one-month postpartum assessment. In addition, infants who were breastfed exclusively during the night at the one month postpartum assessment were significantly bigger ( $t=2.04, p=.04$ ) and longer ( $t=2.26, p=.03$ ) at birth compared to infants who received formula during the night. However, the differences were not clinically significant. Supplemented infants were slightly lighter (3.3 versus 3.4 kg) and slightly shorter (50.0 versus 51.4 cm) at birth compared to the exclusive BF group. Unfortunately, without information about BF initiation or BF hospital practice hospital, infant weight gain or loss during the first 10-14 days after birth, and availability of BF support for mothers during the first month postpartum, this finding remains a trend that needs further investigation. .

The infant's sleep arrangement at home did not differ by feeding group. Compared to findings of other studies supporting the positive association between co-sleeping or bed-sharing and BF (Ball, 2003; McKenna, Ball, & Gettler, 2007), infant sleep location at home in our sample had no association with night-time infant feeding method at one month postpartum. Infant sleep arrangement variable was categorized into bed sharing

and room sharing which in either category, there was proximity between mother and infant given that the sample was predominantly low-income and the majority of participants lived in small quarters due to the expensive accommodation of the San Francisco Bay Area. There was no difference in maternal perception of the infant's temperament between infants who were breastfed exclusively at night and those who received formula supplementation at night. The significant association between the hospital rooming-in practice and nighttime exclusive BF behavior at one month after birth complements results from recent study indicated that hospital practices can make a difference in early BF success of mothers who intended to exclusively breastfeed (Declercq, Labbok, Sakala, & O'Hara, 2009).

Findings from these three papers suggested that some changes are needed for the theoretical model. These changes should occur in the Individual Factors as part of the Modifying Conditions and Mediating Mechanisms for both mother and infant. Figure 6 shows the revised model with changes included in bold. Depending on the research question, maternal sleep, emotions and stress can also act as modifying conditions affecting BF behavior. The randomized controlled trial upon which this dissertation was based provided a sleep hygiene intervention to help new mothers better cope with their new role and relationship. If researchers were to examine whether stress was a factor affecting BF behavior, maternal stress would be considered a mediating mechanism. Likewise for infant, sleep, feeding pattern, and temperament can also act as modifying conditions because intervention was not intended to change their sleep, feeding pattern or temperament.

The findings of this dissertation study provide some answer to the four questions posed at the onset of the research. For the first question regarding what happen in the first three months postpartum, the results indicate that mother's nocturnal sleep quantity (more sleep time) and hospital rooming-in practice (mother-infant dyad always or mostly together). The second question remains unanswered. The findings of this study merely confirm that BF behavior of women from lower income and ethnically diverse backgrounds compared to women from higher income status include less exclusive BF and more use of formula supplementation specifically at night-time (Doan, Gardiner, Gay, & Lee, 2007). Chapter two of the dissertation provides a partial answer to the third question regarding the BF interventions and their effectiveness in helping women to continue to breastfeed after the first three months postpartum. From the literature, all the BF interventions were effective for increasing BF initiation but have no effect on exclusive BF beyond the first few months postpartum. The fourth question regarding when would be the most appropriate time to intervene to promote exclusive BF for low-income and ethnically diverse women becomes the final question for this dissertation. The results indicate that by the end of one month after birth, 45% of infants in this sample of predominantly low-income and ethnically diverse mother-infant dyads received formula supplementation. Therefore, the most appropriate time to intervene is before the end of the first month. The study findings are congruent with national statistics showing the greatest decline in exclusive BF rate occurs during the first month after birth (Labarere et al., 2005) and is related to early use of formula supplementation (CDC, 2008).

### Clinical Implications

The findings of this study indicate the importance of assessment of sleep for new mothers during the first month postpartum. New mothers should be encouraged to breastfeed exclusively, especially at nighttime, to get more sleep. Term infants who are smaller at birth were more likely to be in the formula supplementation group, but the clinical importance of this finding remains a trend to be evaluated when the finding is replicated in further research.

Why women from lower income and ethnically diverse backgrounds are less likely to BF exclusively by one month postpartum compared to women in higher income status requires further investigation, especially in the social context of the mother-infant dyad. As scientists, we are intrigued to know what motivates people to exhibit certain health behavior. BF is considered a preventive health behavior. There is so much about the social context of the mother-infant dyad and its effect on health behavior that is yet to be discovered. Future study may use a qualitative approach to learn more about the lived experience of new mothers during the night while coping with sleep loss and infant feeding. The themes discovered in qualitative study could be used to develop more effective interventions for helping women to maintain BF for at least three months postpartum. Having maintained BF for three months, the six-month requirement by Healthy People 2010 would be easily obtainable. Hence, there will be savings made in total health care costs. BF maintenance through the first six months of life is truly the first step in the direction of eliminating health care disparity for the United States and the global community.

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Table 1 - Summary of Theories Frequently Used in Human Lactation Research

<b>Theory</b>	<b>Assumptions/ Concepts</b>	<b>Utility/ Measure</b>	<b>Time</b>
Theory of Attachment (Ainsworth, 1967; Bowlby, 1969; Shore 2004)	Maternal responsiveness is considered a high priority in cognitive and social development for children	Maternal responsiveness or mother-child interaction Maternal behavior	PP*
Theory of Reasoned Action (Ajzen & Fishbein, 1980)	People's behavior follows reasonably from their beliefs, attitudes, and intentions	Nurses' attitude toward BF Feeding intentions & behavior	AP/ PP
Theory of Planned Behavior (Ajzen, 1985, 1987, 1991)	Human action is guided by three kinds of considerations: behavioral beliefs, normative beliefs, and control beliefs.	Attitudes toward BF Factors influencing BF initiation Continuation of BF BF Attrition Prediction Tool (Janke, 1994; Dick et al, 2002)	AP/ PP
Social Cognitive Theory (Bandura, 1977)	People learn through attention, retention, motor reproduction, and motivation	Maternal confidence BF Self-Efficacy Scale (Dennis 1999/ 2002)	AP/ PP
Grounded Theory (Glazer & Strauss, 1967; Strauss & Corbin, 1990)	Theory emerged from data; important concepts: categories, codes, and coding	BF ,“becoming a mother” Pain in BF	AP/ PP
Phenomenology (Husserl, Heidegger, Sartre, Merleau-Ponty)	Conscious experience from the first-person point of view; Intentionality is the central structure of an experience	Meaning of BF experience	PP

\*PP: postpartum, AP: antepartum

Table 2 - Critique of Theory Using Criteria Proposed by Meleis (2005)

Criteria	Social Contextual Model
Relationship between structure (e.g., assumptions, propositions, concepts) and function (e.g., domains) including consistency, simplicity or complexity, tautology/teleology	Conceptual basis includes complex multidimensional relationships between sociodemographic characteristics and different approaches to health behaviors and health outcomes. Relational propositions, concepts & domains (e.g., social context) are clearly presented. Teleology is not applicable here since concepts derive from existing theories instead of by consequences.
Diagram of theory (e.g., clarity, logical representation, visual/graphic depiction)	Schemas developed logically represent conceptual dimensions and relationships that can be operationalized. However, model appears linear without feedback mechanisms
Circle of contagiousness: Origin of theory, spread of theory, influence of theory/theorist	Model developed from well-known and established social/behavioral theories (e.g., Social Cognitive Theory) and other existing model. Used in multiple studies by The Harvard Cancer Prevention Program Project where Sorensen et alia collaborated. The model has also been used elsewhere.
Usefulness: Use in research, practice, education, administration	Used to develop and test intervention aiming at changing health behaviors of low SES and diverse population. However, modification is necessary to address specific health behavior / ethnicity. Findings of studies have effects on policy.
External components of theory (e.g., congruence with other professional and/or social values, social significance)	Illuminated the pathways by which socioeconomic position and race may influence health behaviors (i.e., risk-related) and health outcomes. Contributed to public health efforts in understanding and thereby reducing health disparities by SES and race/ethnicity.

Table 3- Grouping of the 21 Studies for Review by Type of Interventions

Types of Interventions	Authors (country)	Year
Individual Factors		
Cochrane review: Intervention before first breast feed	Dyson et al	2005
Dyad: Skin-to-skin	Carfoot et al (UK)	2005
Dyad: Skin to skin	Moore and Anderson	2007
Mother: Breast pain and use of acupuncture	Kvist et al (Sweden)	2007
Mother: Nipple pain and treatment	Manizheh et al (Iran)	2007
Infant: Bottle/cup vs. Pacifier use	Howard et al (US)	2003
Infant: Sleep location	Ball et al (UK)	2006
Interpersonal Factors		
Cochrane review: Support for BF mothers	Britton et al. (US/world)	2007
PC support: subgroup low-income, Latina	Anderson et al (US)	2005
HCP: midwife support	Wallace et al (Scotland)	2006
LC support: face-to-face vs. telephone	Fallon et al (Australia)	2005
LC support	Bonuck et al (US)	2005
Qualitative: Mother's response to support	Memmott & Bonuch (US)	2006
Qualitative: Father's support	Fagerskiold (Sweden)	2008
Organizational Factors		
Cochrane review: Workplace interventions	Abdulwaduh & Snow (US/world)	2007
Corporate lactation program	Cohen et al (US)	2002
Employer-sponsored lactation program	Ortiz (US)	2004
Hospital-based vs. home visit	Escobar et al (US)	2001
Group prenatal care	Ickovics et al (US)	2007
WIC BF promotion	Petrova et al. (US)	2008
BFHI and home visit vs. BFHI	Coutinho et al (Brazil)	2005

Table 4 - BF and Sociodemographic Characteristics by Night Feeding Group

Variable (mean $\pm$ SD) or frequency (%)	Exclusive BF (N=67)	Supplementation (N=59)	Test Statistics
Age in years	27.8 $\pm$ 6.2	25.5 $\pm$ 6.9	$t(124)=1.95, p=.05$
Currently married	20 (30%)	18 (30%)	NS
Planned BF months	9.0 $\pm$ 3.9	8.3 $\pm$ 4.9	NS
Intention to BF	67 (100%)	55 (93%)	$(\chi^2(1) = 4.69, p = .03)$
Race			$\chi^2(4)=11.3, p=.02$
African American	5 (8%)	12 (14%)	
Asian	19 (28%)	21 (36%)	
Caucasian	23 (34%)	7 (12%)	
Latina	15 (22%)	13 (22%)	
Mixed/Other	5 (8%)	6 (10%)	
Currently in relationship	60 (90%)	44 (75%)	$\chi^2(1)=4.88, p=.03$
Working at 36 weeks pregnant	14 (21%)	5 (8%)	$\chi^2(1) = 3.78, p=.05$
Working at 1 month postpartum	0	5 (8%)	$\chi^2(1) = 5.91, p=.01$
Education: completed college	27 (40%)	19 (32%)	NS
Help with baby at night			$\chi^2=10.09, p=.02$
No help	27 (40%)	19 (32%)	
One night	15 (22%)	5 (8%)	
Two nights	13 (19%)	11 (19%)	
Three nights	12 (18%)	24 (41%)	

Table 5 – Comparison of Sleep Quantity &amp; Quality by Time and Group

Variable (mean ± SD)	Exclusive BF (N=67)	Supplementation (N=59)	Test Statistics
TST-night (minutes)			F=5.64, p=.019, $\eta^2 = .044$
Last month of pregnancy	408 ± 84	417 ± 85	
1 month postpartum	385 ± 66	358 ± 66	
TST-day (minutes)			NS
Last month of pregnancy	79 ± 61	90 ± 70	
1 month postpartum	89 ± 64	88 ± 71	
WASO (%)			NS
Last month of pregnancy	21 ± 12	20 ± 13	
1 month postpartum	27 ± 10	28 ± 10	
GSDS Total Score			NS
Last month of pregnancy	47.1 ± 16.0	43.2 ± 17.3	
1 month postpartum	49.2 ± 15.8	51.5 ± 15.3	

BF: BF; TST: total sleep time; GSDS: General Sleep Disturbance Scale; PP: Postpartum;

WASO: Wake after sleep onset as a percentage of TST-night

Table 6 – Mother Sociodemographic, BF and Labor Characteristics by Group

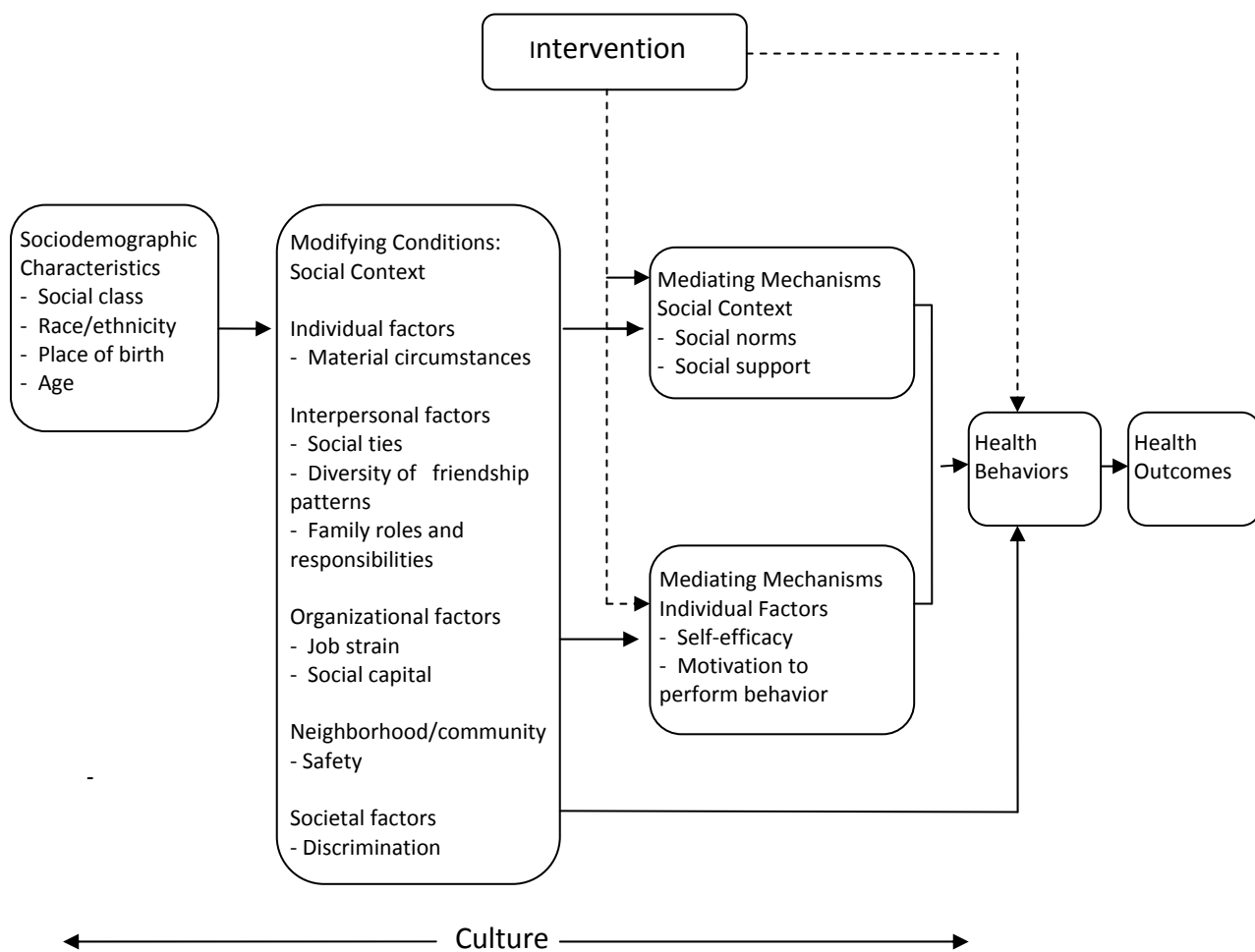
Variable Mean±SD or Frequency (percent)	Exclusive BF (N=66)	Supplementation (N=54)	Test Statistics
Age in years	27.9 ± 6.12	24.9± 6.64	t=2.55, df=118, p=.01
Intended to breastfeed	66 (100%)	50 (93%)	$\chi^2=5.06$ , df=1, p=.02
Planned BF duration in months	8.7 ± 3.71	8.1 ± 4.86	NS
Working at 36 week pregnant?	14 (21%)	4 (7%)	$\chi^2=4.44$ , df=1, p=.03
Working at 1 month postpartum?	0 (Webster's New 20th Century Dictionary)	4 (7%)	$\chi^2=5.06$ , df=1, p=.02
Education: Completed college	27 (41%)	16 (30%)	NS
Had labor & delivery complications	21 (32%)	20 (37%)	NS
Labor duration in hours	18.4 ± 12.14	18.1± 13.47	NS
Labor was induced	37 (56%)	31 (57%)	NS
Got an epidural	51 (77%)	42 (78%)	NS

Table 7 – Infant Characteristics by Feeding Group

Variable (mean ± SD)	Exclusive BF (N=66)	Supplementation (N=54)	Test Statistics
Birth length (cm)	51.2±2.56	50.0 ±2.90	t=2.26, p=.03
Birth weight (kg)	3.4 ± 0.51	3.3 ± 0.46	t=2.04, p=.04
Birth method			NS
Spontaneous vaginal delivery	39 (59%)	33 (61%)	
Assisted vaginal delivery	8 (12%)	3 (6%)	
Cesarean	19 (29%)	18 (33%)	
Age at assessment (days)	27.0 ± 4.43	27.6 ± 5.11	NS
Boy	35 (53%)	32 (59%)	NS
Girl	31 (47%)	22 (41%)	
Frequency of hospital room-sharing			$\chi^2=9.73$ , df=4, p=.04
Always	39 (59%)	28 (53%)	
Most of the time	22 (33%)	16 (30%)	
Half of the time, Occasionally or Never	5 (8%)	9 (17%)	
Sleeping arrangement at home			NS
Bed sharing	23 (35%)	21 (39%)	
Room sharing	43 (65%)	33 (61%)	
Maternal perception of sleep			NS
Very good	31 (47%)	19 (35%)	
Fairly good	32 (49%)	32 (59%)	
Fairly bad	2	2 (4%)	
Very bad	1 (1%)	1 (2%)	
Temperament score	3.4 ±1.33	3.3 ±1.26	NS



Figure 1 – Conceptual model of health behavior change (Sorensen et al. 2007/2003)



Dotted lines represent the impact of the intervention through the mediating mechanisms and on the health behavior outcomes

Figure 2 - Conceptual Model of a Moderator Effect

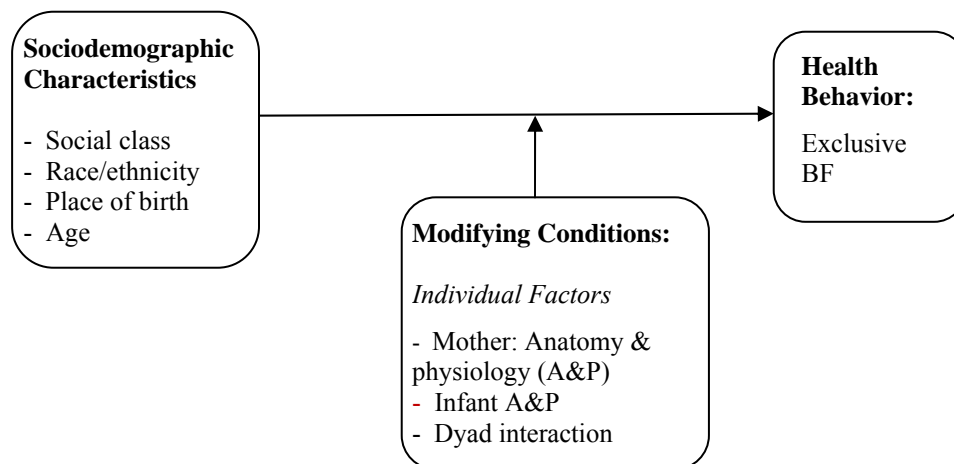


Figure 3 - Conceptual Model of a Mediator Effect

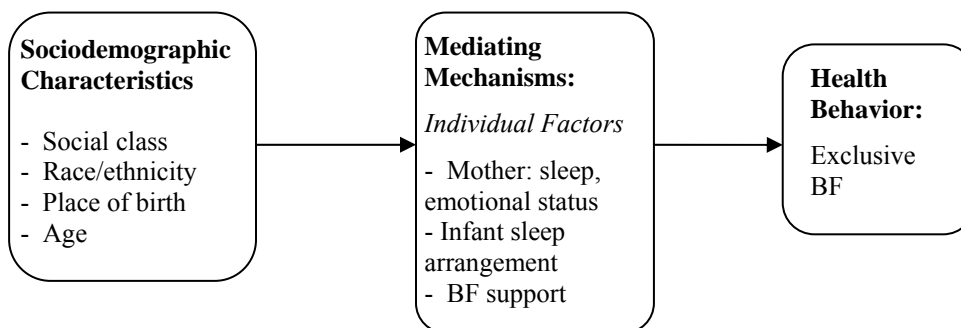
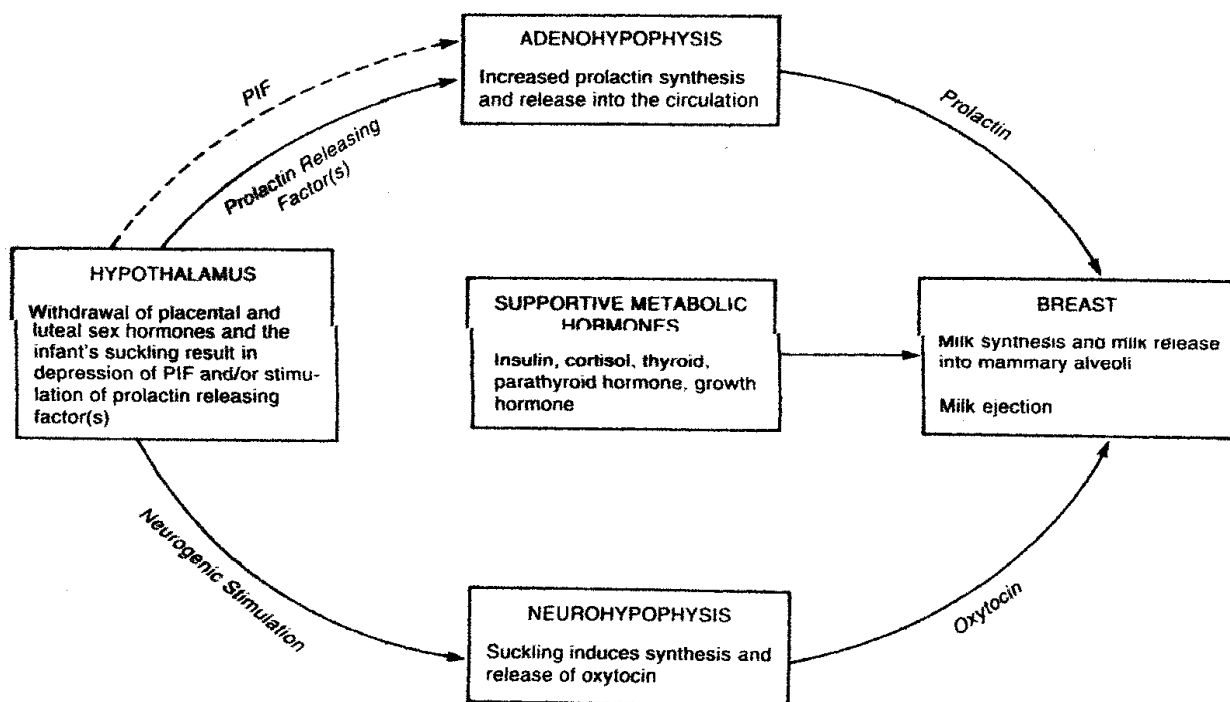


Figure 4 - Hormonal Preparation of Breast for Lactation (Lawrence &amp; Lawrence, 2005)



PIF=Prolactin-inhibitory factor

Figure 5 - Conceptual Model of BF Maintenance

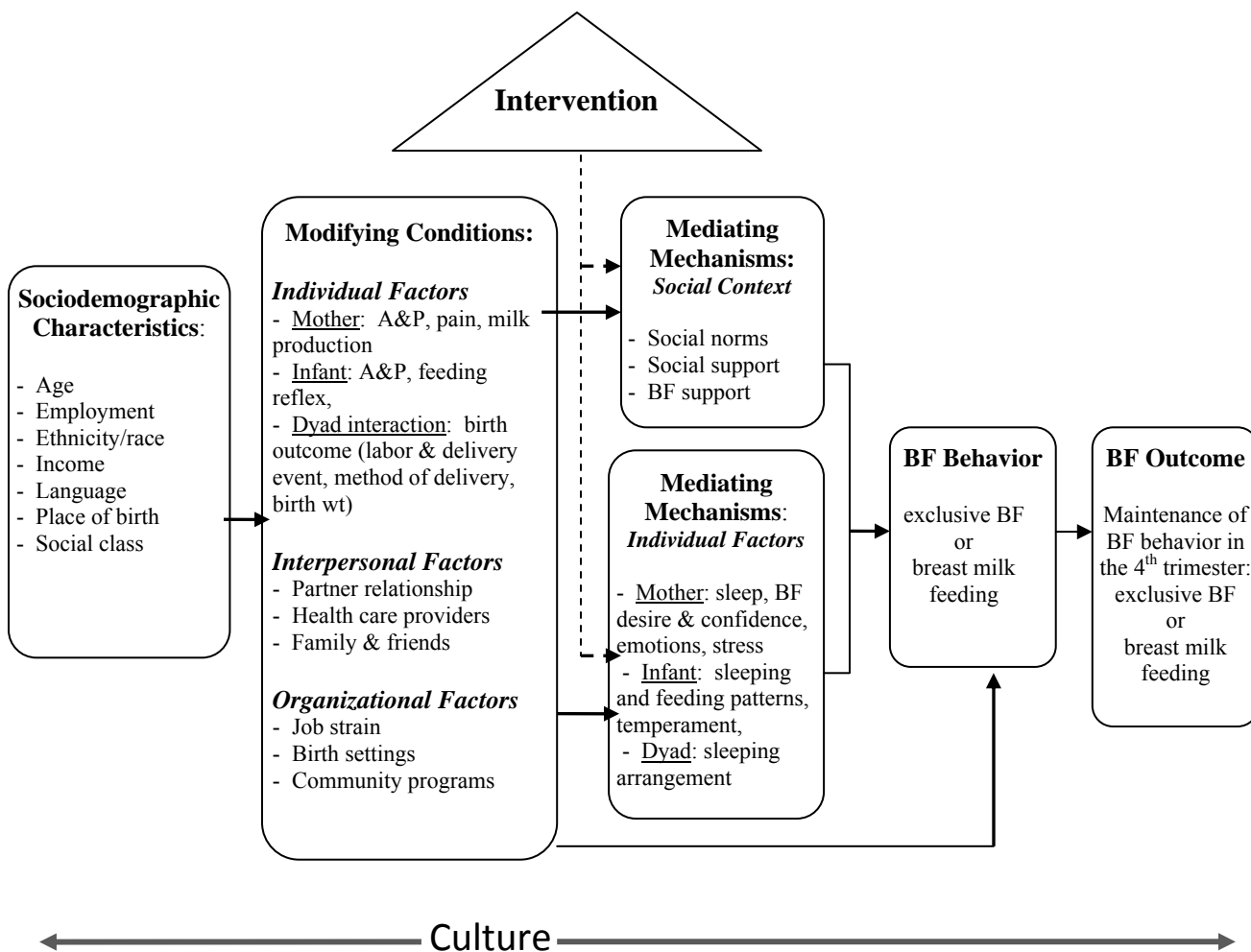


Figure 6 - Comparison of Nocturnal Sleep by Time and Night Feeding Group

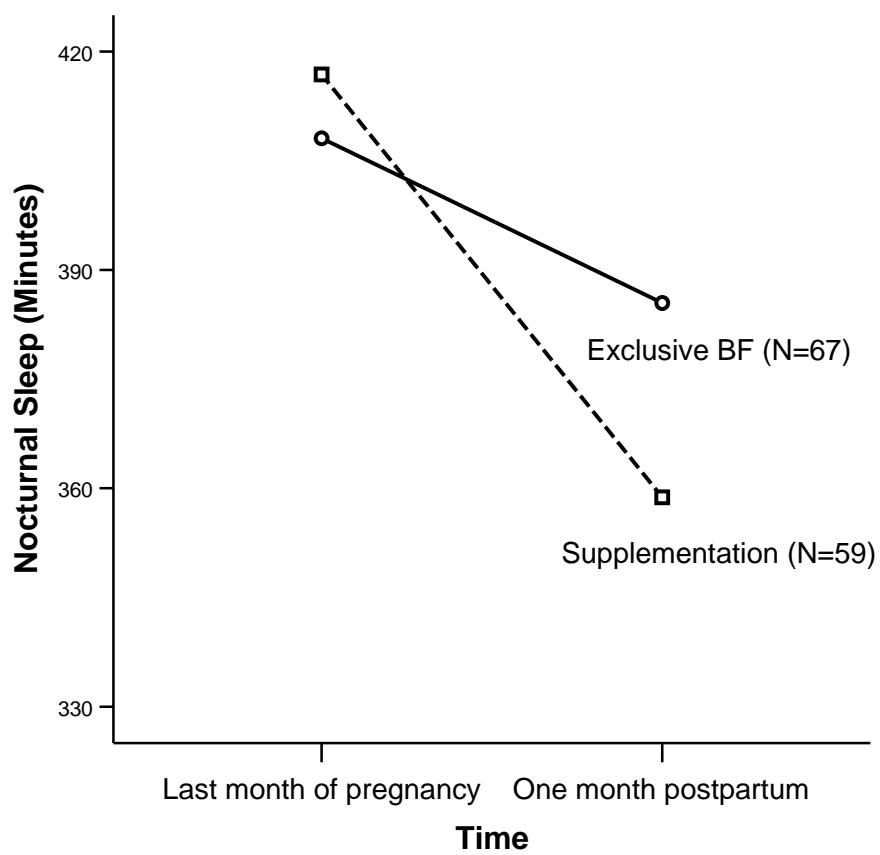
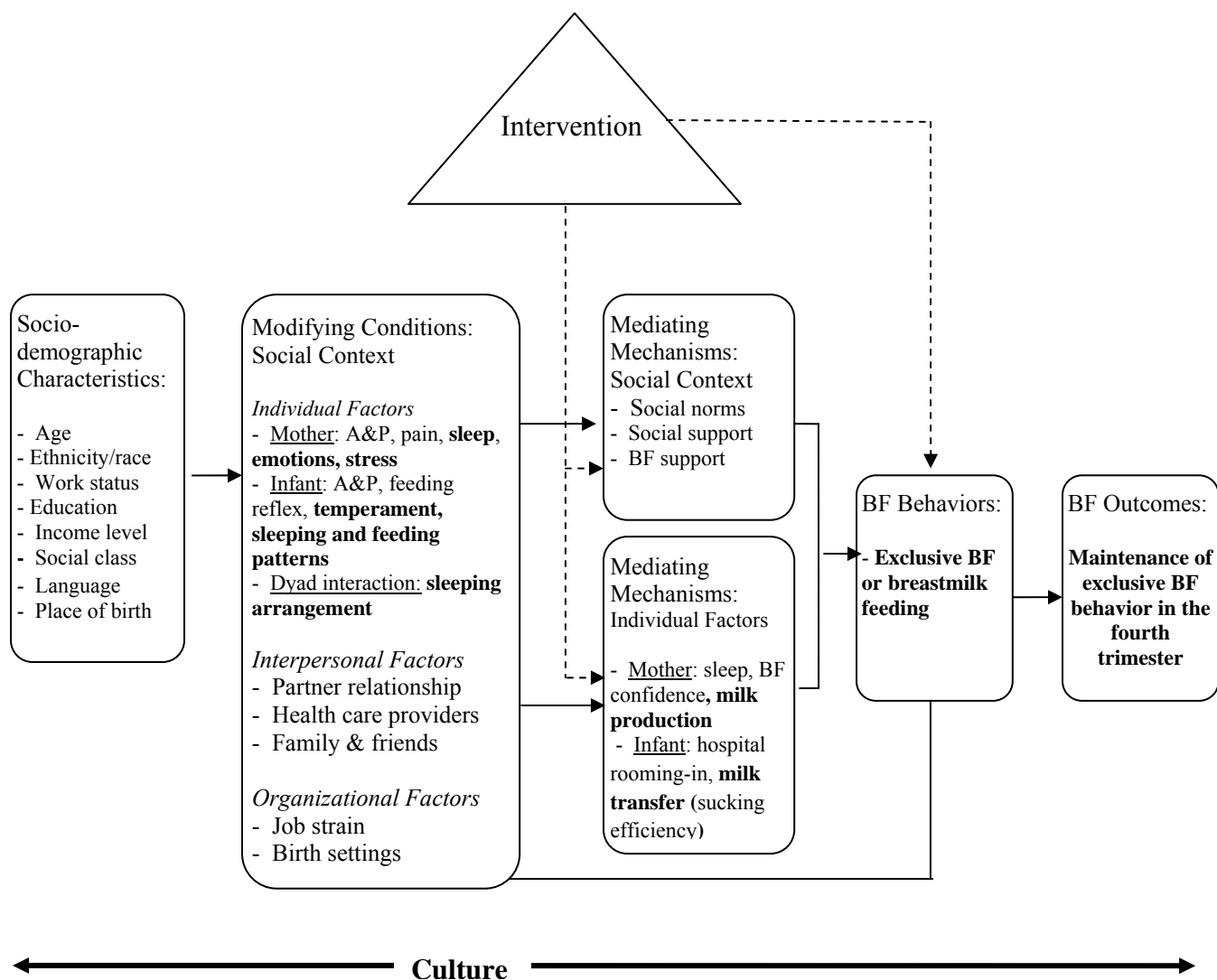


Figure 7 – Revised Conceptual Model of BF Maintenance



## APPENDIX A: SUMMARY OF STUDIES BY MODIFYING CONDITIONS

Author. (year)/ Timing of intervention Design/ Method	Sample / Setting Social context	Intervention BF Outcomes. Measures, Definitions	Results Critique
<i>Individual Factors</i>			
<p>Dyson et al. (2005) Early Postpartum Cochrane systematic review of randomized controlled trials (RCT) to evaluate the effectiveness of interventions to promote BF initiation</p>	<p>N= 7 RCTs, total 1388 women. <u>Setting:</u> 6 trials in the United States (US), 1 in Nicaragua <u>Social context:</u> US considered to be high-income country; Nicaragua low to middle-income country. Five trials in the US (582 women) were conducted among low-income women</p>	<p>Interventions before first breast feed were classified into 3 types: health education, BF promotion packs, and early mother-infant contact <u>Outcome:</u> Success of the first breast feed. No specified measures or definitions of first breast feed</p>	<p>Health education interventions for low-income U.S. women significantly increase BF initiation rate (relative risk[RR] 1.53, 95% CI 1.25 to 1.88). The other 2 types of intervention were shown to be ineffective for BF initiation <u>Critique:</u> No clinical or theoretical basis for success of first breast feed.</p>
<p>Carfoot et al. (2005) Early Postpartum Randomized controlled trial (RCT)</p>	<p>N= 204 primiparous &amp; multiparous mother-newborn dyads, randomized to intervention (n=102) or control group (n=102). <u>Setting:</u> Hospital in Cheshire, United Kingdom (UK) <u>Social context:</u> Not reported</p>	<p>Intervention: uninterrupted (minimum 45 minutes) skin-to- skin contact following birth. Controls received standard newborn and postpartum care. <u>Outcomes:</u> Success of 1<sup>st</sup> breast feed, assessed by research assistants using the BF Assessment Tool, was defined a priori as a score &gt;8. BF at 4 months assessed by self-reports.</p>	<p>Intervention babies were found to be more successful at first breastfeed compared to controls (91% vs. 83%) – but results were not significant. No effect on BF rate at 4 months postpartum. <u>Critique:</u> No report of interrater reliability for 2 observers; success at first feed defined by infant sucking was not a good measure unless there was successful milk transfer.</p>
<p>Moore &amp; Anderson. (2007) Early Postpartum</p>	<p>N= 20 primiparous mother-newborn dyads, randomized to intervention (n=10) or control group (n=10). <u>Setting:</u> Hospital in Tennessee, US <u>Social context:</u> White</p>	<p>Intervention: skin-to- skin contact for mother-infant dyads from birth until first breast feed (about 2 hours). Controls received standard newborn and postpartum care. <u>Outcomes:</u> Successful first breast feed, and <i>exclusive</i> BF</p>	<p>Intervention had significant effect on success of first breast feed (<math>p &lt; .02</math>) and time to effective BF (<math>p &lt; .04</math>) but no effect on exclusive BF at one month.</p>



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	and college educated	at one month postpartum.  Both measures by mother's report. Success defined by sucking competency using the Infant Breast Feeding Assessment Tool.	<u>Critique:</u> Results were not analyzed by intent to treat. Non-significance at 1 month could be due to small sample
Kvist et al. (2007) /Sweden  Postpartum  RCT to examine the effects of acupuncture treatment on pain relief and satisfaction with BF among women with inflammatory breast symptoms	N = 210 cases of inflammatory breast symptoms of lactating mothers randomly assigned to 1 of 3 treatment groups with n=70 in each group.  <u>Setting:</u> Midwife run BF clinic in Sweden  <u>Social context:</u> homogeneous Swedish	All women received essential care. Intervention group 1 received essential care and oxytocin nasal spray. Group 2 received acupuncture at 2 points. Group 3 received acupuncture at 3 points. Treatment was administered ad lib by midwives with various levels of expertise in acupuncture.  <u>Outcomes:</u> Pain relief and satisfaction with BF.  Pain measured by visual analog scale (0= no pain, 10=worst possible). Satisfaction with BF measured on a 4 point Likert scale (0= decided to wean, 4=very satisfied)	Pain scores on day 3 and day 4 of treatment were significantly higher ( $p < .01$ ) for women in Group 1 than those in Group 2 and Group 3. Satisfaction with BF on days 3, 4, and 5 did not differ among the groups  <u>Critique:</u> Selection bias Generalizability of findings is limited to similar settings of midwifery-run clinics and specific populations who wanted acupuncture treatment for mastitis.
Manizheh et al. (2007) /Iran  Postpartum  RCT to examine the effect of peppermint gel compared to lanolin and placebo on the treatment and prevention of nipple pain.	N = 216 first-time mothers randomly assigned to 1 of 3 groups (n=72 in each group)  <u>Setting:</u> Home of participant. Iran  <u>Social context:</u> homogeneous Iranian	Women were randomly assigned to receive either peppermint gel, lanolin, or placebo.  <u>Outcomes:</u> Cracked nipples in the first 2 weeks; pain relief and BF status at six weeks postpartum.  Pain was measured by an unspecified scale.	The use of peppermint gel compared favorably to lanolin and placebo in preventing nipple crack ( $p < .01$ ). Pain and BF outcomes at 6 weeks did not differ between the 3 groups.
Howard et al. (2003)  Postpartum  RCT to examine effect of artificial nipples use on BF duration. Data were collected at delivery	N = 700 breastfed newborns randomly assigned to bottle/early pacifier (n=169), bottle/late pacifier (n=167), cup/early pacifier (n=185), or cup/late pacifier (n=179).	<u>Intervention:</u> The cup/bottle intervention was for infants who received supplemental feedings: cup (n =251), bottle (n =230).  <u>Outcomes:</u> BF duration measured as times to cessation	In-hospital supplemental feeding significantly ( $p \leq .001$ ) predict shorter duration of BF.  <u>Critique:</u> Selection bias of women who wished

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and at 2, 5, 10, 16, 24, 38, and 52 weeks' postpartum.	<u>Setting:</u> U.S. hospital <u>Social context:</u> White, well-educated, married women.	of BF (classified as full, exclusive, or overall).	to use pacifiers or were undecided.
Ball et al. (2006) Postpartum RCT, non-blinded, to examine infant sleep proximity to mother during hospitalization	N= 64 mother-newborn dyads <u>Setting:</u> UK hospital following childbirth <u>Social context:</u> not specified	Infants were randomly allocated to 1 of 3 sleep arrangements: 1) baby in mother's bed; 2) baby in crib attached to mother's bed; and 3) baby in stand-alone bed adjacent to mother's bed. <u>Outcomes:</u> BF frequency and sleep of mother and infant.	Infants sleeping in mother's bed or/and in crib attached to mother's bed breastfed significantly ( $p < .01$ ) more frequently. No differences in mother or infant sleep duration among the groups
<i>Interpersonal Factors</i>			
Britton et al. (2007). Postpartum and Antepartum Cochrane systematic review. Selection criteria included randomized or quasi-randomized clinical trials with intervention offering extra BF support to help women continue BF	N= 34 clinical trials of 29,385 mother-infant dyads <u>Settings:</u> Home, hospital, community clinic in 14 countries <u>Social context:</u> women from different social groups (one UK study); low-income and ethnically diverse (two US studies); teen mothers (one Australian study)	Goal: to evaluate effectiveness of interventions that offered extra support to BF mothers compared to usual care. <u>Outcomes:</u> Effects of professional support, lay support, and lay-and- professional support on duration of <i>any</i> and <i>exclusive</i> BF.	- Professional support is effective in prolonging exclusive BF. - WHO/UNICEF training courses is effective for professional training. - Lay support effective in promoting exclusive BF and <i>any</i> BF. - Combinations of professional and lay support can be effective in prolonging any BF, especially within the first two months. <u>Critique:</u> No reliable estimates for the isolated effects of each component of multi- component interventions due to clinical and methodological heterogeneity.
Anderson et al. (2005) /US Antepartum &	N=162 mother-infant dyads, randomized to intervention (n=72) or	Intervention: BFHI standard + peer counselor support offering 3 AP home visits,	Mothers in control group significantly less likely to breastfeed

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Postpartum RCT	control (n=63) group  <u>Setting:</u> Birth setting is Baby-Friendly hospital  <u>Social context:</u> Low-income & predominantly Latina	<b>daily</b> perinatal visits, <b>9</b> PP home visits, and ad lib telephone counseling. Control received BFHI standard care.  <u>Outcomes:</u> Exclusive BF, measured by <b>self-report</b> using “24-hour”, “previous week” recall (For the past 24 hours/ week, did your baby receive any foods other than breast milk?) or “ever given” recall (Did the infant receive any foods other than breastmilk since birth?)	exclusively at hospital discharge. No significant effect on exclusive BF at 3 months between the groups.  Puerto Ricans had the worst BF outcomes compared to all other Latina subgroups.  <u>Critique:</u> Effects of culture was not examine
Wallace et al. (2006) /UK Postpartum RCT	N= 370 mother-baby dyads (188 intervention and 182 controls)  <u>Setting:</u> Hospital following childbirth. Scotland.  <u>Social context:</u> not reported; assumed all English primiparas	Intervention: Hands-off midwife support. Mothers to be out of bed and sit upright for first breastfeed while receiving hands-off BF support  <u>Outcomes:</u> BF status ( exclusive, any) measured by self-report (infant feeding diary)	No significant differences between groups were found in outcomes at 6 or 17 weeks postpartum for either <i>exclusive</i> or <i>any</i> BF  <u>Critique:</u> Subject burden – cumbersome to get out of bed just for verbal instruction
Fallon et al. (2005) /Australia Postpartum Prospective cohort	696 Intervention 625 Comparison  <u>Setting:</u> a private and a public hospital. Australia	Intervention: Lactation consultant support: face-to-face vs. telephone Telephone-based professional BF support by lactation consultant within 48 hours post discharge, then weekly for 3 times  Goal: To evaluate effectiveness of telephone based BF support service vs. face to face (in home, at hospital) services. Exclusive BF (EBF) Partial BF  Outcome measure: Exclusive BF at 3 months postpartum	For women from <u>private hospital</u> Compared to control, women in intervention group had higher exclusive BF at 4 weeks but <u>not</u> at 3 months. No effects observed for mothers from <u>public hospital</u> for both time periods.  <u>Critique:</u> No randomization to intervention (home visit vs. telephone). Selection bias: those who got visits lived closer to hosp of delivery, were older, and had more stable relationship.

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Bonuck et al. (2005)  Prenatal & Postpartum  RCT, non-blinded.  Baseline prenatal interviews (demographic & BF experience), then interviews at 1, 2, 3, 4, 6, 8, 10, and 12 months after birth (data on weekly feeding patterns)	N= 338 mother-infant dyads (n=163 intervention, n =175 control)  <u>Setting:</u> US Hospital, community centers, home of participants.  <u>Social context:</u> low- income, primarily Hispanic and/or Black. Race/ethnicity, country of origin.	Intervention group received up to 2 prenatal meetings with lactation consultant, 1 postpartum hospital and/or home visit, and telephone calls as needed. Controls received the standard of care.  <u>Outcomes:</u> Duration and intensity of BF up to 12 months (measured by telephone interview at each time point; women were asked of weekly feeding since last interview using the Index of BF Status scale with 7 level). Exclusive BF defined as no infant formula or solid.	No effect on exclusive BF rates which remained low and did not differ between groups at any point. Compared to foreign- born, US-born women had lower BF intensity.  <u>Critique:</u> self-report data subject to recall bias. Reporting exclusive BF at 1, 2, 3, & 6 months would make more sense than at 13 weeks then 52 weeks.
Memmott and Bonuck (2006)  Qualitative: to explore women's reaction to lactation consultant support intervention	N=21 women at one year postpartum (n=11 intervention, n=10 control group in RCT described above)  <u>Setting:</u> home of participants.  <u>Social context:</u> low- income, primarily Hispanic and/or Black. Race/ethnicity, country of origin.	Intervention: See Above  Method: Interview, face-to- face, using interview guide. Interviewer made note during interview then transcribed afterward.	Women in intervention group perceived lactation consultant as key in helping them to decide and maintain BF. Some women in control group perceived follow-up phone calls as supportive.  <u>Critique:</u> Mono- method (one interview lasted 10-30 minutes); lack rigor.
Fagerskiold (2008) Sweden Postpartum Qualitative	N= 20 first-time fathers  <u>Setting:</u> Home of participants. Sweden	Method: Grounded theory. Use	Fathers's attitudes toward BF seemed ambiguous  <u>Critique:</u> No triangulation of method; no audit trail
<i>Organizational Factors</i>			
Abdulwaduh & Snow (2007). US/world  Postpartum	No RCT or quasi RCT identified	Workplace intervention	Impact of workplace intervention on outcomes for employers, mothers,

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Cochrane review			and infants is unknown
Cohen et al. (2002)  Antepartum & Postpartum  Descriptive: corporate lactation program focusing on promoting BF through male employees.	N= not specified. Men employees and their female partners  <u>Setting:</u> Los Angeles Department of Water & Power  <u>Social Context:</u> diverse cultural, professional, and economic background	The Fathering Program offered fathers and their partners group BF classes, individual lactation counseling, and breast pumps for partner to use at home or at work.  <u>Outcomes:</u> BF promotion among male employees; BF duration. BF defined as <i>any</i> BF or breast milk feeding.	Success at getting more men enrolled in BF promotion program sponsored by employer  Average duration of BF was 8 months for infants of fathers who participated in the program.  <u>Critique:</u> An innovative approach to BF promotion. No causal relationship due to study design.
Ortiz et al. (2004)  Antepartum & Postpartum  Descriptive, retrospective	N= 462 mothers  <u>Setting:</u> Five US corporations with 12,000-18,000 employees.  <u>Social context:</u> women returned to work after childbirth; diverse ethnic, professional, and economic background	As part of company benefit package, the Corporate Lactation Program (CLP) offered all full-time female employees who decided to breastfeed BF classes, electric breast pump with instruction, weekly telephone call from lactation consultant during the first month postpartum and the first month returning to work.  <u>Outcomes:</u> BF initiation and duration of breast milk expression. BF is defined as “feeding human milk or a combination of human milk and formula or cow’s milk”	BF initiation rate was 97.5% for CLP participants; 57.8% BF for at least 6 months.  About 90% of women returned to work within the 5 <sup>th</sup> month postpartum. Mean pumping duration at work for these women was 6.3±3.87 months.  <u>Critique:</u> No causal relationship due to study design.
Escobar et al. (2001)  Postpartum  RCT	N=1014 mother-infant pairs (506 control and 508 intervention).  <u>Setting:</u> Home, and Health Maintenance Organization (Kaiser Santa Clara)  <u>Social context:</u> middle- class women with	Intervention: Postpartum home visit by registered nurse. Control received hospital-base follow up  <u>Outcomes:</u> BF continuation and maternal satisfaction, assessed by telephone interview at 2 weeks postpartum.	Compared to hospital- based follow-up, home visits achieved same clinical outcomes and were associated with higher maternal satisfaction. No effect on BF continuation  <u>Critique:</u> generalizable to similar HMO setting

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	Kaiser insurance		only
Ickovics et al. (2007)  Antepartum & Postpartum	N= 1,047 pregnant women randomly assigned to either standard (n=394) or group prenatal care (n=653).  <u>Settings:</u> Two US university-affiliated prenatal clinics  <u>Social context:</u> young women 14-25 years, African-American	Women in group prenatal care received 2-hour care session (in group) included physical assessment, education and skills building, and support of other women in the group. Control received standard prenatal care.  <u>Outcomes:</u> Perinatal outcome and BF initiation. No definition of BF.	Group prenatal care demonstrated to be cost-effective in obtaining equal or improved perinatal outcomes. BF initiation rate was significantly higher in group care(66.5% vs 54.6%, $P<.001$ )  <u>Critique:</u> decreased comparability of BF outcome due to no standard description.
Petrova et al. (2008)  Antepartum & Postpartum  RCT to compare the effectiveness of a support intervention on infant feeding.	N= 104 WIC participants, randomized to intervention (n=52) or control group (n=52)  <u>Setting:</u> Community WIC center, US.  <u>Social context:</u> low- income, inner city, predominantly Latina	Intervention received one to- one pre- and postnatal BF education and support from a lactation consultant.  <u>Outcome:</u> Infant feeding was classified as exclusive BF, partial BF, and bottle feeding, assessed by maternal self- reports during the first 7 days, 1, 2, and 3 months postpartum.	During the first 7 days, exclusive BF rate was 45.6% for intervention and 28.9% for control group. No effect by 3 months as these rates had dropped to 13.9% and 10.5%.  <u>Critique:</u> Findings redundant as it had been demonstrated by other studies
Coutinho et al. (2005) /Brazil  Postpartum  Randomized clinical trial to compare the hospital-based intervention (BFHI training of maternity staff) with a combined hospital- based and community-based intervention (BFHI training and postnatal home visits).	N= 350 mothers (175 intervention; 175 control)  <u>Setting:</u> Hospitals in process of BFHI certification, Brazil.  <u>Social context:</u> Low- income Brazilian	Intervention group received 10 postpartum home visits for BF support. Control had no home visits. BF practices were studied on days 1, 10, 30, 60, 90, 120, 150, and 180  <u>Outcome:</u> Rate of exclusive BF from birth to 6 months. <i>Exclusively BF</i> was defined as 100% breastmilk (no water, other liquids, or solids); <i>BF</i> defined as breastmilk plus other food or liquid (including other milk); <i>other milk</i> defined as any non-breastmilk.	Mean exclusive BF rate from 10-180 days for women who received home visits (46%)was significantly greater ( $p<.001$ ) than those without (13%)  <u>Critique:</u> Findings contribute to the effectiveness of combined BFHI and extra support on exclusive BF.

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October 20, 2009

Date