CHAPTER 2

Breastfeeding and Nurturescience

Nils Bergman

Introduction

Breastfeeding is a brain-based behavior of the newborn, an inborn ability that is regulated by the limbic system. Newborns are born with the behavioral capability to breastfeed. However, this capability is fragile and requires the uninterrupted presence of the mother, with specific stimuli at early critical periods working to reinforce the inborn ability (Alberts & Pickler, 2012). The behavior can easily be modified, modulated, or abolished. This normal innate behavior that the newborn exhibits at the breast, which develops and matures in the first day, is breastfeeding. One of its components is suckling, but breastfeeding involves far more: It is part of the total occupation of the newborn (Alberts, 1994). The restoration of this behavior is the objective of this book.

I shall use the terms *suckle* or *suckling* to refer to the somatic behavior of the infant on the breast. Accepting the word *sucking* as an activity for breastfeeding may cause confusion and reinforces the cultural myth that bottle feeding and breastfeeding are equivalent. There is even research evidence that points to bottle feeding being harmful (Chen et al., 2000), even though it is assumed to be normal.

Likewise, many labor ward routines and hospital practices are not supported by scientific research or evidence-based medicine (Smith & Kroeger, 2004). Numerous assumptions concerning fetal and newborn brain development have been derived to justify our practices, rather than the other way around. Ongoing research even disproves those assumptions, leaving most of our practices without justification. These practices cause a host of behavioral problems in babies, not the least evidenced by breastfeeding problems and failure of newborns and infants to suckle normally. The extent of these problems and their implications to society, with the new knowledge we have, justifies a new science, which I have termed *nurturescience* (Bergman et al., 2019). This is based on a broad base of different sciences encompassing or focusing on the perinatal period and early development. Nurture, in all its meanings, turns out to be central, and maternal–infant separation is its antithesis (Bergman, 2019).

Early Developmental Mechanisms

Genes and DNA

After conception, there is a very rapid differentiation and development of the fetal brain. For the first 10 to 14 weeks, development is determined by heredity, by genes expressed from the fetus' DNA. At 20 weeks' gestation, all anatomical parts of the brain are in place, and the DNA has put in place the template that makes development possible, like an unformatted hard disk. The primary element in subsequent development is experience.

There are surprisingly few genes, however each has many epigenes, which act like switches or controls for the gene. The environment interacts with the epigenes to determine how the gene will become expressed. Developmental variability is almost always expressed as a function of gene and environment interaction (G x E). In the short term, this is always "adaptive" and assumed for the better, but in the long term it can be for better or for worse (Ellis & Del Giudice, 2019).

Neural Cells

The functional cell of the brain for our purposes is the neuron. Neurons form in the brain until 28 weeks of gestational age, and not beyond (with few exceptions). After they are formed, they migrate to other parts of the brain, and in the process they connect to sensory organs. They are sensitive cells, and when they are sensitized, they trigger an action potential, or fire. Various sensations will make various cells fire. That firing initially causes budding and then axon formation on one end and dendrite formation on the other. Ongoing firing makes more branches, and at the ends of branches synapses form, which when fired repeatedly result in stabilization of the synapse, or wiring. Shatz (1992)—with unusual brevity for a neuroscientist—summarizes thus: "Cells that fire together, wire together" (p. 64). Ultimately, almost all the neurons of the brain will be connected to one another in a network. The sum of all such possible networks is now called the "connectome" (Crossley et al., 2014), and can be visualized by tractography.

Neuronal Plasticity

Genetic determination does continue after 14 weeks, but its importance in the development process is overtaken by two more important processes, the first of which has been described; the second can be described as *use it or lose it*.

From very early in gestation, there is a parallel process of programmed cell death and elimination of redundancy, or pruning. By 40 weeks of gestational age, half the precious neurons that were formed have been lost! Unused neurons undergo programmed cell death and are dismantled and removed, a process called apoptosis. A suboptimal level of stimulation results in fewer branches and poorer connections in the remaining neurons. A certain critical repetition of firing is needed to stabilize the synapse, which is then immune from elimination or removal. This process continues throughout development (McCain & Mustard, 1999).

Neuronal plasticity, therefore, relates to the interplay between firing and wiring of neurons and removing those that are not used (Teicher et al., 2002). From 28 weeks the number of neurons is maximal, from 40 weeks through to 1 year the number of synapses peak, and from there on neuronal plasticity refers to pruning and removing neurons and their synapses. (This is also called *sculpting*, in that the end result comes from removing unwanted parts.) The parts of the brain that now capture the stimuli become pathways, and they may or may not myelinate, which makes them faster and more complex pathways. The end result of this process is a hardwired brain. It used to be thought that the brain could regenerate and repair because an amazing recovery in function is observed in many cases. A very young brain can wire new pathways with residual neural cells, but this ability is rapidly lost. Old neurons can, however, make new dendrites (branches) and synapses throughout life. The brainstem (which controls breathing, heart rate, and so on) is hardwired at the time of birth. The limbic system of the brain, which controls basic autonomic functions, moods, emotions, and self-control, is hardwired by the age of 3 years. The cerebral cortex and the cerebellum retain a degree of neuronal plasticity into adult life, and cortical synapses continue to form as needed (McCain & Mustard, 1999).

Essentially, the genes set in motion a process that establishes the scaffolding of the brain, but the final result as to what cells remain and how cells are connected is determined by experience, the result of neuronal plasticity (Teicher et al., 2002). This is in sharp contrast to the belief that most medical professionals have derived from their training: If brain development is genetic, then it does not matter too much if some experience along the way is poor. Although the growth in absolute brain size after birth is clearly seen, the assumption that new neurons are added is false.

Developmental Competence

Throughout the developmental sequence, whether embryo, fetus, newborn, or infant, the organism is regarded from a biological perspective as complete for that stage (Alberts, 1994; Als et al., 1994). A fetus succeeds very well in the uterus, where its behaviors ensure well-being and development. These behaviors are actually neurobehaviors because they are governed by the developing midbrain and limbic system. The organism is not designed to succeed outside the uterus while it is a fetus. It may seem a bit obvious, but the key principle is that each stage of development is completely dependent on being in the right place. Ecology is the study of how organisms relate to each other and their environment. For the fetus, the mother is another organism as well as the environment; that is not a contradiction, but rather an imperative.

Developmental competence requires the successful accomplishment of the requirements of each stage in order to be able to work toward competence at the next level (National Research Council Institute, 2000). In many school systems you have to pass the current grade if you are to have the background skills to pass the next grade. Likewise, suboptimal development at any stage of the organism will impact the developmental trajectory in a negative way. This is summarized by the National Scientific Council on the Developing Child:

> *Neural circuits that process basic information are wired earlier than those that process more complex information. Higher circuits build on lower circuits, and skill development at higher levels is more difficult if lower level circuits are not wired properly.* (Shonkoff, 2010)

Throughout this development, the organism's experience drives the development. This experience translates to sensory stimuli sent to the brain, which is first and foremost a sensory organ. The fetus has extraordinary sensory discrimination. Various sensory systems are activated during the second trimester; by the beginning of the third trimester, its discrimination in terms of kinesthesia, smell, and sound are greater than at any other time in life (Graven, 2004; Philbin, 2004; Schaal et al., 2004). In effect, the brain makes sense of sensations. However, the brain is primarily a social organ; the sense the brain makes of its ecology and its experience is fundamentally about relationships.

Neurobehavior

The newborn behavior arises from the limbic system and expresses itself through three main systems: the autonomic nervous system, the hormonal system, and the somatic (or muscular) system. Although these can be studied separately, and parts of each can be studied in detail, what is essential to appreciate is that there is a program that integrates autonomic, hormonal, and somatic expression, and it is the program as a whole that achieves the required homeostasis, well-being, and development. The term *homeorhesis* refers to homeostasis along a developmental trajectory; homeostasis alone would put development on hold.

There are three behavioral programs: nutrition, defense, and reproduction. They are mutually exclusive, meaning that the body does not operate more than one at a time. Each has its own set of hormones, its own autonomic wiring, and its own muscular or somatic functions (Despopoulos & Silbernagl, 1986). The analogy to computer software is apt: A computer operates in a single environment at a time, be it word processing, spreadsheet, or database.

The *nutrition* program is the default setting. This is mainly governed by a parasympathetic or vagal nervous system (with sympathetic counterbalance) and ensures that the body keeps balance and homeorhesis and that food is digested, with temperature and metabolism controlled. There are many hormones, including insulin and growth hormone.

The *defense* program actively and immediately switches off other programs. It is governed mainly, but not exclusively, by the sympathetic nervous system; its hormones include adrenaline and cortisol, and its somatic expression is summarized in the well-known phrase *fight or flight*. This can, however, be overwhelmed, and then a more primitive parasympathetic program joins the sympathetic to produce *freeze*. When threat increases further, the parasympathetic takes over completely and produces *dissociation*.

The *reproduction* program is sensitive, uses both parts of the autonomic nervous system, and, depending on the timing and circumstances, expresses itself through a host of hormones, including estrogen and oxytocin.

It is critically important to understand that the place or habitat determines which of the programs will operate. The brain is continually making an appraisal as to whether the place, or environment, is safe or unsafe; Porges calls this "neuroception" (Porges, 2004). Biologists use the term *habitat* for place, and habitat determines the neurobehavior of the organism. This behavior is focused on ensuring well-being through the fulfillment of basic biological needs. The habitat that the organism occupies provides these needs, so *niche* refers to the behaviors appropriate to the habitat (Alberts, 1994). Thus, the fetus acts successfully in the uterus to ensure the *basic biological needs* of oxygenation, warmth, nutrition, and protection, to achieve balance and homeorhesis.

At birth, mammals experience a habitat transition. What is evident from biological studies is that the newborn is in control of its destiny, and that control depends entirely on being in the right habitat. For example, newborn rats will, without maternal assistance, move toward the mother's belly to find warmth, to suckle, and to ensure protection (Alberts, 1994). In the process, they will evoke or elicit caregiving behaviors from their mother.

Timetables

Another important factor determining brain development is time and timing. The ongoing presence of the mother is part of the essential experience for the developing organism. The sound of the mother's heartbeat gives an ongoing awareness of time (Rivkees, 2004). The mother's daily rhythms and routines imprint themselves on the developing brain, and maternal biorhythms also influence the developing fetus (Browne, 2004). The infant's brain develops sleep cycling during the last trimester, with cycles lasting from 60 to 90 minutes. These become more differentiated and developed after birth and are important for the wiring of the brain (Rivkees, 2004). Lastly, an orderly expression of genes according to an inherent timetable will initiate development, and experience continues it. Timing is embedded in innate or genetic timetables, a kind of biological clock that creates a developmental agenda (McCain & Mustard, 1999). These have also been described as "brain expectations" (Schaal et al., 2004, p. 270).

Critical Periods

This development agenda or timetable has critical periods, which are defined as "windows of opportunity in early life when a child's brain is exquisitely primed to receive sensory input in order to develop more advanced neural systems" (Shore, 1997). The timetable primes particular parts of the brain in the specific sequence required to achieve a higher level of function and therefore structure. During such times, the brain is "exquisitely susceptible to adverse factors," and these can both "positively and negatively impact the structural organization of the brain" (Schore, 2001a, p. 12). Neuroscientists have in fact identified this by studying adult brain pathology and tracing back in time, and they conclude that "alterations in the functional organization of the human brain . . . are correlated with the absence of early learning experiences. Social stressors are far more detrimental than nonsocial aversive stimuli" (Schore, 2001b, p. 206). The infant's immature brain is "exquisitely vulnerable to early adverse experiences, including adverse social experiences" (Schore, 2001b, p. 208; also described by Teicher, 2002).

In the study of such early experiences and critical periods, there is generally a salient stimulus, a particular stimulation required along a specific pathway to fire and wire over a particular period (McCain & Mustard, 1999). However, "the wiring of the brain's pathways is best supported when it can integrate quality sensory input through several pathways at once, particularly during critical periods of development" (McCain & Mustard, 1999, p. 27).

Many physicians and researchers do not accept that the concept of a critical period, as described in animals, applies to humans. In lower-order animals, such periods may be extremely short and transient, and it is believed that humans develop far more slowly; therefore, this does not apply. This assumption is, however, just that: an assumption without proof. The term *sensitive period* is often more accepted. There are aspects of development that take longer and have resilience and therefore qualify as sensitive; while allowing this, I maintain that this is not a valid reason for rejecting critical periods in human development.

The Critical Period of Birth

For any mammal, the transition from uterine to extrauterine life is a critical period in more ways than one. The fetus is suddenly transposed from placental nutrition in a liquid environment to a new means of nutrition in an air environment. There are critical adaptations the organism must achieve, and for many species there is significant mortality in the process. However, from a neurological use of the term, birth is the ultimate critical period. The events of the innate timetable have been converging to prepare for birth. From an evolutionary perspective, this was an extremely dangerous event, and there is an extremely precise series of steps and events that must be accomplished very rapidly for survival. At birth, all the senses of the newborn are exquisitely primed to receive new stimuli, and the infant feels everything maximally, without filters. (Filters develop quickly, an early form of learning, as synapses are pruned.) Each of the senses has a key role to ensure that pathways are fired, which in turn will enable subsequent higher levels of functioning.

Skin-to-Skin Contact and Smell

The salient stimuli that the newborn timetable requires at birth are mother's smell (likely reassuring of continuity and safety) and skin-to-skin contact, which will provide a bundle of warmth, touch, stability, and movement. Essentially, the rich parasympathetic and sympathetic innervation of the skin allows the maternal and newborn autonomic nervous systems to communicate directly. In this way, the baby learns what normal is, and the physiological set points are regulated. Further, the nerve fibers of smell and touch lead directly to the amygdala (seat of emotional memory and fear conditioning) (Schore, 2001). The amygdala then fires and wires a pathway to the left frontal lobe, activating the approach center of the brain (prefronto-orbital tract) (Amodio et al., 2008; Schore, 2001). The earlier default was a right-sided avoidance center, so now the amygdala can appropriately signal an approach to good emotions and expectations of a reward and an avoidance of bad emotions to avoid punishment. This is the platform for future emotional and social intelligence. This takes 6 to 8 weeks to hardwire optimally (Schore, 2001a); the mother's continuous presence is needed to achieve the optimal pathway. Notice that it was the same skin-to-skin contact that achieved regulation in the newborn body that also led to emotional and social intelligence (Ludwig & Welch, 2020). However, all the senses make a package of "quality sensory input through several pathways at once" (McCain & Mustard, 1999, p. 27) that reinforce the pathway and connect it to others. These stimulations will fire and wire the brain and create the first beginnings of vital pathways, which need ongoing stimulation to establish and hardwire. Clearly, there is only one place where this package exists: the mother. And at birth, the baby needs the full exposure of these stimuli without filters.

Self-Attachment

All mammals at birth behave in very specific stereotypical ways, unique to their species, involving movements toward the mother and the nipple, with subsequent suckling. In many mammals, this is immediately evident at birth. The human being is a mammal, and as such is no different from other mammals. Due to relative biological immaturity, the human newborn requires approximately an hour of undisturbed time (Widstrom et al., 2019) for the infant to begin suckling; in other mammals, this can be much shorter or much longer.

The reproduction program is operative at this critical time, in both mother and newborn. The salient stimuli required of the particular pathways in the critical period stimulate specific areas of the limbic system. This makes the autonomic nervous system adjust or regulate to achieve homeorhesis, the required hormones are produced, and the appropriate somatic or body movements take place. It is only the latter that we can observe as behavior, but that behavior is dependent on the autonomic and hormonal events (Despopoulos & Silbernagl, 1986).

Given the labor ward routines developed in the past 100 years, this was unknown until the work of Winberg, Widstrom, Righard, and others in the late 1970s (Righard & Alade, 1990), more recently described as "the nine steps" (Widstrom et al., 2010). The observed behavior is generally termed *self-attachment*. The suckling observed at the end of self-attachment is evidence that the requirements of the particular critical period have been achieved.

It is, however, not the complete picture, which is greatly more complex. The next stage follows immediately. Neurons need repetitive firing in order to stabilize and wire into pathways. The salient stimuli should continue. After successful self-attachment, the newborn will go into a sleep cycle. Sleep cycling is now recognized as an absolute requirement for healthy brain development. It is involved in all stages of neuronal development, pathway formation, and circuit maintenance for memory and learning (Peirano & Algarin, 2007). One important part of the sleep cycle is quiet sleep, when short-term sensory memory is fired through the amygdala and hippocampus for long-term memory (Graven, 2006), and another is at the end of the cycle when new synapse connections are observed. Healthy sleep cycles occur only when the salient stimuli—those ensuring maternal presence—remain in place. Newborns in skin-to-skin contact will wake spontaneously after 2 to 6 hours on average. In separated newborns, the postnatal sleep may be up to 12 hours or more. Separated infants experience chaotic sleep patterns and may not achieve the wiring that came from the firing (Ludington-Hoe et al., 2006).

As noted earlier, the place determines behavior, and stimuli activate the autonomic nervous system and the hormones and make muscles do the right thing. The purpose of these behaviors is to ensure the basic biological needs of the organism (Alberts, 1994):

- Oxygenation
- Warmth
- Nutrition
- Protection

When these needs are met, the infant will continue to function (suckle and then breastfeed), which will ensure that these needs continue to be met. This further ensures that the brain structure continues to develop, which provides for both better breastfeeding and for the ability to function at subsequently more complex levels. A package of critical pathways has been stimulated, only some of which may be evident in observable muscular behaviors. The metabolic (autonomic and hormonal) adjustment of achieving cardiorespiratory balance and thermal regulation and other homeorhesis in general requires approximately 6 hours of continued mother–infant skin-to-skin contact after birth (Bergman et al., 2004). Other evidence of a critical period is that a single dose of glucose given to newborns at 3 hours of age had a negative impact on the breastfeeding rate at 3 months of age (Martin-Calama et al., 1997). The psychoimmune axis is activated at this early stage, and skin-to-skin contact in the first day improved immunity during the first year of life (Sloan et al., 1994; Syfrett & Anderson, 1993). Stettler et al. (2005) reported that in

American infants bottle-fed with formula, the amount of weight gained in the first week of life accurately predicts their obesity at 30 years of age. This period is likely also fundamental for the microbiota, which the mother shares with her infant, with profound impact on immunity and development (Dominguez-Bello et al., 2010; Douglas-Escobar et al., 2013).

Regulation and Emotional Connection

John Bowlby first introduced the terms *bonding* and *attachment* (Bowlby, 1969), and Mary Ainsworth later designed measures and definitions (Ainsworth et al., 1978). These have remained mostly unquestioned and undeveloped in scientific and clinical mindsets, not taking into account the broader developments described earlier in terms of nurturescience. Myron Hofer very specifically sought to find the underlying biological rationale for bonding, and first described what he called the *psychobiological roots of early attachment* (Hofer, 2006). His findings identified those roots in early maternal regulation of the neonate and infant, a sensory-mediated support to the autonomic nervous system at a brainstem level. However, this support extended simultaneously to the amygdala (emotional brain) and social brain, described also by Jaak Panksepp as the *integrative emotional system for social affect* (Panksepp, 1998). The subsequent consolidation of this takes 6 to 8 weeks, and is the platform for lifelong health (Schore, 2001a, 2001b). From a good base is likely to emerge a secure attachment; conversely, early relational trauma may lead to attachment disorders. More recently, the early regulation is reviewed as the *autonomic socio-emotional reflex* (Ludwig & Welch, 2020), and the key developmental objective at birth is *emotional connection* (Frosch et al., 2019). Accomplishing good emotional connection is achieved by early buffering, another term for *regulation* that includes ongoing emotional support in managing stress and development (Gunnar & Quevedo, 2007). Toxic stress is defined as the absence of the buffering protection of adult support (Bergman, 2019; Shonkoff et al., 2012).

Early observations corroborate the previous statements: Klaus and Kennell accurately described major differences in maternal behavior following early continuous contact (Klaus & Kennell, 1976), though this was ridiculed at the time (Lamb, 1982). Gene Anderson described the mother–infant dyad as “mutual caregivers” (Anderson, 1989, p. 196). Mammalian research clearly shows that the newborn has as great an effect on the mother as vice versa. The pair should be regarded as a single psychobiological organism, a healthy ecology. Mammalian research also elucidates the purpose of this very early critical period; it is to establish the full package of breastfeeding behavior. Mammals that are disturbed during such critical periods fail to establish breastfeeding and die. Mammalian young (and primates in particular) generally wean of their own volition. Our Western culture, however, weans early and does not recognize the need to breastfeed for 2 years or more; therefore, researchers would not imagine looking for such an outcome. Human beings are generally not regarded as being controlled by instincts, as in the meaning of an animal behavior over which there is no control, the view being that uniquely among creatures, the human makes a cerebral cortical and conscious choice. However, the old mammalian brain is in accord and synchrony with our biology and our well-being, and it has an impeccable evolutionary track record. When cerebral choice goes against the old mammalian brain, we may be “straining mother–infant dyads beyond their limits of adaptability” (Lozoff et al., 1977, p. 1), and we are likely doing harm.

Later Developmental Mechanisms

In the first weeks of life a number of new neurological processes occur that are important in understanding the newborn and in supporting its development and breastfeeding.

State Organization

State organization refers to the infant's ability to appropriately control the levels of sleep and arousal (Ludington-Hoe & Swinth, 1996). This is also related to sleep cycling as previously mentioned; organisms cycle through various states, with each state having a specific purpose and specific risks (Graven, 2006). In the first 90 minutes of life, a healthy, undrugged newborn will be in the active awake state, and this corresponds with the critical period: a conscious and aware absorption of sensory stimuli. Thereafter, regular cycling enhances development (Lehtonen & Martin, 2004), and extremes of deep sleep and hard crying should be avoided (Schore, 2001b). The concept of state organization can be expanded to the other two primary occupations of the newborn, namely feeding and interacting with caregivers. Feeding and sleeping centers in the hypothalamus are closely intertwined (Lohr & Siegmund, 1999), and the development of feeding, sleeping, and maternal interaction is closely matched over the first 6 months of life (Spangler, 1991). This may also be related to infant attention, the ability to achieve attentive control, which is a key agenda or achievement in the first weeks of life (Als et al., 1994). The human being is above all a social being, and the ability to relate starts with this capability, an important achievement toward attachment.

Emotional Connection and Attachment

Regulation and emotional connection precede what is later measured as attachment. Mothers (and other family members) behave in very specific ways to newborns; for example, they speak in a particular kind of voice and seek out eye contact. The response from the infant creates a kind of reverberation, or a two-way game. It starts on the first day and continues in ever more complex and variable forms throughout the first few years of life. In the first months of life, this maternal infant contingent interaction is the primary driving force in sculpting the infant's brain into its final configuration (Swain et al., 2007; Teicher et al., 2002). Through these processes, the pathways for optimal right brain development will be laid down (Schore, 2001a). Breastfeeding is the basic and fundamental activity or behavior that ensures continuity and a sense of well-being that will optimize the result of the brain sculpting. It also provides species-specific and unique nutritional requirements designed for brain growth.

Touch and contact facilitate "the flow of affective information from the infant . . . to the mother. The language of mother and infant consists of signals produced by the autonomic nervous system of both parties" (Schore, 2001a, p. 32). A feature of human development is that the autonomic nervous system (which regulates heart rate, breathing, and all homeorhesis) is wired to the cranial nerves, whereby the mother's face, movements, and emotional face play register through the infant's cranial nerves to the autonomic and hormonal homeorhesis of the baby, and vice versa (Ludwig & Welch, 2020; Porges, 2001).

From years of study, Myron Hofer concludes:

> From his academic career studying infant development, Myron Hofer concludes that the mother's mere presence is important to the infant's wellbeing and acts like an "invisible hothouse". Multisensory stimulation from numerous subtle reciprocal interactions during seemingly ordinary caretaking have important developmental effects on the infant. (Gallagher 1992). "Through *hidden maternal regulators* a mother precisely controls every element of her infant's physiology, from its heart rate to its release of hormones, from its appetite to the intensity of its activity." (Gallagher 1992)

The key developmental mechanism that sustains the "invisible hothouse" is the neurobehavior called suckling. This behavior is place dependent, and for the first weeks of life it requires continuous mother–infant skin-to-skin contact.

In this chapter on breastfeeding and nurturescience, I have sought to be consistent with the term *homeorhesis* rather than *homeostasis*. Hofer describes a maternal-infant interaction as the underlying mechanism for *regulation*, taking place in a safe, oxytocin-mediated neural space. His studies show that separation from maternal regulation produces a brief period of dysregulation, followed by a return to stable vital signs that he denotes as *homeostasis* (Hofer, 2006). However, this homeostasis is a stress response in an unsafe and cortisol-mediated neural space. Maternal regulation is fundamental, and is followed by co-regulation (Ludwig & Welch, 2020); self-regulation works but with potential long-term harm (Bergman et al., 2019).

Conclusion

"The mammalian brain is designed to be sculpted into its final configuration by the effects of early experiences" (Teicher et al., 2002, p. 397). These experiences are embedded in the attachment relationship.

Separation Behaviors

Protest–Despair Response

In the first section of this chapter, three limbic system programs were described. Further, it is the habitat and neuroception that determines which of those programs control the body. The reproduction and nutrition programs have been described, and the habitat that elicits them is the mother's chest, or mother–infant skin-to-skin contact. At birth and in the weeks beyond, the human organism recognizes only two habitats: mother or other.

Separation from the mother to any other habitat will immediately elicit the defense program. This was first described as *protest–despair* (Bowlby, 1969) and has been extensively studied in animals since the 1950s (Harlow, 1965). The organism knows its life and survival depend on the right habitat, and the first response to separation from that is a sympathetically mediated protest, shown by crying and by extensor activity. The crying and activity are intended to alert the primary caregiver of the crisis and threat to life and health. Protest as such is not necessarily harmful, and may even be necessary for optimal development of resilience, unless it is repetitive and prolonged (Schore, 2001b). When protest does not give the desired result, the parasympathetically mediated despair phase follows. The sequence is regarded as a single neurological behavior, or program. In despair, the organism shuts down all metabolic systems for prolonged survival, conserving calories by lowering the temperature and heart rate, with inhibition of crying and immobilization, feigning death. At birth, the protest–despair behavior is easily observed. In my own research, separation in the first hour of life results in a very brief vigilance and freeze response, followed by a dissociation seen as a profound parasympathetic despair response, evidenced by a slower heart rate and a drop in core temperature of 1°C or 2°C within 5 minutes (faster than possible by evaporative and radiative cooling) (Bergman et al., 2004).

Porges provides a rationale for this, in terms of the development stages of the autonomic nervous system (Porges, 1998). At birth, the human has developed only the first part of the autonomic nervous system, the unmyelinated or primitive vagus nerve, which provides the parasympathetic nervous system pathway to the body. In nutrition mode, it governs the body metabolism; in defense mode, it shuts down metabolism completely and causes dissociation or immobilization. At 8 weeks of age, the second part, the sympathetic nervous system, becomes active. When activated, this system produces a muscular response, the well-known fight or flight. At 6 months of age, a third stage or layer appears, the myelinated vagus. This is the part that connects to the cranial nerves and higher cerebral centers and allows the organism to make social choices and choose between immobilization or fight or flight, or it can choose from complex alternatives determined by interpretation of the social relationships in the stress situation.

Hyperarousal Dissociation

For many years, the medical establishment regarded the human being as exalted and unique in nature, and no parallels to protest–despair were drawn from or researched in mammal studies. This is ironic because Harlow started his research on monkeys after observations of human orphans in Germany after World War II. However, in the 1990s major research on the human brain took place in a variety of disciplines, including psychiatry and psychopathology (Schore, 2001a, 2001b). Without reference to mammalian studies, the exact parallels are reported, only in different words. Protest is called *hyperarousal*, and despair is called *dissociation*. The research shows that in hyperarousal the brain is hypermetabolic, with massive activation of the sympathetic nervous system. In dissociation, the sympathetic system remains maximal, but the parasympathetic system is equally massively activated and tries to make the brain hypometabolic. This creates “a chaotic biochemistry in the developing brain” and a “toxic neurochemistry” (Schore, 2001b, p. 212). The massive firing of the stress pathways reinforces them to the point where they rapidly become exempt from elimination and so are hardwired. The result is that more adaptive and alternative pathways do not get the opportunity to develop, and the organism is left with primitive, monotonous, and simplistic responses to stress and an inefficiently regulating right brain, which impacts future psychiatric and somatic health across the life span. Potential pathways that would have been conducive to health, waiting for stimuli in critical periods, will now atrophy and may be removed altogether. Infant mental health is defined as the ability to vary response to stress, and this depends on an efficiently regulated right brain (Schore, 2001b). Hyperarousal–dissociation retards the development of this ability. Another set of terms is described in the context of abuse in infants and older children, being a set sequence of threat responses consisting of *vigilance*, *freeze*, and *dissociation* (Perry, 2001).

The exact biochemical mechanisms for how this is achieved have been described. The epigenes mentioned earlier were first described by Meaney, Szyf, and their colleagues. They demonstrated how early adversity in the form of suboptimal maternal care in rat pups resulted in methylation of cortisol receptors in the hippocampus, turning down expression of those receptors (Meaney & Szyf, 2005). Normally cortisol would stimulate those receptors to activate the negative feedback loop to the hypothalamic-pituitary-adrenal axis, but with fewer receptors cortisol is increased and prolonged in the circulation in response to threat. The short-term adaptation is that such pups are wired for adversity, but in the long term high levels of cortisol increase "wear and tear" on autonomic control systems, creating an allostatic load that leads to poorer physical health (McEwen, 1998). The fetal metabolic programming or Barker hypothesis comes from epidemiological studies of birth records followed through to adult life and provides further support (Barker et al., 2002). If the uterine environment has been suboptimal in any way, this can hardwire the brainstem and limbic system in ways that will adversely impact health across the life span. The WHO has recognized a new pandemic dubbed syndrome X or metabolic syndrome—a combination of hypertension, obesity, and diabetes. It is possible that the early pathways for autonomic control of blood pressure and hormonal control of fat cells and glucose metabolism were laid down under stress conditions in the perinatal period. These persist and set the future adult on a trajectory of a thrifty limbic regulation of metabolism, which, in an environment of plenty, results in syndrome X (Hochberg et al., 2011). The mechanism for epigenetic change through allostatic load operates throughout development on all systems (Hochberg et al., 2011).

It is not only active harm that makes poor outcomes, but also neglect: The absence of positive stimulation at critical times may be as harmful as the presence of a negative stimulus. Insofar as negative experiences result in hardwired pathways persisting into adult life, conclusions are that adverse social experiences have worse effects than "aversive nonsocial stimuli" (Schore, 2001b, p. 206) such as hypoxia, intracranial bleeds, or chemicals. In the early developing brain, neural precursor cells are able to replace damaged cells to some extent, and the long-term outcome is potentially better than that of an equivalent injury later in life. When bad pathways are hardwired, the potentially good and preferred pathways are dismantled and removed, and long-term permanent problems result. Schore writes, "Neuroscience is currently exploring early beginnings of adult brain pathology . . . [and showing] alterations in the functional organization of the human brain . . . correlated with the absence of early learning experiences" (Schore, 2001b, p. 204).

Resilience

The key development objective described in nurturescience is *resilience* (Bergman et al., 2019). This is defined as the capacity to maintain healthy emotional functioning in the aftermath of a stressful experience. This harks back to the optimal expression of cortisol receptor genes that lower cortisol levels faster. It is, however, mainly grounded in the oxytocin (sociality) and dopamine (reward) systems of the brain, which in turn are also key parenting (read buffering) brain systems (Strathearn, 2011). The antithesis of resilience is vulnerability, and the psychobiological mechanisms have been described in detail (Charney, 2004).

Practice Recommendations

What are the implications of this new knowledge? One of the primary axioms of the medical profession is *primum non nocere*, or *first do no harm*. What we really want to do is prevent things from going wrong in the first place. Avoiding harm is called *nonmaleficence* in medical ethics, in which there is also an obligation of *beneficence*: It is not enough to avoid harm, we must also actively do good. Mothers and infants should never be harmed by being separated; their mutual regulation and emotional connection should be actively supported. The behaviors described in this chapter will then emerge, and they can be supported and encouraged according to the circumstances.

If some adverse circumstances should arise, and for some overriding reason separation is necessary, then our knowledge of neuroscience should guide the rehabilitation of the neurobehavior of suckling, and restoration to the mother or another primary caregiver should be achieved as soon as possible. Being born too soon is a specific set of such circumstances, which requires even closer attention to guidance from nurturescience. That toxic stress is applicable to this population has been well described (Sanders & Hall, 2017), and I have presented a specific set of practical measures to prevent it (Bergman, 2015).

When the newborn infant is separated, autonomic and hormonal systems rapidly achieve dissociation. One hormone in particular is worthy of mention: somatostatin (Uvnas-Moberg, 1989). This hormone is the antagonist to growth hormone, and it acts directly on the gut with a powerful inhibitory action on the 20 or more hormones described that regulate every aspect of gut function. Its own direct effects are to inhibit gastrointestinal secretion, inhibit gut motility, and reduce blood flow to the gut and absorption from the gut. The result of this is gastric retention, vomiting, and constipation. This will occur even if mother's milk is put into the gut. Somatostatin is relatively easy to measure. It has been found that after restoration of the right habitat, it takes at least 20 and probably 30 minutes to eliminate somatostatin from the system. Cortisol behaves in the same way; it is probable that other dissociation hormones do so also, but they have yet to be measured. Autonomic effects are likely to recover more quickly. The advice, therefore, is that for any intervention or therapy, the first 30 minutes should start with doing absolutely nothing, apart from placing baby on mother's chest and making them both comfortable. If after 30 minutes both are sleeping, therapy should await their spontaneous awakening.

There are reports of warm baths having a positive effect on restoration. This may well enhance the quality of the restored maternal–infant environment, evoking memories in the child. This is perhaps more effective if the infant is some weeks old and has mastered state and attentional behaviors and therefore can engage more directly. There may be other measures that are also supportive in restoring the mother–infant connection and fostering attachment.

After things have gone wrong, very specific management and skills are needed, as described in this book. But these do require some basic fundamentals to be in place, if we want to elicit the limbic neurobehavior of breastfeeding, so we must restore the infant's habitat, its optimal ecology, as a foundation for resilience.

The next chapter of this book summarizes research that has been done on current labor ward routines and makes suggestions consistent with a better understanding of modern neuroscience. Separation causes stress in the mother and infant (Sanders & Hall, 2017). Maternal anxiety has adverse effects, including potentially decreased milk production. But her stress is evident also to the baby, and it reinforces baby's hyperarousal–dissociation. Chapter 3 contains more information on the effect of birth interventions on infant neurobehavior.

The present reality is that most newborns experience prolonged separation. The kinds of questions that need to be answered are as follows:

- How much separation can the newborn tolerate?
- How long does it take for the newborn organism to recover from separation?

There was an ongoing debate as to how long mother and newborn should stay together after birth. The World Health Organization (WHO) and UNICEF, in the Baby-Friendly Hospital Initiative (BFHI), initially recommended 30 minutes and subsequently extended it to 60 minutes. The question should in fact be the opposite; the debate should be about when separation of mother and infant should take place, if at all. It is purely our Western culture and entrenched hospital practices, unsupported by any kind of science or research, that assumes maternal-infant separation is of no consequence, but required and normal (Bergman, 2014, 2019).

"Society reaps what it sows in the way that infants and children are treated. Efforts to reduce exposure to stress and abuse in early life may have far-reaching impacts on medical and psychiatric health and may reduce aggression, suspicion and untoward stress in future generations" (Teicher et al., 2002, p. 416).

REFERENCES

Ainsworth, M. D., Blehar, M., Werner, D., & Werner, D. (1978). *Patterns of attachment: A psychological study of the strange situation*. Lawrence Erlbaum Associates.

Alberts, J. R. (1994). Learning as adaptation of the infant. *Acta Paediatrica* (Suppl 397**),** 77–85. 10.1111/j.1651-2227.1994.tb13269.x

Alberts, J. R., & Pickler, R. H. (2012). Evolution and development of dual ingestion systems in mammals: Notes on a new thesis and its clinical implications. *International Journal of Pediatrics*, 2012, 730673. 10.1155/2012/730673

Als, H., Lawhon, G., Duffy, F. H., McAnulty, G. B., Gibes-Grossman, R., & Blickman, J. G. (1994). Individualized developmental care for the very low-birth-weight preterm infant. Medical and neurofunctional effects. *Journal of the American Medical Association*, *272*(11), 853–858. 10.1001/jama.1994.03520110033025

Amodio, D. M., Master S. L., Yee, C. M., & Taylor, S. E. (2008). Neurocognitive components of the behavioral inhibition and activation systems: Implications for theories of self-regulation. *Psychophysiology*, *45*, 11–19.

Anderson, G. C. (1989). Risk in mother–infant separation postbirth. *Image: Journal of Nursing Scholarship*, *21*(4), 196–199. 10.1111/j.1469-8986.2007.00609.x

Barker, D. J., Eriksson, J. G., Forsen, T., & Osmond, C. (2002). Fetal origins of adult disease: Strength of effects and biological basis. *International Journal of Epidemiology*, *31*(6), 1235–1239. 10.1136/bmj.301.6761.1111

Bergman, N. (2015). Neuroprotective core measures 1–7: Neuroprotection of skin-to-skin contact (SSC). *Newborn and Infant Nursing Reviews*, *15*(3), 5.

Bergman, N. J. (2014). The neuroscience of birth—and the case for zero separation. *Curationis*, *37*(2), 1–4. 10.1053/j.nainr.2015.06.006

Bergman, N. J. (2019). Birth practices: Maternal-neonate separation as a source of toxic stress. *Birth Defects Research*, *111*(15), 1087–1109. 10.1002/bdr2.1530

Bergman, N. J., Linley, L. L., & Fawcus, S. R. (2004). Randomized controlled trial of skin-to-skin contact from birth versus conventional incubator for physiological stabilization in 1200- to 2199-gram newborns. *Acta Paediatrica*, *93*(6), 779–785. 10.1111/j.1651-2227.2004.tb03018.x

Bergman, N. J., Ludwig, R. J., Westrup, B., & Welch, M. G. (2019). Nurturescience versus neuroscience: A case for rethinking perinatal mother–infant behaviors and relationship. *Birth Defects Research*, *111*(15), 1110–1127. 10.1002/bdr2.1529

Bowlby, J. (1969). *Attachment and loss*. Basic Books.

Browne, J. V. (2004). Early relationship environments: Physiology of skin-to-skin contact for parents and their preterm infants. *Clinical Perinatology*, *31*(2), 287–298, vii. 10.1016/j.clp.2004.04.004

Charney, D. S. (2004). Psychobiological mechanisms of resilience and vulnerability: Implications for successful adaptation to extreme stress. *American Journal of Psychiatry*, *161*(2), 195–216. 10.1176/appi.ajp.161.2.195

Chen, C. H., Wang, T. M., Chang, H. M., & Chi, C. S. (2000). The effect of breast- and bottle-feeding on oxygen saturation and body temperature in preterm infants. *Journal of Human*

Lactation, *16*(1), 21–27. 10.1177/089033440001600105

Crossley, N. A., Mechelli, A., Scott, J., Carletti, F., Fox, P. T., McGuire, P., & Bullmore, E. T. (2014). The hubs of the human connectome are generally implicated in the anatomy of brain disorders. *Brain*, *137*(Pt 8), 2382–2395. 10.1093/brain/awu132

Despopoulos, A., & Silbernagl, S. (1986). *Color atlas of physiology*. Georg Thieme Verlag.

Dominguez-Bello, M. G., Costello, E. K., Contreras, M., Magris, M., Hidalgo, G., Fierer, N., & Knight, R. (2010). Delivery mode shapes the acquisition and structure of the initial microbiota across multiple body habitats in newborns. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(26), 11971–11975. 10.1073/pnas.1002601107

Douglas-Escobar, M., Elliott, E., & Neu, J. (2013). Effect of intestinal microbial ecology on the developing brain. *JAMA Pediatrics*, *167*(4), 374–379. 10.1001/jamapediatrics.2013.497

Ellis, B. J., & Del Giudice, M. (2019). Developmental adaptation to stress: An evolutionary perspective. *Annual Review of Psychology*, *70*, 111–139. 10.1146/annurev-psych-122216-011732

Frosch, C. A., Fagan, M. A., Lopez, M. A., Middlemiss, W., Chang, M., Hane, A. A., & Welch, M. G. (2019). Validation study showed that ratings on the Welch Emotional Connection Screen at infant age six months are associated with child behavioural problems at age three years. *Acta Paediatrica*, *108*(5), 889–895. https://doi.org/10.1111/apa.1473110.1111/apa.14731

Gallagher, W. (1992, July/August). Motherless child. *The Sciences*, 12–15.

Graven, S. N. (2004). Early neurosensory visual development of the fetus and newborn. *Clinics in Perinatology*, *31*(2), 199–216, v. 10.1016/j.clp.2004.04.010

Graven, S. N. (2006). Sleep and brain development. *Clinics in Perinatology*, *33*, 693–706. 10.1016/j.clp.2006.06.009

Gunnar, M., & Quevedo, K. (2007). The neurobiology of stress and development. *Annual Review of Psychology*, *58*, 145–173. 10.1146/annurev.psych.58.110405.085605

Harlow, H. F. (1965). Total social isolation: Effects on macaque monkey behavior. *Science*, *148*(3670), 666. 10.1126/science.148.3670.666-a

Hochberg, Z., Feil, R., Constancia, M., Fraga, M., Junien, C., Carel, J. C., Boileau, P., Le Bouc, Y., Deal, C. L., Lillycrop, K., Scharfmann, R., Sheppard, A., Skinner, M., Szyf, M., Waterland, R. A., Waxman, D. J., Whitelaw, E., Ong, K., & Albertsson-Wikland, K. (2011). Child health, developmental plasticity, and epigenetic programming. *Endocrine Reviews*, *32*(2), 159–224. 10.1210/er.2009-0039

Hofer, M. A. (2006). Psychobiological roots of early attachment. *Current Directions in Psychological Science*, *15*(2), 84–88. 10.1111/j.0963-7214.2006.00412.x

Klaus, M. H., & Kennell, J. H. (1976). *Maternal infant bonding*. CV Mosby.

Lamb, M. E. (1982). The bonding phenomenon: Misinterpretations and their implications. *The Journal of Pediatrics*, *101*(4), 555–557. 10.1016/s0022-3476(82)80699-9

Lehtonen, L., & Martin, R. J. (2004). Ontogeny of sleep and awake states in relation to breathing in preterm infants. *Seminars in Neonatology*, *9*, 229–238. 10.1016/j.siny.2003.09.002

Lohr, B., & Siegmund, R. (1999). Ultradian and circadian rhythms of sleep-wake and food-intake behavior during early infancy. *Chronobiology International*, *16*(2), 129–148.

Lozoff, B., Brittenham, G. M., Trause, M. A., Kennell, J. H., & Klaus, M. H. (1977). The mother-newborn relationship: Limits of adaptability. *Journal of Pediatrics*, *91*(1), 1–12. 10.3109/07420529909019081

Ludington-Hoe, S. M., Johnson, M. W., Morgan, K., Lewis, T., Gutman, J., Wilson, D., & Scher, M. S. (2006). Neurophysiologic assessment of neonatal sleep organization: Preliminary results of a randomized, controlled trial of skin contact with preterm infants. *Pediatrics*, *112*(5), e909–e923. 10.1542/peds.2004-1422

Ludington-Hoe, S. M., & Swinth, J. Y. (1996). Developmental aspects of kangaroo care. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, *25*(8), 691–703. 10.1111/j.1552-6909.1996.tb01483.x

Ludwig, R. J., & Welch, M. G. (2020). How babies learn: The autonomic socioemotional reflex. *Early Human Development*, *151*, 105183. 10.1016/j.earlhumdev.2020.105183

Martin-Calama, J., Bunuel, J., Valero, M. T., Labay, M., Lasarte, J. J., Valle, F., & de, M. C. (1997). The effect of feeding glucose water to breastfeeding newborns on weight, body temperature, blood glucose, and breastfeeding duration. *Journal of Human Lactation*, *13*(3), 209–213. 10.1177/089033449701300309

McCain, H. N., & Mustard, J. F. (1999). Reversing the real brain drain. Early years study. In *Reversing the real brain drain: Early years study* (pp. 25–52), Ontario Children's Secretariat.

McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine*, *338*(3), 171–179. 10.1056/NEJM199801153380307

Meaney, M. J., & Szyf, M. (2005). Maternal care as a model for experience-dependent chromatin plasticity? *Trends in Neurosciences*, *28*(9), 456–463. 10.1016/j.tins.2005.07.006

National Research Council Institute. (2000). *From neurons to neighborhoods*. National Academy Press.

Panksepp, J. (1998). *Affective neuroscience*. Oxford University Press.

Peirano, P. D., & Algarin, C. R. (2007). Sleep in brain development. *Biological Research*, *40*(4), 471–478. 10.4067/S0716-97602007000500008

Perry, B. D. (2001). The neurodevelopmental impact of violence in childhood. In D. Schetky & E. P. Benedek, *Textbook of child and adolescent forensic psychiatry* (pp. 221–238). American Psychiatric Press, Inc.

Philbin, M. K. (2004). Planning the acoustic environment of a neonatal intensive care unit. *Clinics in Perinatology*, *31*(2), 331–352, viii. 10.1016/j.clp.2004.04.014

Porges, S. W. (1998). Love: An emergent property of the mammalian autonomic nervous system. *Psychoneuroendocrinology*, *23*(8), 837–861. 10.1016/S0306-4530(98)00057-2

Porges, S. W. (2001). The polyvagal theory: Phylogenetic substrates of a social nervous system. *International Journal of Psychophysiology*, *42*(2), 123–146. 10.1016/S0167-8760(01)00162-3

Porges, S. W. (2004, May). Neuroception: A subconscious system for detecting threats and safety. *Zero to Three*, 19–24.

Righard, L., & Alade, M. O. (1990). Effect of delivery room routines on success of first breast-feed. *Lancet*, *336*(8723), 1105–1107. 10.1016/0140-6736(90)92579-7

Rivkees, S. A. (2004). Emergence and influences of circadian rhythmicity in infants. *Clinics in Perinatology*, *31*(2), 217–228. 10.1016/j.clp.2004.04.011

Sanders, M., & Hall, S. (2017). Trauma-informed care in the newborn intensive care unit: Promoting safety, security and connectedness. *Journal of Perinatology*, *38*(1), 3–10. https://doi.org/10.1038/jp.2017.124

Schaal, B., Hummel, T., & Soussignan, R. (2004). Olfaction in the fetal and premature infant: Functional status and clinical implications. *Clinics in Perinatology*, *31*(2), 261–vii. 10.1016/j.clp.2004.04.003

Schore, A. N. (2001a). Effects of a secure attachment relationship on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal*, *22*(1-2), 7–66. https://doi.org/10.1002/1097-0355(200101/04)22:1<7::AID-IMHJ2>3.0.CO;2-N

Schore, A. N. (2001b). The effects of early relational trauma on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal*, *22*(1-2), 201–269. https://doi.org/10.1002/1097-0355(200101/04)22:1<201::AID-IMHJ8>3.0.CO;2-9

Shatz, C. J. (1992). The developing brain. *Scientific American*, *267*(3), 60–67.

Shonkoff, J. P. (2010). Building a new biodevelopmental framework to guide the future of early childhood policy. *Child Development*, *81*(1), 357–367. 10.1111/j.1467-8624.2009.01399.x

Shonkoff, J. P., Garner, A. S., Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. (2012). The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*, *129*(1), e232–e246.

Shore, R. (1997). *Rethinking the brain: New insights into early development*. Families and Work Institute. 10.1542/peds.2011-2663

Sloan, N. L., Camacho, L. W., Rojas, E. P., & Stern, C. (1994). Kangaroo mother method: Randomised controlled trial of an alternative method of care for stabilised low-birthweight infants. *Lancet*, *344*(8925), 782–785. 10.1016/S0140-6736(94)92341-8

Smith, L. J., & Kroeger, M. (2004). *Impact of birthing practices on breastfeeding* (2nd ed.). Jones & Bartlett Publishers.

Spangler, G. (1991). The emergence of adrenocortical circadian function in newborns and infants and its relationship to sleep, feeding and maternal adrenocortical activity. *Early Human Development*, *25*(3), 197–208. 10.1016/0378-3782(91)90116-K

Stettler, N., Stallings, V. A., Troxel, A. B., Zhao, J., Schinnar, R., Nelson, S. E., Ziegler, E. E., & Strathearn, L. (2011). Maternal neglect: Oxytocin, dopamine and the neurobiology of attachment. *Journal of Neuroendocrinology*, *23*(11), 1054–1065. 10.1111/j.1365-2826.2011.02228.x

Strom, B. L. (2005). Weight gain in the first week of life and overweight in adulthood. *Circulation*, *111*, 1897–1903. 10.1161/01.CIR.0000161797.67671.A7

Swain, J. E., Lorberbaum, J. P., Kose, S., & Strathearn, L. (2007). Brain basis of early parent–infant interactions: Psychology, physiology, and in vivo functional neuroimaging studies. *Journal of Child Psychology & Psychiatry*, *48*(3/4), 262–287. 10.1111/j.1469-7610.2007.01731.x

Syfrett, E. B., & Anderson, G. C. (1993). Early and virtually continuous kangaroo care for lower-risk preterm infants: Effect on temperature, breastfeeding, supplementation and weight. In *Biennial Conference of the Council of Nurse Researchers*. American Nurses Association.

Teicher, M. H. (2002). Scars that won't heal: The neurobiology of child abuse. *Scientific American*, *286*(3), 68–75.

Teicher, M. H., Andersen, S. L., Polcari, A., Anderson, C. M., & Navalta, C. P. (2002). Developmental neurobiology of childhood stress and trauma. *The Psychiatric Clinics of North America*, *25*(2), 397–426. 10.1016/S0193-953X(01)00003-X

Uvnas-Moberg, K. (1989). Gastrointestinal hormones in mother and infant. *Acta Paediatrica Scandinavica Supplementum*, *351*, 88–93.

Widstrom, A. M., Brimdyr, K., Svensson, K., Cadwell, K., & Nissen, E. (2019). Skin-to-skin contact the first hour after birth, underlying implications and clinical practice. *Acta Paediatrica*, *108*(7), 1192–1204. 10.1111/apa.14754

Widstrom, A. M., Lilja, G., Aaltomaa-Michalias, P., Dahllof, A., Lintula, M., & Nissen, E. (2010). Newborn behaviour to locate the breast when skin-to-skin: A possible method for enabling early self-regulation. *Acta Paediatrica*, *100*(1), 79–85. 10.1111/j.1651-2227.2010.01983.x

© wong sze yuen/Shutterstock.

CHAPTER 3

Impact of Birth Practices on Breastfeeding

Linda J. Smith

For breastfeeding to succeed, the baby must be able to feed (cue, move to breast, attach, suck, swallow, and breathe smoothly); the mother must be producing milk normally and willing to bring the baby to breast many times a day and night; breastfeeding must be comfortable for both; and the surroundings must support the dyad. If any of these factors are suboptimal, breastfeeding can be a struggle for the mother and/or baby with the likelihood of exclusive and long comfortable breastfeeding rapidly decreasing. Birth is more than a physical event. According to Olza and colleagues, birth is a neuropsychosocial event with profound psychological and neuroendocrinological implications to both the mother and baby (Olza et al., 2020).

Premature weaning from the breast (lack of breastfeeding) is associated with a host of short- and long-term consequences (U.S. Department of Health and Human Services, 2011; Victora et al., 2016). Although most mothers *want* to breastfeed, many mothers in the United States are not meeting their *own* breastfeeding goals (Centers for Disease Control and Prevention et al., 2021). Some of these barriers are directly or indirectly related to birth-related practices or events. If the mother and baby are separated, if the baby is unable to breastfeed, or if lactogenesis is delayed or impaired, then the baby will likely be fed a breastmilk substitute (Grummer-Strawn, 2018). Any practice or event, intentional or unintentional, that contributes to delayed or impaired exclusive breastfeeding puts the mother and baby at higher risk of poorer health outcomes. The effects of birth interventions on these child health outcomes are cumulative, synergistic, and associated with long-term health problems (Peters et al., 2018). There is still a paucity of research that addresses the direct relationships of birth practices to breastfeeding outcomes.

Professional segmentation is a major barrier to accurately evaluating breastfeeding-related outcomes of birth practices, despite the fact that “mothers and babies form an inseparable biological and social unit” (World Health Organization [WHO] & United Nations Children’s Fund [UNICEF], 2003). During pregnancy and breastfeeding, professional specialties tend to focus on either the mother or the baby, but rarely both (Smith & Kroeger, 2010). Obstetricians and anesthesiologists are rarely involved in helping the mother–baby dyad initiate breastfeeding. Likewise, pediatricians are rarely involved in decisions regarding labor management or may be unaware of birth complications that can affect breastfeeding. Midwives and nurses often provide continuity of care across the perinatal continuum, but may lack in-depth or specialized education about breastfeeding (WHO & UNICEF, 2021). Communication channels between prebirth and postbirth care providers may be inadequate, leaving breastfeeding to fall through the cracks. Many high-quality global programs have been developed (WHO & UNICEF, 2018, 2020), yet are not fully or consistently implemented worldwide.

Planned or emergent practices and events during birth can influence three critical aspects needed for breastfeeding: proximity of mother and baby, infant’s feeding ability, and maternal lactogenesis. Evidence-based practices utilized during birth and postpartum can prevent or minimize the negative effect of routine or medically appropriate interventions.

Proximity Versus Separation of Mother and Baby

During pregnancy, the mother is the baby's entire environment. The baby swallows *and* breathes amniotic fluid, which matures the lungs and provides protein and tactile experiences in the gut. Some babies suck their fingers, which may be practice for coordinating suck, swallow, and breathing patterns later.

A normal baby placed in skin-to-skin contact (SSC) with the mother immediately after birth can crawl to the breast and begin breastfeeding in as little as 5 minutes or within the first 60 to 70 minutes (Bullough et al., 1989; Bystrova et al., 2003; Dumas et al., 2013; Widström et al., 2011). The infant instinctively moves through nine distinct stages in the first hours after birth (Widström et al., 2011). If the infant is separated during this sequence, smooth transitioning to normal feeding may be disrupted (Crenshaw et al., 2012).

Abundant research reports multiple risks of separation of a healthy mother and baby to the infant's ability to feed. Separation, even for quick procedures as seemingly benign as weighing and measuring, disrupts the infant's sucking response (Bystrova et al., 2009; Righard & Alade, 1990, 1992). Separation instantly raises stress hormones (Meaney et al., 1995), including salivary cortisol, epinephrine, and norepinephrine (Pados, 2019). If stress is persistent, the unmyelinated vagus is activated, triggering a "freeze" response (Pados, 2019). The combination of stress hormones, neurotransmitters, and unmyelinated vagus activation triggers simultaneous hyperarousal and dissociation (protest–despair) (Bergman et al., 2004). Separated babies cry more (Christensson et al., 1992; Christensson et al., 1995). Persistent crying may raise the risk of postbirth intracranial bleeds (Anderson, 1989), particularly in preterm infants, negatively impacting muscle tone, sucking and swallowing skills, and control of breathing (Avrahami et al., 1996).

Infants' temperature is normally well-regulated by the mother's body during SSC. Maternal regulation of infant temperature by SSC is more effective and consistent than when the baby is in a warmer (Christensson et al., 1992). At the very least, when a baby is in an electronic warmer, the baby is not breastfeeding.

In the early weeks and months of the COVID-19 pandemic, health authorities' recommendations were inconsistent regarding keeping mothers and babies together during birth and early postpartum. Reports circulated that in some places, babies were separated from their mothers at birth and even formula-fed out of fear of the newborns being infected by a sick mother. WHO guidance was consistent: "Mothers and infants should be enabled to remain together and practise skin-to-skin contact, kangaroo mother care and to remain together and to practise rooming-in throughout the day and night, especially immediately after birth during establishment of breastfeeding, whether they or their infants have suspected, probable or confirmed COVID-19 virus infection" (WHO, 2020). As the pandemic continued and research confirmed the extremely low risk of breastfeeding and infant contact with a masked mother, the WHO policy of keeping the mother–baby dyad together was confirmed (Bartick et al., 2021; Rollins et al., 2021; Stuebe, 2020).

Infant Factors That Affect Breastfeeding Initiation

What Babies Expect at Birth

At birth, the baby's internal and external environment drastically and permanently changes. Suddenly, gravity, sound, temperature, and light are unmediated; the baby must coordinate sucking, swallowing, and breathing to obtain food and air; and the entire skin surface is bombarded by new, often harsh, sensations. The skin areas with the largest representation in the sensory cortex of the brain are the hands (especially the thumbs), lips, tongue, pharynx, and feet—precisely those body parts that are involved when a baby crawls to the breast and latches on after childbirth. The baby has now begun the period of "exterogestation" (Montagu, 1986), meaning maturing outside the womb. The closer the baby's external environment is to the former internal environment, the more the baby can stabilize and focus on growth and development (Hofer, 2006).

Oral experiences matter. Ideally, the baby's first oral experience is determined and controlled by the baby as she moves to the mother's breast, uses her hands, oral and visual senses to find the breast, and draws the nipple and areola into her mouth. Oral experiences *other than* baby-led self-attachment may alter neuromuscular behaviors central to breastfeeding (Mobbs et al., 2016).

Neurobehavioral Alterations Related to Maternal Drugs Administered During Labor

Babies need intact neuromuscular functions to suck, swallow, and breathe for effective feeding. Narcotics and anesthetic drugs given by intravenous injection have long been known to depress respiratory function (Nissen et al., 1995) and are dose-related.

Drugs administered during labor quickly appear in umbilical cord blood within a few seconds to a few minutes and may persist for lengthy periods (Loftus et al., 1995). Labor pain relief medications such as narcotics are chosen for their effect on sensory nerves, with an effort to find drugs that do not affect motor nerves and have the least impact on the infant. Although various combinations of drugs have been studied, no single protocol or combination is consistently used, reported, or evaluated for breastfeeding outcomes.

The pediatric half-life of some opiates is longer than the maternal half-life. Drugs are cleared via infant metabolism, taking about five half-lives for approximately 97% of the drug to clear. Decades ago, Sepkoski et al. reported the effects of epidural bupivacaine using the Neonatal Behavioral Assessment Scale: Deficits in motor organization (sucking) and orientation (cueing) were dose related and persisted for at least 30 days (Sepkoski et al., 1992). Measurement ceased at 30 days, so the duration of any potential negative effects remains unknown.

There is mounting evidence that narcotics administered into the epidural space affect the infant's neurobehavior, including the ability to suck, swallow, and breathe in a coordinated manner. Ransjö-Arvidson et al. documented that "several types of analgesia given to the mother during labor may interfere with the newborn's spontaneous breast-seeking and breastfeeding behaviors and increase the newborn's temperature and crying" (Ransjö-Arvidson et al., 2001). Jordan et al. reported that "intrapartum fentanyl may impede establishment of breastfeeding, particularly at higher doses" (Jordan et al., 2005). Beilin et al. (2005) reported that among experienced breastfeeding mothers, dose-related administrations of fentanyl were associated with stopping breastfeeding before 6 weeks (Beilin et al., 2005). Wiklund et al. reported that infants exposed to epidural anesthesia were nearly four times less likely to suckle the breast in the first 4 hours after birth and were nearly half as likely to be exclusively breastfed at hospital discharge (Wiklund et al., 2009).

Brimdyr and colleagues (2015) conducted a rigorous video ethnographic study at Loma Linda Medical Center in California, which is a designated Baby-Friendly Hospital™. They reported that babies exposed to epidural fentanyl, born vaginally to low-risk mothers, and placed skin-to-skin on their mothers' bodies immediately after birth were significantly less likely to achieve sucking during the first hour after birth than babies not exposed to fentanyl. The authors concluded that the combined effects of synthetic oxytocin and fentanyl significantly decreased the likelihood of a baby suckling while skin-to-skin during the first hour after birth. This finding is profoundly important because sucking within the first hour is a core indicator of normal neuromuscular behavior of newborns (Dumas et al., 2013; Widström et al., 2011). A Norwegian study added evidence that fentanyl has a negative effect on the infants' ability to feed. "The odds of non-exclusive breastfeeding were doubled with EDA fentanyl (odds ratio [OR] 2.45, 95% confidence interval [CI] 1.34–4.48, $p = 0.004$) and four times higher with IV+EDA fentanyl (OR 4.20, 95% CI 2.49–7.09, $p < 0.001$) compared with no opioid exposure. Spontaneous suckling was negatively associated with intrapartum fentanyl use ($p < 0.001$) irrespective of mode of administration. When the IV fentanyl doses exceeded 200 μg compared with less than 200 μg, we found a reduction in exclusive breastfeeding (81% vs. 89%; $p = 0.014$) and spontaneous suckling (68% vs. 83%; $p < 0.001$) and an increase in breastfeeding problems (41% vs. 27%; $p = 0.004$) (Oommen et al., 2021).

Recent studies continue to document negative outcomes of epidural analgesia related to breastfeeding. A cohort study of 1,221 first-time mothers in Ireland reported that women using epidurals were more likely to require a vacuum- or forceps-assisted birth; have longer first and second stages of labor; are more likely to be febrile; and are half as likely to be breastfeeding at 3 months' postpartum (Newnham et al., 2021). A population representative survey of 1,835 Australian mothers revealed a sevenfold risk of instrumental delivery for those receiving an epidural during labor, along with an increased risk of the baby requiring NICU admission and a reduced breastfeeding continuation versus those using breathing and massage for pain relief (Adams et al., 2015). A cohort study from Shanghai, China, reported that babies of mothers who received epidurals were at higher risk of infection (Jia et al., 2021). Babies who are ill do not feed well.

Epidural drugs reduce the infant's ability to cope with pain by altering maternal β-endorphins produced during labor (Goland et al.,

1981) and the levels of β-endorphins in colostrum and milk (Zanardo et al., 2001). SSC and breastfeeding are comforting (Gray et al., 2002; Gray et al., 2000) and promotes infant oxytocin release, enhancing feeding and relational activities (Pados, 2019). Human milk itself is analgesic (Harrison et al., 2016; Shah et al., 2012). If the infant's ability to suck is compromised by epidural drugs, the pain-relieving components in milk are reduced, and the baby is more likely to be separated from the mother because of poor feeding, the outcome may be an infant who suffers more pain and is unable to relieve that pain through normal breastfeeding.

When narcotic pain relief is administered, especially via epidural injection, other drugs are commonly used as well. Synthetic oxytocin is often administered to augment contractions and interferes with both the mother's and baby's emerging innate behaviors and the mother's oxytocin levels (Jonas et al., 2009; Jonas et al., 2008). Takahashi and colleagues studied the sucking behaviors of 2-day-old infants and oxytocin levels in the infants and their mothers to analyze the effects of epidural analgesia alone, epidural analgesia plus oxytocin, and oxytocin alone. They reported: "Epidural analgesia and epidural analgesia with oxytocin infusion in connection with birth negatively influenced infant rooting behavior and maternal mean oxytocin levels, respectively. Oxytocin infusion alone was without effect. The data also suggest that infants who suck well stimulate oxytocin release more efficiently, as expressed by a high oxytocin variance, leading to a better stimulation of milk production and consequently to a reduced infant weight loss 2 days after birth" (Takahashi et al., 2021).

Iatrogenic Immaturity and Negative Outcomes Related to Induction of Labor

Infant maturity is a significant trigger of onset of labor (Nommsen-Rivers et al., 2012; Vidaeff & Ramin, 2008). Induction of labor, especially prior to 39 completed weeks of gestation, is associated with an increased risk of infant death (Kramer et al., 2000) and other complications. Immaturity with impaired coordination of sucking, swallowing, and breathing is probably the most significant consequence of elective induction. In addition, artificial rupture of membranes increases the risk of infection; chemical induction with oxytocin increases the risk of infant jaundice; and induced labors are more painful for the mother, which increases the infant's exposure to drugs for labor pain. Babies of mothers who received oxytocin during labor were twice as likely to have sucking problems in the first hours and days after birth (Wiklund et al., 2009) and less likely to achieve effective sucking within the first hour after birth (Brimdyr et al., 2015). Induction of labor, even for a compelling medical reason, may result in a late preterm baby with immature or disorganized feeding abilities and a higher risk of readmission to the hospital (Boies et al., 2016).

In a large multicenter study in Spain (Espada-Trespalacios et al., 2021) of 5,717 nulliparous mothers, 24.7% of labors were induced. Induction more than doubled the risk of Cesarean surgery and epidural use; nearly doubled the likelihood of instrument use; and increased the likelihood of postpartum hemorrhage, not having SSC with the mother, and not initiating breastfeeding.

Induction of labor usually triggers other interventions which both individually and collectively can negatively impact breastfeeding. A large population-based cohort study of 491,590 women in Australia reported that instrument use more than doubled the likelihood of jaundice and increased the risk for infections, eczema, and metabolic disorders. "*Conclusion*: Children born by spontaneous vaginal birth had fewer short-and longer-term health problems, compared with those born after birth interventions" (Peters et al., 2018). A 16-year retrospective study of linked health data of long-term outcomes from induction of labor in uncomplicated pregnancies of low-risk women concluded that "IOL [induction of labor] for non-medical reasons was associated with higher birth interventions, particularly in primiparous women, and more adverse maternal, neonatal and child outcomes for most variables assessed" (Dahlen et al., 2021). Pharmacological and medical interventions in labor are likely to have a negative synergistic effect on newborn feeding.

Physical (Mechanical) Forces That Alter Feeding Behavior

Normal birth involves molding of the fetal skull: shifting of the four segments of the occiput, both parietal bones, and three segments of each temporal bone (Netter, 1989). The parietal bones override the basilar portion of the occiput and the two halves of the frontal bone, allowing the fetal head to rotate and descend through the maternal pelvis (**Figure 3-1**).

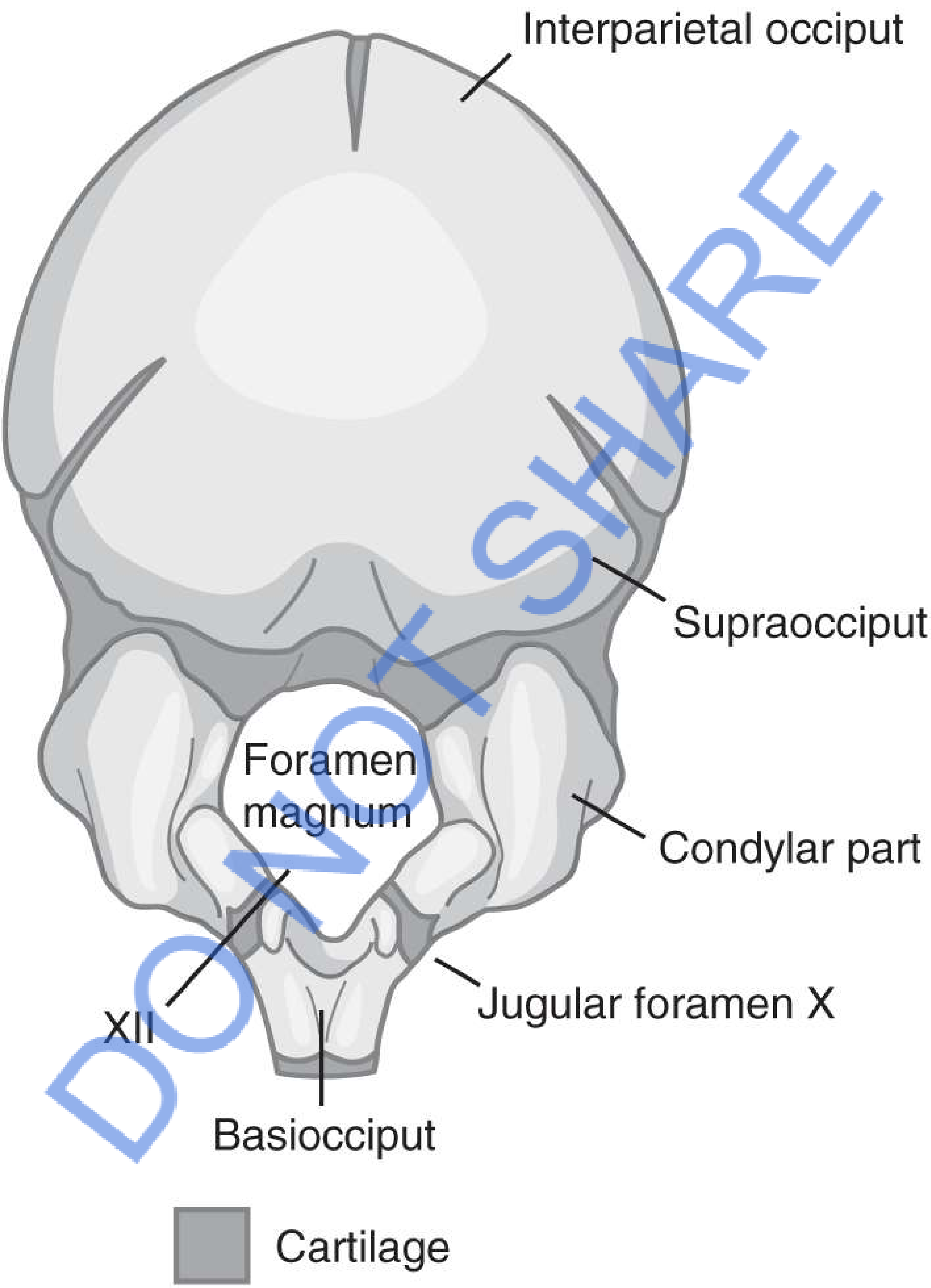

FIGURE 3-1 External view of the occiput at birth.

Description

Six cranial nerves contribute to the control of sucking, swallowing, and breathing. Disruption of any of these nerves can alter the infant's feeding abilities.

- The trigeminal nerve (V) has sensory fibers to the palate, tongue, lower jaw, and nose (smell), as well as motor fibers to the muscles of mastication.
- The facial nerve (VII) has sensory fibers to the palate, tongue, and tear ducts, as well as motor fibers to the facial muscles and lips.
- The hypoglossal nerve (XII) controls tongue movement, including the patterns necessary for latching and sucking. In the infant, cranial nerve XII lies in the space between segments of the occipital bone that later fuse to form the hypoglossal canal in adults. Any nerve entrapment of the hypoglossal nerve(s) can result in disordered contraction patterns in the tongue muscle group. Excess forces during birth including cesarean surgery may disrupt the structures of the cranial base and alter function of the hypoglossal nerves, which could affect milk transfer (Evans et al., 2003) and breastfeeding duration (Hobbs et al., 2016).
- The glossopharyngeal nerve (IX) has sensory fibers in the posterior palate and tongue, which, among other functions, trigger the gag response.
- The vagus nerve (X) has sensory fibers to the heart, lungs, trachea, bronchi, larynx, pharynx, gastrointestinal tract, and external ear, as well as motor fibers to the larynx, heart, lungs, trachea, liver, and gastrointestinal tract.
- The spinal accessory nerve (XI) innervates the trapezius and sternocleidomastoid (SCM) muscles, which stabilize the infant's head and maintain airway patency.

Mechanical analysis of the forces of labor on the fetal skull confirms clinicians' observations of the effects of molding (Kumpulainen et al., 2020). After birth, sucking and crying help expand the cranial vault and allow the bones to gradually move back into alignment during the first 1 to 2 weeks' postbirth (Ward, 2003).

Constrained intrauterine positions can result in deformational asymmetry of fetal parts, resulting in conditions such as torticollis (Lee et al., 2011), developmental hip dysplasia, and clubfoot. Deformation happens when a normally formed structure is exposed to excessive pressures that alter its shape. Cranial asymmetry of the occipital, temporal, and/or parietal bones is often accompanied by disrupted alignment of the cranial base (Frymann, 1966). In the first 1 to 3 days of life, cranial asymmetry is associated with primiparity, assisted delivery, and long labor. Early posterior cranial flattening or other unusual head shapes can progress to deformational plagiocephaly (asymmetry without suture fusing) if they affect the infant's habitual head position. Cranial asymmetry is more common in males and twins, and on the right side it may be associated with torticollis (shortening of the SCM muscle). Cephalohematoma is a well-known risk factor for posterior deformational plagiocephaly. Multiple births and uterine constraints have been reported as risk factors for plagiocephaly but not for true synostosis (premature fusion of the sutures) (Peitsch et al., 2002; Waddington El Fau-Snider et al., 2015). Excessive pressure to the fetal head related to uterine tetany, forceps delivery, or fundal pressure can increase fetal intracranial pressure (Amiel-Tison et al., 1988).

Instruments used in birth increase the amount of force applied to the occipital segments and entails a documented risk of complications. Hall et al. reported that "data strongly suggests that success of breastfeeding is associated with events in the first two weeks of life, if not the first 3 to 5 days" (Hall et al., 2002). Vacuum vaginal delivery was a strong predictor of early cessation of breastfeeding (Hall et al., 2002).

Babies with ineffective suck may have cranial, postural, and/or jaw asymmetry. Wall and Glass reported that of 11 babies with mandibular asymmetry and torticollis seen in a Seattle lactation clinic, "10 of the 11 mothers had complications of labor and birth, including prolonged labor in 6 cases, resulting in 1 forceps-assisted birth and 4 Cesarean births" (Wall & Glass, 2006). Severe torticollis may impede the fetus's cardinal movements that allow it to fit through the pelvis during the birth process, making the birth more difficult. Moderate facial asymmetry is associated with longer second stage labors, larger infants, and greater risk of birth trauma (Stellwagen et al., 2008). It can be difficult to tease out the relative contributions of the infant's anatomy and birth interventions necessitated by their condition.

More definitive research on the effect of mechanical (physical) forces of labor on the infant's ability to suck, swallow, and breathe needs to be conducted. Asymmetry in any part of the infant's body, especially the head and neck, may be one indication of irregularities or abnormalities that contribute to poor feeding behavior. See Chapter 8 for more information on assisting breastfeeding infants with asymmetry.

Oral suctioning is associated with risks of oral aversion; injury to the posterior oropharynx; removing normal, immunologically important mucus; and failing to prevent meconium-aspiration pneumonia, even in babies born through meconium-stained amniotic fluid (Vain et al., 2004). Current research strongly recommends wiping the newborn's nose and mouth instead of suctioning (Kelleher et al., 2013) even when the amniotic fluid is stained with meconium (American Congress of Obstetricians and Gynecologists, 2007). Even when suctioning is medically appropriate, the procedure can compromise early feeding behaviors.

Birth Injuries and Insults

Injuries to the baby's head, face, or upper body can interfere with the baby's ability to suck, swallow, and breathe comfortably. Lacerations can occur during forceps use or cesarean surgery; forceps or vacuum extractors can cause bruising or wounds.

Instrument delivery with forceps causes lateral compression of the parietal and three segments of each temporal bone. Forceps use may cause bruising and nerve damage to the sides of the infant's cranium, causing the jaw to deviate to the paralyzed side when the mouth is open (Tappero & Honeyfield, 1993). Bruising can increase the risk for jaundice; treatment for jaundice may result in separation from the mother and formula supplementation. A baby with bruises or lacerations on the head may be unable to feed in positions that put pressure on the wounded areas.

Brachial plexus injuries cause the infant significant pain, especially when the child is held in certain positions and postures that mothers might unknowingly adopt during breastfeeding (Blair & Smith, 2007; Mollberg et al., 2005). Birth injuries (cephalohematoma; skull, clavicle, arm, or facial fractures; dislocation of triangular cartilage of the nasal septum; nerve injuries; subgaleal hemorrhage; intracranial bleeding) are more common in mechanically difficult births, instrument-assisted births, and cesarean births. Birth-related fractures were rare (0.075%), but most likely in large infants and in forceps or ventouse deliveries in a 16-year study of over 87,000 births (Rehm et al., 2020). There was a similar low rate of facial nerve and brachial plexus injuries combined in the same cohort, with the same risk factors, plus an increased risk of facial nerve injury in emergency surgical birth (Rehm et al., 2019).

Failure of instrumental delivery can increase fetal injury and exposure to hypoxia or stress from multiple attempts or delayed birth (Seki, 2018). Vacuum extractor attempts are most likely to fail (Gurney et al., 2021), but infant outcomes with an emergency Cesarean at full dilation were not better. Cesarean birth also affects infant feeding abilities; for example, Chinese researchers recorded poorer intraoral vacuum pressures during breastfeeding in 1-day-old infants born by Cesarean than those born vaginally (Zhang et al., 2016).

A small minority (2% to 3%) of full-term infants with birth asphyxia or acidosis may develop bleeding inside the skull or brain, which releases brain constituents into the blood (Gazzolo et al., 2002). Infants may seem normal at birth but rapidly develop symptoms as blood collects and puts pressure on the brain or injures brain cells. Poor feeding may be one sign of intracranial hemorrhage (Avrahami et al., 1996). Others include inconsolable crying, change in muscle tone or level of consciousness, and seizures.

Metabolic Alterations from Maternal IV Fluids

Maternal overhydration by large volumes of intravenous fluids appears correlated to excess newborn weight loss, as reported by Noel-Weiss and colleagues: “Timing and amounts of maternal IV fluids appear correlated to neonatal urine output and newborn weight loss” (Noel-Weiss, Woodend, & Groll, 2011; Noel-Weiss, Woodend, Peterson, et al., 2011). These authors suggest delaying the initial assessment of birth weight until 24 hours to assure accuracy (Noel-Weiss, Woodend, Peterson, et al., 2011.). Excess newborn weight loss is often a reason that infants are given breastmilk substitutes instead of assistance with breastfeeding. Infants born by Cesarean are more likely to lose more than 10% of their birth weight in the first few days of life (Govoni et al., 2019; Manganaro et al., 2001). Measuring weight loss from the Cesarean-born infant’s 24-hour weight as proposed by Noel-Weiss and colleagues (Noel-Weiss, Woodend, Peterson, et al., 2011.) reduced unnecessary supplementation without increasing maximum weight loss, transcutaneous bilirubin, or length of stay (Deng & McLaren, 2018).

Maternal Birth Factors That Affect Breastfeeding

What Mothers' Bodies Expect at Birth Regarding Breast Calibration and "External Gestation"

When a baby is placed in immediate and uninterrupted SSC with the mother after birth, the baby exhibits nine stages of instinctive behavior culminating with an effective breastfeed before the mother and baby fall into a restful sleep (Widström et al., 2019; Widström et al., 2011). This interaction with the baby continues the normal physiological processes of lactogenesis that began in pregnancy. The mother's body appears to *expect* this early contact to calibrate milk production. The powerful pulse of oxytocin at birth (Olza et al., 2020) is quickly followed by another bolus of oxytocin in the first hour or so, moving colostrum to the anterior breast for easy infant intake and profoundly affecting the mother's experience of birth and her baby. In SSC, the mother is immersed in multisensory stimuli from the newborn, literally bathing her in oxytocin essential for lactation, bonding, socialization, and recovery (Uvnäs-Moberg et al., 2020).

CNS Alterations from Drugs: Delayed Onset of Lactation and Altered Oxytocin Response

Labor pain medications are known to delay lactogenesis. Lind, Perrine, and Li reported that "mothers who received labor pain medications were more likely to report delayed onset of lactation (DOL), regardless of delivery method" (Lind et al., 2014). In a sample of 2,586 women, 23.4% experienced DOL, defined as "milk coming in" more than 3 days after delivery. The highest rates of DOL occurred in women who underwent an emergency cesarean section with an epidural plus another medication. For more than half of this group of women, their milk did not “come in” until after 3 days (72 hours).

Jonas et al. reported that “Epidural analgesia in combination with oxytocin infusion influenced endogenous oxytocin levels negatively” (Jonas et al., 2009). Maternal CNS alterations related to epidural use include hyperthermia and overt clinical fever (Lieberman et al., 2000; Segal, 2010) and reduced thermal responsiveness to the infant when the baby is in SSC (Jonas et al., 2007). When the mother is febrile, infection is suspected; the infant may be separated for testing and/or treatment. Separation for maternal infection with COVID-19 was practiced in some places, despite WHO recommendations to care for the mother and baby together (WHO, 2020).

A Swedish study compared the influence of oxytocin and epidural on the personality profiles of 69 women. At 2 days’ postpartum, the mothers who received epidural exhibited reduced maternal socialization and increased anxiety and aggression. The authors state that “EDA [epidural anesthesia] may also block the release of oxytocin in women during birth” (Jonas et al., 2008). The Academy of Breastfeeding Medicine’s Clinical Protocol #5 states “Epidural analgesia, intramuscular opioids, exogenous oxytocin, and ergometrine have all been associated with lower rates of breastfeeding initiation” (Holmes et al., 2013).

Physical (Mechanical) Forces That Alter Feeding Behavior: Surgery and Injuries

When the mother receives an epidural, her mobility and choice of position is restricted, often slowing the progress of labor and increasing the risk of fetal malpresentation, abnormal pressures on the infant skeleton, and longer labor (Lieberman & O’Donoghue, 2002). Induction of labor increases risks to the mother of Cesarean surgery, instrument delivery, postpartum hemorrhage, episiotomy, lack of immediate SSC with her baby, and delayed or impaired breastfeeding (Espada-Trespalacios et al., 2021).

Metabolic Alterations from IV Fluids

Intravenous fluids are administered to prevent supine hypotension when an epidural is placed during labor, before a planned Cesarean section, or when some labor complications arise. A prospective, longitudinal observational cohort pilot study with repeated measures and within-subjects design was conducted by Kujawa-Myles, Noel-Weiss, Dunn, Peterson, and Cotterman (Kujawa-Myles et al., 2015) who concluded, "The findings demonstrate that mothers . . . who received IV fluids in labor and postpartum had higher levels of breast edema" (p. 1). Breast edema may interfere with the infant's ability to effectively latch and feed. Intravenous hydration is associated with excess weight loss in newborns, leading to excess formula supplementation (Chantry et al., 2011). Maternal IV hydration is also associated with infant hypoglycemia, hyponatremia, and jaundice (Singhi & Chookang, 1984). Interrupted breastfeeding and supplementation with a breastmilk substitute is more likely when infants are diagnosed with these conditions.

Solutions: Policies and Strategies to Prevent, Recover, and Support Breastfeeding

Global health policies provide evidence-based recommendations for care during birth that strongly support and protect breastfeeding. *WHO Recommendations: Intrapartum Care for a Positive Childbirth Experience* provide evidence-based guidance during labor and birth (WHO, 2018b). These recommendations appeared in many other documents, policies, and statements from advocacy and professional organizations. Key recommendations central to breastfeeding include:

- 48: Newborns without complications should be kept in skin-to-skin contact (SSC) with their mothers during the first hour after birth to prevent hypothermia and promote breastfeeding.
- 49: All newborns, including low-birth-weight (LBW) babies who are able to breastfeed, should be put to the breast as soon as possible after birth when they are clinically stable, and the mother and baby are ready.

The Baby-Friendly Hospital Initiative (BFHI; WHO & UNICEF, 2020) continues to improve early and sustained breastfeeding rates. Full implementation of the Ten Steps to Successful Breastfeeding has a documented positive relationship to breastfeeding initiation and continuance (Silva et al., 2020).

The WHO recently released several new products with detailed guidance for clinical practice. All are available at https://www.who.int/health-topics/breastfeeding#tab=tab_1

- Protecting, promoting and supporting breastfeeding: The BFHI for small, sick and preterm newborns
- Competency Verification Toolkit: Ensuring competency of direct care providers to implement the BFHI

- Indicators for assessing infant and young child feeding practices: Definitions and measurement methods
- BFHI training course for maternity staff

The most important and effective strategies to help an infant recover from birth-related insults are (1) SSC, (2) SSC, and (3) more SSC. SSC between baby and mother does not preclude or replace treatment of any injuries. "Healthy infants should be placed and remain in direct skin-to-skin contact with their mothers immediately after delivery until the first feeding is accomplished. . . . Delay weighing, measuring, bathing, needle-sticks, and eye prophylaxis until after the first feeding is completed" (Gartner et al., 2005, p. 498). Virtually all nonemergency procedures can be done with the baby resting on the mother's body or lying supine next to her in her bed. Let the mother and baby get to know one another without interruption (Morrison et al., 2006). Staff and family should fully support the mother's cues and requests for privacy or companionship, food and drink, warmth, and so on. Nursing staff should specifically discourage anyone other than the mother (including other hospital staff) from handling, holding, feeding, or otherwise removing the baby from the mother's arms or bed. Safety should be assured for mother and baby, of course, by unobtrusive and careful observation from a short distance. Nothing should be introduced into the baby's mouth other than the mother's breast until many weeks—preferably 6 months—after the baby's first effective breastfeed. The BFHI steps 4, 6, 7, 8, and 9 address these strategies in detail (see **Box 3-1**).

Box 3-1 Ten Steps to Successful Breastfeeding (2018)

Critical Management Procedures

1. a. Comply fully with the *International Code of Marketing of Breast-Milk Substitutes* and relevant World Health Assembly resolutions.
   b. Have a written infant feeding policy that is routinely communicated to staff and parents.
   c. Establish ongoing monitoring and data-management systems.

2. Ensure that staff have sufficient knowledge, competence, and skills to support breastfeeding.

Key Clinical Practices

3. Discuss the importance and management of breastfeeding with pregnant women and their families.
4. Facilitate immediate and uninterrupted skin-to-skin contact and support mothers to initiate breastfeeding as soon as possible after birth.
5. Support mothers to initiate and maintain breastfeeding and manage common difficulties.
6. Do not provide breastfed newborns any food or fluids other than breast milk, unless medically indicated.
7. Enable mothers and their infants to remain together and to practise rooming-in 24 hours a day.
8. Support mothers to recognize and respond to their infants' cues for feeding.
9. Counsel mothers on the use and risks of feeding bottles, teats, and pacifiers.
10. Coordinate discharge so that parents and their infants have timely access to ongoing support and care.

Reproduced from World Health Organization & UNICEF. (2018). (World Health organisation, 2018) *Implementation guidance: protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services – the revised Baby-friendly Hospital Initiative*. Geneva, Switzerland: Author

---

Mother and baby should remain together throughout the recovery period, even after Cesarean surgery or other operative procedures, and supported to breastfeed on cue 24 hours a day (BFHI steps 4, 7, 8, and 9). The baby's first deep sleep after birth occurs about 1 to 2 hours after birth and is about 60 minutes long (Bergman, 2013), followed by alternating wakefulness and sleep with frequent breastfeeding sessions. Before birth, the baby received nourishment *continually* through the umbilical cord and *intermittently* by sucking and swallowing amniotic fluid. Colostrum is thick, almost gel-like, and is released in relatively small quantities that are easier to manage during the first days of coordinating sucking, swallowing, and breathing. As the mother and baby adapt to external gestation with frequent unrestricted breastfeeding, the dyad's mutual breastfeeding dance continues to improve and mature.

Some babies are too compromised to feed effectively. In that case, follow three rules:

1. Feed the baby.
2. Support the mother's milk production.
3. Keep the dyad together while the baby's problems are identified and resolved.

Smith's ABC protocol may be useful (**Figure 3-2**). The first priority is always "Feed the baby." The next priority is "Try the easy solutions that do not involve equipment first." The following is a sequential, three-step strategy to support or restore effective breastfeeding. The goal is staying at or returning to step 1, effective feeding directly at the breast. Many of the concepts central to the BFHI *Ten Steps to Successful Breastfeeding* are integrated into this protocol.

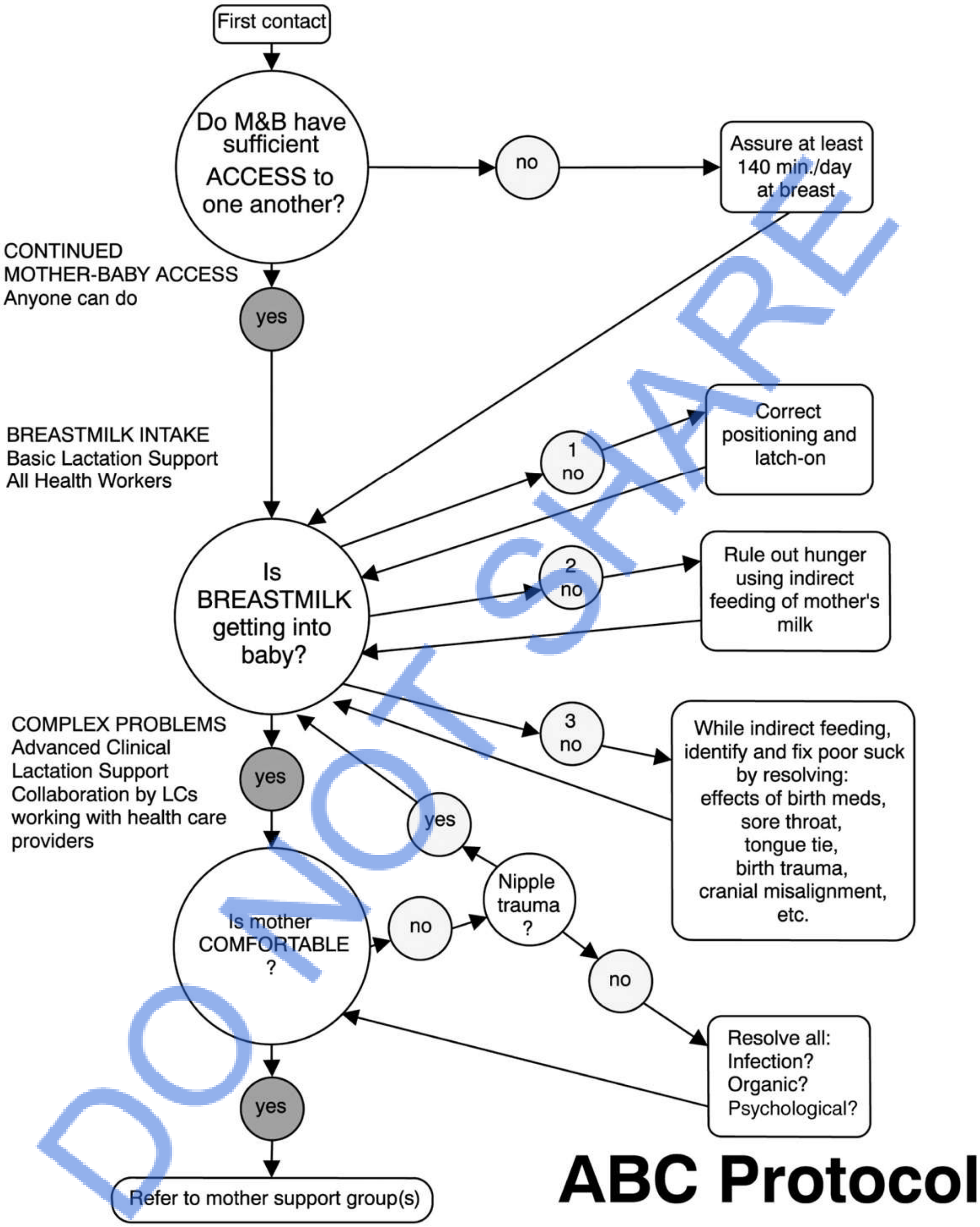

FIGURE 3-2 Smith's ABC protocol.™

Reprinted with permission of Linda J. Smith and Dennis Smith.

<u>Description</u>

Step 1: Feed the Baby at the Breast (1 to 3 Days)

Goal: Rule out behavioral issues and minor mechanical issues. The first step is supporting the mother and baby together.

First, assure that the baby has enough time and access to the mother's breast (BFHI steps 4, 7, and 8). If the baby isn't near the breast, she or he can't breastfeed! The baby should be at the breast for a minimum of 140 minutes per 24 hours, or an average of about 11 minutes per hour (De Carvalho et al., 1983; Kent et al., 2006). Many babies cluster feedings into 10- to 30-minute sessions, using one or both breasts, every 1 to 2 hours (Bergman, 2013). It is unlikely and unusual for an infant to sleep more than about 1 to 2 hours at a stretch in the first 6 months (La Leche League International et al., 2014). Other patterns are common if the total time at the breast is sufficient.

Warning signs:

- There are *consistently* fewer than eight feedings per 24 hours.
- The feedings are *consistently* less than 5 to 10 minutes per breast.
- Mother removes the baby from the breast at a predetermined time.
- A pacifier is used.
- The mother is worried that the baby isn't getting enough milk.

What to do: Get the baby to the breast!

- Keep mother and baby in nearly constant SSC for 24 to 48 hours.
- Maximize the amount of time the baby is at the breast, as continuously as possible.
- Stop all pacifier and bottle (artificial nipple) use. Pacifiers keep the baby away from the breast. All sucking should be at the breast.

Caution: If the mother will not or cannot bring the baby to the breast frequently for any reason, the baby is at immediate risk of inadequate caloric intake. Follow rule 1: Feed the baby with any reasonable source of nutrition, by any method while addressing this issue. Breastfeeding is impossible without frequent breast contact. That's why it's called *breast*feeding.

Second, assure adequate milk transfer. The baby can be near food but not actually eating. Audible swallowing should be heard during most of the feed at a rate of about one swallow per second, with pauses between bursts of swallows (Riordan et al., 2005).

Warning signs:

- *Consistently* fewer than 8 or more than 16 feedings per 24 hours.
- Feedings are *consistently* shorter than 5 minutes or longer than 30 minutes (Kent et al., 2006).
- Rapid sucking occurs with little or no swallowing most of the time.
- Baby sucks 3 to 4 times, falls asleep, *stays at the breast*, and repeats this pattern.
- Mother's nipple is creased, cracked, flattened, or painful after feeding.
- Breast fullness does not change (soften) because of feeding.

What to do: Make sure milk is getting from the mother to the baby!

- Assure baby's deep attachment (grasp/latch) to the breast.
- Assure good alignment of the baby's body.
- Assure that the baby is sucking and swallowing normally (Genna & Sandora, 2016).

When to go to step 2:

- Improved positioning *does not* result in audible swallowing.

- Improved positioning *does not* eliminate nipple compression or pain.
- Baby pulls away from breast, screams, or cannot stay at the breast.
- Baby does not release the breast spontaneously with obvious satiety in ~10 to 30 minutes.

Step 2: Feed the Baby Expressed Milk Indirectly (Not at the Breast; 1 to 3 Days) (BFHI Steps 5 and 6)

Goal: Continue to feed the baby while correcting short-term suck problems.

Because the baby's direct breastfeeding is not yet effective, indirect feeding of the mother's own expressed milk while establishing lactogenesis is the next step. Ineffective sucking results in inadequate milk intake for the baby and causes milk retention, engorgement, and a subsequently lowered milk supply in the mother. Hunger may cause a poor or disorganized sucking response in the baby, resulting in a self-fulfilling vicious circle. Step 2 breaks this cycle by assuring adequate nutrition for the baby while maintaining or increasing the mother's milk production. The feeding method used in step 2 should correct early interferences and/or avoid compromising future direct breastfeeding. A disorganized suck caused by hunger may resolve in 2 to 5 days if artificial nipples (teats) are avoided and sufficient calories are consumed; feeding at the breast can then begin again.

First, get milk. To increase the milk supply, the mother should *remove milk from the breast more frequently and thoroughly*. Hand expression is the most effective method of milk expression in the first 48 hours; after that, using a hospital-grade electric breast pump with a double collection kit and manually expressing milk before and after pumping is recommended (Morton et al., 2009; Ohyama et al., 2010). Collect milk in a pattern similar to how a normal baby would feed: Begin within the first hour after birth or when it becomes obvious that the baby is not feeding effectively for at least 140 minutes per 24 hours, or about every 2 hours during waking hours and at least once or twice at night. When the breasts begin to feel full, express milk again. At each session, continue expressing until the milk flow ceases, or at least past one let-down response (Meier et al., 2008). If the mother feels milk dripping or leaking at any time, *collect milk immediately*. If the mother's own milk is unavailable, pasteurized donor human milk from a qualified milk bank is the next best option (WHO & UNICEF, 2003).

Warning signs:

- The milk volume does not increase in 2 to 5 days of frequent expressing or pumping.
- Nipple or breast pain occurs or continues.
- The mother is taking hormonal contraceptives.
- The mother had any surgery on her breast(s).

What does not matter (for milk production):

- What the mother drinks or eats.
- Suggesting the mother "rest and relax."
- Waiting to express milk until the breast feels full.

Second, feed the baby with an open cup or anything *other* than an artificial teat (nipple). The goal is to provide calories while permitting or encouraging normal wavelike tongue movements. Feed the baby with a small open cup, spoon, or dropper (Howard et al., 2003). The use of a feeding tube device placed at the breast is not effective at this point because feeding tube devices placed at the breast do not remove milk from the breast. If a baby cannot get milk out of a breast filled with milk, it is unlikely the child can get milk out of a tube placed at the breast.

Third, keep attempting to breastfeed the baby. After giving 1 to 2 ounces of milk (5 to 15 mL for babies younger than 3 days of age) by an alternate method, try breastfeeding. Placing the baby skin-to-skin on the mother's unclothed upper torso with the mother in a semi-reclining position often triggers breast-seeking behavior and self-attachment. Help the mother and baby achieve meticulous comfortable attachment and positioning, preferably without touching the mother or baby (Colson et al., 2008). Breastfeeding should be comforting for mother and baby even if few calories are obtained. Monitor the baby's weight, stools, and urine with accurate equipment.

When to go to step 3:

- Breastfeeding causes nipple pain, compression, or damage.
- Baby continues to be unable to attach and feed from the breast.
- Baby's suck does not improve after 2 to 5 days of increased calories.
- Baby has a difficult time feeding from alternate devices.

Step 3: Find Out Why the Baby Cannot Obtain Milk at the Breast

Goal: Identify and fix the cause of the underlying suck problem.

Continue to feed the baby with the mother's expressed milk, using any non-teat feeding device that accomplishes effective, comfortable feeding. Follow the number 1 rule: feed the baby. Consider *volume* of milk first, then *type* of milk, then feeding *method*. Denying a baby food to improve the suck is unjustified. Babies must receive adequate and appropriate nutritional support while oral motor problems are solved. Help the mother maintain (normalize) milk production in the most efficient manner. Because the baby's feeding problem has persisted despite previous strategies, further investigation is needed to identify whether the baby has a disorganized or dysfunctional suck. Disorganized and dysfunctional suck patterns are not corrected by using artificial nipples. An artificial nipple (teat) should be used only as a last resort for feeding. Many parents are at the last resort stage if step 3 becomes necessary.

Step 3 includes complete and careful medical evaluation and close follow-up by the baby's primary care provider. Normal breastfeeding does not *cause* sucking problems. However, sucking problems jeopardize the baby's nutritional status. Virtually all infant problems including ineffective or compromised oral motor responses are exacerbated by inadequate nutrition. Ineffective or inappropriate feeding practices may further compromise undernourished babies with feeding problems. In nearly all situations, the mother's expressed milk is best even if direct feeding at the breast is not possible or must be modified. Maintaining mother's milk production is usually the easiest part of managing step 3 problems. The lactation consultant can continue to help the mother maintain milk production and preserve and enhance whatever at-breast feeding is possible.

The reasons and remedies for suboptimal sucking responses in otherwise healthy babies are under-researched. Nonetheless, the underlying causes of poor sucking patterns may have long-term consequences to the baby that are unrelated to feeding. The following possibilities should be explored in cooperation and collaboration with the entire healthcare team:

1. *Effects of labor medications:* Narcotic analgesia, epidural anesthesia, and general anesthesia can affect the baby's sucking and alertness for several hours to several weeks after birth.
   a. *To identify:* Maternal intrapartum pain medication (Smith & Kroeger, 2010).
   b. *Remedy:* Time. If the baby cannot feed effectively, hand express to normalize milk production beginning within 1 to 2 hours after birth. Additional expression with a breast pump may help. Feed the milk to the baby using an open cup or non-teat method until the effects of the medication have diminished. There should be noticeable improvement within a week, even if total resolution takes longer. If there is no change or improvement, seek further evaluation.
   c. *Cost:* Breast pump (if used) and patience.
2. *Sore throat from suctioning or intubation:* Vigorous suctioning or intubation may cause swelling or result in soreness in the mouth and/or throat. Some babies will react by biting, clenching, and/or guarding the airway with strong tongue elevation.

   a. *To identify:* A history of suctioning, intubation, or other oral trauma.
   b. *Remedy:* Time and gentle, respectful oral experiences. A suctioned baby may not want anything in his or her mouth for a while, not even a breast. Cup feeding is usually the preferred strategy. Do not use pacifiers, finger feeding, or artificial nipples in this situation.
   c. *Cost:* Breast pump (if used) and patience.
3. *Head insult or injury during birth:* Intrapartum use of forceps or vacuum extraction, prolonged pushing, excessive or persistent cranial molding, or cephalohematoma.
   a. *To identify:* Injury to the head during birth or immediately postpartum.
   b. *Remedy:* Time, gentle patience, and posture changes for the baby. Treat the baby as if the child has a severe headache. Keep the sore side up and higher than the baby's heart. Reduce sensory input by reducing noise and music, light, touch, and excessive motion. Maximize SSC upright against the mother or a parent's bare chest in a quiet, darkened place. If the baby can feed effectively in one position, use it frequently without trying for variety. Cool cloths on the baby's head may help. Some clinicians suggest judicious use of infant pain relief medications. Cup feeding of pumped milk may be more comfortable for the baby than feeding directly at the breast.
   c. *Cost:* Breast pump (if used) and patience.
4. *Oral abnormalities or variations, especially tongue-tie (ankyloglossia):* See Chapter 8 for more information about ankyloglossia.
   a. *To identify:* Use a validated assessment tool. Visual clues include a heart-shaped or square-tipped tongue or a tongue that cannot extend past the lower lip without curling or denting. Functional clues include absent tongue peristalsis, the tongue tip cannot rise to the palate, the mother's nipples are creased and cracked

across the tip or have unhealed wounds on the tip, or the baby cannot obtain milk at the breast.

b. *Remedy:* Evaluation and treatment by a qualified healthcare professional. The professional will release the frenulum (perform a frenotomy; see Chapter 9) with sterile scissors or laser, and immediately have the baby put to the mother's breast. A frenotomy can be done within hours of the baby's birth. Maternal comfort and infant sucking effectiveness are often improved immediately and continue to evolve over several days.

c. *Cost:* Medical or dental outpatient surgical treatment, which may be covered by insurance.

5. *Misalignment of cranial bones during birth that does not spontaneously resolve in 1 to 2 weeks* (Frymann, 1966). A mechanically difficult birth may cause pressure on cranial, sensory, and motor nerves, which in turn can affect sucking, swallowing, and digestion.

   a. *To identify:* Signs include gagging, weak suck, abnormal tongue movements, facial asymmetry (Wall & Glass, 2006), postural asymmetry, head molding persisting more than a week, arching, plugged tear ducts, baby's inability to turn the head both ways easily, and/or palpable ridges along cranial suture lines.

   b. *Remedy:* Evaluation and treatment by a doctor of osteopathy, physical therapist, pediatric chiropractor, cranial-sacral therapist, or another qualified provider trained in manipulative techniques on infants is required. These therapeutic modalities are subtle, gentle, and have produced remarkable results (Herzhaft-Le Roy et al., 2017) (see Chapter 12).

   c. *Cost:* The cost varies and may be covered by insurance.

6. *Other medical or health problems in the baby:* Other medical or health problems that affect feeding ability include but are not limited to cardiac abnormalities, neurological problems, severe allergies, fungal or other mouth infections, metabolic abnormalities, and congenital issues. Some providers suggest that feeding behavior is the first thing to go wrong when a severe problem is developing in

a baby. Always remain in close collaboration with the baby's primary care provider whenever step 3 becomes necessary.

The following is a summary of the protocol:

Step 1: Direct breastfeeding; keep mother and baby together (BFHI steps 4, 6, 7, 8, and 9).

- Assure sufficient time at the breast (quantity issue).
- Assure effective feeding at the breast (quality issue).

Step 2: Indirect feeding of the mother's own milk; keep mother and baby together (BFHI steps 5 and 6).

- Maintain or increase the mother's milk production.
- Feed the baby by methods that encourage proper tongue movements.
- Continue attempts to breastfeed directly.

Step 3: Investigate why the baby cannot feed at the breast while keeping mother and baby together.

- Continue indirect feeding with the mother's expressed milk while possible causes and remedies are investigated.
- Support the mother's milk production, her efforts, and her motivation.
- Collaborate with other providers.

Summary of Recovery From and Resolution of Birth-Related Infant Problems

Obviously, babies must be born. The optimal way to prevent complications arising from birth practices is to minimize the use of interventions. A normal birth usually leads to normal breastfeeding. However, complications during pregnancy, labor, and birth do occur, and properly used interventions can be lifesaving for the mother and/or baby. Even when they are necessary and properly used, interventions can have a profound negative effect on the infant, the mother, and the course of breastfeeding. The rate at which interventions are used is the chief concern, not the interventions themselves. The WHO and other health-policy bodies have published research-based data on the recommended rates of medically necessary interventions. In many places, local rates of induction, Cesarean surgery, and epidural use far exceed medically necessary rates.

In 2015, a consortium of international organizations dedicated to evidence-based care of women and children published criteria for a mother–baby friendly birthing facility. “A FIGO, ICM, WRA, IPA, WHO mother–baby friendly birthing facility:

1. Offers all birthing women the opportunity to eat, drink, walk, stand, and move about during the first stage of labor and to assume the position of her choice/comfort during the second and third stages, unless medically contraindicated.
2. Has clear, nondiscriminatory policies and guidelines for the treatment and care of HIV-positive mothers and their newborns, as well as policies for counseling and provision of postpartum family planning, and youth-friendly services.
3. Provides all mothers with privacy during labor and birth.
4. Allows all birthing women the comfort of at least one person of her choice (e.g. father, partner, family member, friend, and traditional

birth attendant as culturally appropriate) to be with her throughout labor and birth.

5. Provides culturally competent care that respects the individual's customs, nonharmful practices, and values around birth, including those women who experience perinatal loss.
6. Does not allow physical, verbal, emotional, or financial abuse of laboring, birthing, and postpartum women and their families.
7. Provides care at affordable costs in line with national guidelines and assures financial accountability and transparency. Families will be informed about what charges can be anticipated and how they might plan to pay for services. Families must be informed if any additional charges apply for complications. Health facilities should have a process for payment that does not include detention of the woman or baby. Refusal of care for the mother or the baby because of inability to pay should not be permitted.
8. Does not routinely employ practices or procedures that are not evidence-based, such as routine episiotomy, induction of labor, or separating mother and baby etc., consistent with international guidelines and action plans. Each birthing facility should have the capacity, staff, policy, and equipment to provide neonatal and maternal resuscitation, minimize the risk of infection, provide prompt recognition and prevention/treatment of emergent maternal and neonatal needs, have established links for consultation and prospectively planned arrangements for stabilization and/or transport sick mothers or sick/premature infants.
9. Educates, counsels, and encourages staff to provide both nonpharmacological and pharmacological pain relief as necessary.
10. Promotes immediate skin-to-skin mother/baby contact and actively support all mothers to hold and exclusively breastfeed their babies as often as possible and provides combined care for mother and baby as appropriate." (International Federation of Gynecology And Obstetrics et al., 2015)

Regardless of events during childbirth, lactation consultants have a key role in helping mothers and babies establish and maintain breastfeeding. Lactation consultants are trained and skilled in observing, assisting, and monitoring the mother–baby dyad as they move along the continuum from internal gestation to exterogestation. Lactation consultants play an important role in documenting and bearing witness to the mother and baby outcomes that may be affected by birth interventions and in aiding the mother–baby dyad to overcome early and/or negative consequences of birth practices.

REFERENCES

Adams, J., Frawley, J., Steel, A., Broom, A., & Sibbritt, D. (2015). Use of pharmacological and non-pharmacological labour pain management techniques and their relationship to maternal and infant birth outcomes: Examination of a nationally representative sample of 1835 pregnant women. *Midwifery*, *31*(4), 458–463. https://doi.org/10.1016/j.midw.2014.12.012

American Congress of Obstetricians and Gynecologists. (2007). ACOG Committee Opinion No. 379: Management of delivery of a newborn with meconium-stained amniotic fluid. *Obstetrics & Gynecology*, *110*(3), 739. https://doi.org/10.1097/01.AOG.0000263928.82639.7f

Amiel-Tison, C., Sureau, C., & Shnider, S. M. (1988). Cerebral handicap in full-term neonates related to the mechanical forces of labour. *Baillieres Best Practice & Research: Clinical Obstetrics & Gynaecology*, *2*(1), 145–165. 10.1016/S0950-3552(88)80069-5

Anderson, G. C. (1989). Risk in mother–infant separation postbirth. *Image Journal of Nursing Scholarship*, *21*(4), 196–199. 10.1111/j.1547-5069.1989.tb00142.x

Avrahami, E., Amzel, S., Katz, R., Frishman, E., & Osviatzov, I. (1996). CT demonstration of intracranial bleeding in term newborns with mild clinical symptoms. *Clinical Radiology*, *51*(1), 31–34. 10.1016/S0009-9260(96)80215-7

Bartick, M. C., Valdés, V., Giusti, A., Chapin, E. M., Bhana, N. B., Hernández-Aguilar, M.-T., Duarte, E. D., Jenkins, L., Gaughan, J., & Feldman-Winter, L. (2021). Maternal and infant outcomes associated with maternity practices related to COVID-19: The COVID mothers study. *Breastfeeding Medicine, 16*(3), 189-199. https://doi.org/10.1089/bfm.2020.0353

Beilin, Y., Bodian, C. A., Weiser, J., Hossain, S., Arnold, I., Feierman, D. E., Martin, G., & Holzman, I. (2005). Effect of labor epidural analgesia with and without fentanyl on infant breast-feeding: A prospective, randomized, double-blind study. *Anesthesiology*, *103*(6), 1211–1217. 10.1097/00000542-200512000-00016

Bergman, N. J. (2013). Neonatal stomach volume and physiology suggest feeding at 1-h intervals. *Acta Paediatrica, 102*(8), 773-777. https://doi.org/10.1111/apa.12291

Bergman, N. J., Linley, L. L., & Fawcus, S. R. (2004). Randomized controlled trial of skin-to-skin contact from birth versus conventional incubator for physiological stabilization in 1200- to 2199-gram newborns. *Acta Paediatrica*, *93*(6), 779–785. https://doi.org/10.1111/j.1651-2227.2004.tb03018.x

Blair, A. C., & Smith, L. J. (2007). *Birth injuries that affect breastfeeding.* International Conference on the Theory and Practice of Human Lactation Research and Breastfeeding Management. Orlando, FL.

Boies, E. G., Vaucher, Y. E., & Null, N. (2016). ABM clinical protocol #10: Breastfeeding the late preterm (34–36 6/7 weeks of gestation) and early term infants (37–38 6/7 weeks of gestation), second revision 2016. *Breastfeeding Medicine*, *11*, 494. 10.1089/bfm.2016.29031.egb

Brimdyr, K., Cadwell, K., Widström, A. M., Svensson, K., Neumann, M., Hart, E. A., Harrington, S., & Phillips, R. (2015). The association between common labor drugs and suckling when skin-to-skin during the first hour after birth. *Birth, 42*(4), 319-328. https://doi.org/10.1111/birt.12186

Bullough, C. H., Msuku, R. S., & Karonde, L. (1989). Early suckling and postpartum haemorrhage: Controlled trial in deliveries by traditional birth attendants. *Lancet*, *2*(8662), 522–525. 10.1016/S0140-6736(89)90652-1

Bystrova, K., Edhborg, V. I. M., Matthiesen, A.-S., Ransjö-Arvidson, A.-B., Mukhamedrakhimov, R., Uvnäs-Moberg, K., & Widström, A.-M. (2009). Early contact versus separation: Effects on mother and infant interaction one year later. *Birth*, *36*(2), 97–109. https://doi.org/10.1111/j.1523-536X.2009.00307.x

Bystrova, K., Widström, A. M., Matthiesen, A. S., Ransjö-Arvidson, A. B., Welles-Nystrom, B., Wassberg, C., Vorontsov, I., & Uvnas-Moberg, K. (2003). Skin-to-skin contact may reduce negative consequences of “the stress of being born”: A study on temperature in newborn infants, subjected to different ward routines in St. Petersburg. *Acta Paediatrica*, *92*(3), 320–326. 10.1111/j.1651-2227.2003.tb00553.x

Centers for Disease Control and Prevention, Chiang, K. V., Li, R., Anstey, E. H., & Perrine, C. G. (2021). Racial and ethnic disparities in breastfeeding initiation-United States, 2019. *Morbidity and Mortality Weekly Report*, *70*, 769–774.

Chantry, C. J., Nommsen-Rivers, L. A., Peerson, J. M., Cohen, R. J., & Dewey, K. G. (2011). Excess weight loss in first-born breastfed newborns relates to maternal intrapartum fluid balance. *Pediatrics*, *127*(1), e171–e179. https://doi.org/10.1542/peds.2009-2663

Christensson, K., Cabrera, T., Christensson, E., Uvnas-Moberg, K., & Winberg, J. (1995). Separation distress call in the human neonate in the absence of maternal body contact. *Acta Paediatrica*, *84*(5), 468–473. 10.1111/j.1651-2227.1995.tb13676.x

Christensson, K., Siles, C., Moreno, L., Belaustequi, A., De La Fuente, P., Lagercrantz, H., Puyol, P., & Winberg, J. (1992). Temperature, metabolic adaptation and crying in healthy full term newborns cared for skin-to-skin or in a cot. *Acta Paediatrica*, *81*, 488. 10.1111/j.1651-2227.1992.tb12280.x

Colson, S. D., Meek, J. H., & Hawdon, J. M. (2008). Optimal positions for the release of primitive neonatal reflexes stimulating breastfeeding. *Early Human Development*, *84*(7), 441–449. https://doi.org/10.1016/j.earlhumdev.2007.12.003

Crenshaw, J. T., Cadwell, K., Brimdyr, K., Widström, A. M., Svensson, K., Champion, J. D., Gilder, R. E., & Winslow, E. H. (2012). Use of a video-ethnographic intervention (PRECESS Immersion Method) to improve skin-to-skin care and breastfeeding rates. *Breastfeeding Medicine, 7*(2), 69-78. https://doi.org/10.1089/bfm.2011.0040

Dahlen, H. G., Thornton, C., Downe, S., de Jonge, A., Seijmonsbergen-Schermers, A., Tracy, S., Tracy, M., Bisits, A., & Peters, L. (2021). Intrapartum interventions and outcomes for women and children following induction of labour at term in uncomplicated pregnancies: A 16-year population-based linked data study. *British Medical Journal Open*, *11*(6), e047040. https://doi.org/10.1136/bmjopen-2020-047040

De Carvalho, M., Robertson, S., Friedman, A., & Klaus, M. (1983). Effect of frequent breast-feeding on early milk production and infant weight gain. *Pediatrics*, *72*(3), 307–311. 10.1542/peds.72.3.307

Deng, X., & McLaren, M. (2018). Using 24-hour weight as reference for weight loss calculation reduces supplementation and promotes exclusive breastfeeding in infants born by Cesarean section. *Breastfeeding Medicine*, *13*(2), 128–134. https://doi.org/10.1089/bfm.2017.0124

Dumas, L., Lepage, M., Bystrova, K., Matthiesen, A. S., Welles-Nystrom, B., & Widström, A. M. (2013). Influence of skin-to-skin contact and rooming-in on early mother–infant interaction: A randomized controlled trial. *Clinical Nursing Research, 22*(3), 310-336. https://doi.org/10.1177/1054773812468316

Espada-Trespalacios, X., Ojeda, F., Nebot Rodrigo, N., Rodriguez-Biosca, A., Rodriguez Coll, P., Martin-Arribas, A., & Escuriet, R. (2021). Induction of labour as compared with spontaneous labour in low-risk women: A multicenter study in Catalonia [Article]. *Sexual & Reproductive Healthcare*, *29*. https://doi.org/10.1016/j.srhc.2021.100648

Evans, K. C., Evans, R. G., Royal, R., Esterman, A. J., & James, S. L. (2003). Effect of Caesarean section on breast milk transfer to the normal term newborn over the first week of life. *Archives of Disease in Childhood: Fetal and Neonatal Edition*, *88*(5), F380–F382. 10.1136/fn.88.5.F380

Frymann, V. M. (1966). Relation of disturbances of craniosacral mechanism to symptomatology of the newborn: Study of 1250 infants. *Journal of the American Osteopathic Association*, *65*, 1059–1075. http://www.jaoa.org

Gazzolo, D., Di Iorio, R., Marinoni, E., Masetti, P., Serra, G., Giovannini, L., & Michetti, F. (2002). S100B protein is increased in asphyxiated term infants developing intraventricular hemorrhage. *Critical Care Medicine*, *30*(0090-3493 (Print)), 1356–1360.

Genna, C. W., & Sandora, L. (2016). Normal sucking and swallowing. In C. W. Genna (Ed.), *Supporting sucking skills in breastfeeding infants*. 3rd edition, p 1–48 Jones & Bartlett Publishers.

Goland, R. S., Wardlaw, S. L., Stark, R. I., & Frantz, A. G. (1981). Human plasma beta-endorphin during pregnancy, labor, and delivery. *Journal of Clinical Endocrinology & Metabolism*, *52*(1), 74–78. 10.1210/jcem-52-1-74

Govoni, L., Ricchi, A., Molinazzi, M. T., Galli, M. C., Putignano, A., Artioli, G., Foa, C., Palmieri, E., & Neri, I. (2019). Breastfeeding pathologies: Analysis of prevalence, risk and protective factors. *Acta Biomedica*, *90*(4-s), 56–62. https://doi.org/10.23750/abm.v90i4-S.8240

Gray, L., Miller, L. W., Philipp, B. L., & Blass, E. M. (2002). Breastfeeding is analgesic in healthy newborns. *Pediatrics*, *109*(4), 590–593. /10.1542/peds.109.4.590

Gray, L., Watt, L., & Blass, E. M. (2000). Skin-to-skin contact is analgesic in healthy newborns. *Pediatrics*, *105*(1), e14. 10.1542/peds.105.1.e14

Grummer-Strawn, L. M. (2018). Clarifying the definition of breast-milk substitutes. *Journal of Pediatric Gastroenterology and Nutrition*, *67*(6), 683. https://doi.org/10.1097/MPG.0000000000002137

Gurney, L., Al Wattar, B. H., Sher, A., Echevarria, C., & Simpson, H. (2021). Comparison of perinatal outcomes for all modes of second stage delivery in obstetric theatres: A retrospective observational study. *BJOG: An International Journal of Obstetrics & Gynaecology*, *128*(7), 1248–1255. https://doi.org/https://doi.org/10.1111/1471-0528.16589

Hall, R. T., Mercer, A. M., Teasley, S. L., McPherson, D. M., Simon, S. D., Santos, S. R., Meyers, B. M., & Hipsh, N. E. (2002). A breast-feeding assessment score to evaluate the risk for cessation of breast-feeding by 7 to 10 days of age. *Journal of Pediatrics*, *141*(5), 659–664. 10.1067/mpd.2002.129081

Harrison, D., Reszel, J., Bueno, M., Sampson, M., Shah, V. S., Taddio, A., Larocque, C., & Turner, L. (2016). Breastfeeding for procedural pain in infants beyond the neonatal period.

Cochrane Database Systematic Review, *10*, CD011248. https://doi.org/10.1002/14651858.CD011248.pub2

Herzhaft-Le Roy, J., Xhignesse, M., & Gaboury, I. (2017). Efficacy of an osteopathic treatment coupled with lactation consultations for infants' biomechanical sucking difficulties: A randomized controlled trial. *Journal of Human Lactation*, *33*(1), 165–172. 10.1177/0890334416679620 http://ezproxy.libraries.wright.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=edswsc&AN=000394897700015&site=eds-live

Hobbs, A. J., Mannion, C. A., McDonald, S. W., Brockway, M., & Tough, S. C. (2016). The impact of Caesarean section on breastfeeding initiation, duration and difficulties in the first four months postpartum. *BMC Pregnancy Childbirth*, *16*, 90. https://doi.org/10.1186/s12884-016-0876-1

Hofer, M. A. (2006). Psychobiological roots of early attachment. *Current Directions in Psychological Science*, *15*(2), 84–88. https://doi.org/10.1111/j.0963-7214.2006.00412.x

Holmes, A. V., McLeod, A. Y., & Bunik, M. (2013). ABM clinical protocol #5: Peripartum breastfeeding management for the healthy mother and infant at term, revision 2013. *Breastfeeding Medicine*, *8*(6), 469–473. https://doi.org/10.1089/bfm.2013.9979

Howard, C. R., Howard, F. M., Lanphear, B., Eberly, S., deBlieck, E. A., Oakes, D., & Lawrence, R. A. (2003). Randomized clinical trial of pacifier use and bottle-feeding or cupfeeding and their effect on breastfeeding. *Pediatrics*, *111*(3), 511–518. 10.1542/peds.111.3.511

International Federation of Gynecology and Obstetrics, International Confederation of Midwives, W. R. A., International Pediatric Association, & World Health Organization. (2015). Mother–baby friendly birthing facilities. *International Journal of Gynaecology and Obstetrics*, *128*(1879-3479 (Electronic)), 95–99. https://doi.org/10.1016/j.ijgo.2014.10.013

Jia, L., Cao, H., Guo, Y., Shen, Y., Zhang, X., Feng, Z., Liu, J., Xie, Z., & Xu, Z. (2021). Evaluation of epidural analgesia use during labor and infection in full-term neonates delivered vaginally. *JAMA Network Open*, *4*(9), e2123757. https://doi.org/10.1001/jamanetworkopen.2021.23757

Jonas, W., Johansson, L. M., Nissen, E., Ejdeback, M., Ransjö-Arvidson, A. B., & Uvnas-Moberg, K. (2009). Effects of intrapartum oxytocin administration and epidural analgesia on the concentration of plasma oxytocin and prolactin, in response to suckling during the second day postpartum. *Breastfeeding Medicine*, *4*(2), 71–82. https://doi.org/10.1089/bfm.2008.0002

Jonas, W., Nissen, E., Ransjö-Arvidson, A. B., Matthiesen, A. S., & Uvnas-Moberg, K. (2008). Influence of oxytocin or epidural analgesia on personality profile in breastfeeding women: A comparative study. *Archives of Womens Mental Health*, *11*(5-6), 335–345. https://doi.org/10.1007/s00737-008-0027-4

Jonas, W., Wiklund, I., Nissen, E., Ransjö-Arvidson, A. B., & Uvnas-Moberg, K. (2007). Newborn skin temperature two days postpartum during breastfeeding related to different labour ward practices. *Early Human Development*, *83*(1), 55–62. https://doi.org/10.1016/j.earlhumdev.2006.05.001

Jordan, S., Emery, S., Bradshaw, C., Watkins, A., & Friswell, W. (2005). The impact of intrapartum analgesia on infant feeding. *BJOG*, *112*(7), 927–934. 10.1111/j.1471-0528.2005.00548.x

Kelleher, J., Bhat, R., Salas, A. A., Addis, D., Mills, E. C., Mallick, H., Tripathi, A., Pruitt, E. P., Roane, C., McNair, T., Owen, J., Ambalavanan, N., & Carlo, W. A. (2013). Oronasopharyngeal suction versus wiping of the mouth and nose at birth: A randomised equivalency trial. *The Lancet, 382*(9889), 326–330. https://doi.org/10.1016/S0140-6736(13)60775-8

Kent, J. C., Mitoulas, L. R., Cregan, M. D., Ramsay, D. T., Doherty, D. A., & Hartmann, P. E. (2006). Volume and frequency of breastfeedings and fat content of breast milk throughout the day. *Pediatrics*, *117*(3), e387–e395. https://doi.org/10.1542/peds.2005-1417

Kramer, M. S., Demissie, K., Yang, H., Platt, R. W., Sauve, R., & Liston, R. (2000). The contribution of mild and moderate preterm birth to infant mortality. Fetal and Infant Health Study Group of the Canadian Perinatal Surveillance System. *Journal of the American Medical Association*, *284*(7), 843–849. 10.1001/jama.284.7.843

Kujawa-Myles, S., Noel-Weiss, J., Dunn, S., Peterson, W., & Cotterman, K. (2015). Maternal intravenous fluids and postpartum breast changes: A pilot observational study. *International Breastfeeding Journal*, *10*(1), 18. https://doi.org/10.1186/s13006-015-0043-8 http://www.internationalbreastfeedingjournal.com/content/10/1/18

Kumpulainen, V., Lehtola, S. J., Tuulari, J. J., Silver, E., Copeland, A., Korja, R., Karlsson, H., Karlsson, L., Merisaari, H., Parkkola, R., Saunavaara, J., Lähdesmäki, T., & Scheinin, N. M. (2020). Prevalence and risk factors of incidental findings in brain MRIs of healthy neonates—The FinnBrain Birth Cohort Study. *Frontiers in Neurology*, *10*(1664-2295 (Print)). https://doi.org/10.3389/fneur.2019.01347

La Leche League International; Wiessinger, D., West, D., Smith, L. J., & Pittman, T. (Eds.). (2014). *Sweet sleep: Nighttime and naptime strategies for the breastfeeding family*. Random House–Ballantine Books.

Lee, Y.-T., Cho, S. K., Yoon, K., Shin, H. K., Kim, E., Kim, Y.-B., Kim, W.-S., Chun, J. M., & Han, B. H. (2011). Risk factors for intrauterine constraint are associated with ultrasonographically detected severe fibrosis in early congenital muscular torticollis. *Journal of Pediatric Surgery*, *46*(3), 514–519. https://doi.org/10.1016/j.jpedsurg.2010.08.003

Lieberman, E., Lang, J., Richardson, D. K., Frigoletto, F. D., Heffner, L. J., & Cohen, A. (2000). Intrapartum maternal fever and neonatal outcome. *Pediatrics*, *105*(1 Pt 1), 8–13. 10.1542/peds.105.1.8

Lieberman, E., & O'Donoghue, C. (2002). Unintended effects of epidural analgesia during labor: A systematic review. *American Journal of Obstetrics & Gynecology*, *186*(5 Suppl Nature), S31–S68. 10.1016/S0002-9378(02)70181-6

Lind, J. N., Perrine, C. G., & Li, R. (2014). Relationship between use of labor pain medications and delayed onset of lactation. *Journal of Human Lactation*, *30*(2), 167–173. https://doi.org/10.1177/0890334413520189

Loftus, J. R., Hill, H., & Cohen, S. E. (1995). Placental transfer and neonatal effects of epidural sufentanil and fentanyl administered with bupivacaine during labor. *Anesthesiology*, *83*(2), 300–308. 10.1097/00000542-199508000-00010

Manganaro, R., Mami, C., Palmara, A., Paolata, A., & Gemelli, M. (2001). Incidence of meconium aspiration syndrome in term meconium-stained babies managed at birth with selective tracheal intubation. *Journal of Perinatal Medicine*, *29*(6), 465–468. https://doi.org/10.1515/JPM.2001.065

Meaney, M. J., O'Donnell, D., Rowe, W., Tannenbaum, B., Steverman, A., Walker, M., Nair, N. P., & Lupien, S. (1995). Individual differences in hypothalamic-pituitary-adrenal activity in later life and hippocampal aging. *Experimental Gerontology*, *30*(3-4), 229–251. 0.1016/0531-5565(94)00065-B

Meier, P. P., Engstrom, J. L., Hurst, N. M., Ackerman, B., Allen, M., Motykowski, J. E., Zuleger, J. L., & Jegier, B. J. (2008). A comparison of the efficiency, efficacy, comfort, and convenience of two hospital-grade electric breast pumps for mothers of very low birthweight infants. *Breastfeeding Medicine*, *3*(3), 141–150. https://doi.org/10.1089/bfm.2007.0021

Mobbs, E. J., Mobbs, G. A., & Mobbs, A. E. (2016). Imprinting, latchment and displacement: A mini review of early instinctual behaviour in newborn infants influencing breastfeeding success. *Acta Paediatrica*, *105*(1), 24–30. https://doi.org/10.1111/apa.13034

Mollberg, M., Hagberg, H., Bager, B., Lilja, H., & Ladfors, L. (2005). Risk factors for obstetric brachial plexus palsy among neonates delivered by vacuum extraction. *Obstetrics & Gynecology*, *106*(5 Pt 1), 913–918. 10.1097/01.AOG.0000183595.32077.83

Montagu, A. (1986). *Touching: The human significance of the skin* (3rd ed.). Harper & Row.

Morton, J., Hall, J. Y., Wong, R. J., Thairu, L., Benitz, W. E., & Rhine, W. D. (2009). Combining hand techniques with electric pumping increases milk production in mothers of preterm infants. *Journal of Perinatology, 29*(11), 757–764. https://doi.org/10.1038/jp.2009.87

Netter, F. (1989). *Atlas of human anatomy*. CIBA-Geigy Corporation.

Newnham, E. C., Moran, P. S., Begley, C. M., Carroll, M., & Daly, D. (2021). Comparison of labour and birth outcomes between nulliparous women who used epidural analgesia in labour and those who did not: A prospective cohort study. *Women and Birth*, *34*(5), e435–e441. https://doi.org/10.1016/j.wombi.2020.09.001

Nissen, E., Lilja, G., Matthiesen, A. S., Ransjö-Arvidsson, A. B., Uvnas-Moberg, K., & Widström, A. M. (1995). Effects of maternal pethidine on infants' developing breast feeding behaviour. *Acta Paediatrica*, *84*(2), 140–145. 10.1111/j.1651-2227.1995.tb13596.x

Noel-Weiss, J., Woodend, A., & Groll, D. (2011). Iatrogenic newborn weight loss: Knowledge translation using a study protocol for your maternity setting. *International Breastfeeding Journal*, *6*(1), 10. http://www.internationalbreastfeedingjournal.com/content/6/1/10 https://doi.org/10.1186/1746-4358-6-10

Noel-Weiss, J., Woodend, A. K., Peterson, W. E., Gibb, W., & Groll, D. L. (2011). An observational study of associations among maternal fluids during parturition, neonatal output, and breastfed newborn weight loss. *International Breastfeeding Journal*, *6*(1), 9. https://doi.org/10.1186/1746-4358-6-9

Nommsen-Rivers, L. A., Dolan, L. M., & Huang, B. (2012). Timing of stage II lactogenesis is predicted by antenatal metabolic health in a cohort of primiparas. *Breastfeeding Medicine*, *7*(1), 43–49. https://doi.org/10.1089/bfm.2011.0007

Ohyama, M., Watabe, H., & Hayasaka, Y. (2010). Manual expression and electric breast pumping in the first 48 h after delivery. *Pediatrics International*, *52*(1), 39–43. https://doi.org/10.1111/j.1442-200X.2009.02910.x

Olza, I. A.-O., Uvnas-Moberg, K., Ekström-Bergström, A. A.-O., Leahy-Warren, P., Karlsdottir, S. I., Nieuwenhuijze, M., Villarmea, S. A.-O., Hadjigeorgiou, E., Kazmierczak, M., Spyridou, A., & Buckley, S. A.-O. (2020). Birth as a neuro-psycho-social event: An integrative model of maternal experiences and their relation to neurohormonal events during childbirth. *PLoS ONE*, *15*(1932-6203 (Electronic)). https://doi.org/10.1371/journal.pone.0230992

Oommen, H., Oddbjørn Tveit, T., Eskedal, L. T., Myr, R., Swanson, D. M., & Vistad, I. (2021). The association between intrapartum opioid fentanyl and early breastfeeding: A prospective observational study. *Acta Obstetricia et Gynecologica Scandinavica*, *100*(12), 2294–2302. https://doi.org/https://doi.org/10.1111/aogs.14268

Pados, B. F. (2019). Physiology of stress and use of skin-to-skin care as a stress-reducing intervention in the NICU. *Nursing for Women's Health*, *23*(1), 59–70. https://doi.org/10.1016/j.nwh.2018.11.002

Peitsch, W. K., Keefer, C. H., LaBrie, R. A., & Mulliken, J. B. (2002). Incidence of cranial asymmetry in healthy newborns. *Pediatrics*, *110*(6), e72. 10.1542/peds.110.6.e72

Peters, L. L., Thornton, C., de Jonge, A., Khashan, A., Tracy, M., Downe, S., Feijen-de Jong, E. I., & Dahlen, H. G. (2018). The effect of medical and operative birth interventions on child health outcomes in the first 28 days and up to 5 years of age: A linked data population-based cohort study. *Birth*, *45*(4), 347–357. https://doi.org/10.1111/birt.12348

Ransjö-Arvidson, A., Matthiesen, A., Lilja, G., Nissen, E., Widström, A., & Uvnas-Moberg, K. (2001). Maternal analgesia during labor disturbs newborn behavior. *Birth*, *28*, 5–12. 10.1046/j.1523-536x.2001.00005.x

Rehm, A., Promod, P., & Ogilvy-Stuart, A. (2019). Obstetric neonatal brachial plexus and facial nerve injuries: A 17 years single tertiary maternity hospital experience. *European Journal of Obstetrics and Gynecology and Reproductive Biology*, *243*, 57–62. https://doi.org/10.1016/j.ejogrb.2019.10.017

Rehm, A., Promod, P., & Ogilvy-Stuart, A. (2020). Neonatal birth fractures: A retrospective tertiary maternity hospital review. *Journal of Obstetrics and Gynaecology: The Journal of the Institute of Obstetrics and Gynaecology*, *40*(4), 485–490. https://doi.org/10.1080/01443615.2019.1631770

Righard, L., & Alade, M. O. (1990). Effect of delivery room routines on success of first breast-feed. *Lancet*, *336*(8723), 1105–1107. 10.1016/0140-6736(90)92579-7

Righard, L., & Alade, M. O. (1992). Sucking technique and its effect on success of breastfeeding. *Birth*, *19*(4), 185–189. 10.1111/j.1523-536X.1992.tb00399.x

Riordan, J., Gill-Hopple, K., & Angeron, J. (2005). Indicators of effective breastfeeding and estimates of breast milk intake. *Journal of Human Lactation*, *21*(4), 406–412. https://doi.org/10.1177/0890334405281032

Rollins, N., Minckas, N., Jehan, F., Lodha, R., Raiten, D., Thorne, C., Van de Perre, P., Ververs, M., Walker, N., Bahl, R., & Victora, C. G. (2021). A public health approach for deciding policy on infant feeding and mother–infant contact in the context of COVID-19 [Review Article]. *The Lancet Global Health*. https://doi.org/10.1016/S2214-109X(20)30538-6

Segal, S. (2010). Labor epidural analgesia and maternal fever. *Anesthesia-Analgesia*, *111*(6), 1467–1475. https://doi.org/doi: 10.1213/ANE.0b013e3181f713d4

Seki, H. (2018). Complications with vacuum delivery from a forceps-delivery perspective: Progress toward safe vacuum delivery. *Journal of Obstetrics and Gynaecology Research*, *44*(8), 1347–1354. https://doi.org/10.1111/jog.13685

Sepkoski, C. M., Lester, B. M., Ostheimer, G. W., & Brazelton, T. B. (1992). The effects of maternal epidural anesthesia on neonatal behavior during the first month. *Developmental Medicine and Child Neurology*, *34*(12), 1072–1080. 10.1111/j.1469-8749.1992.tb11419.x

Shah, P. S., Herbozo, C., Aliwalas, L. L., & Shah, V. S. (2012). Breastfeeding or breast milk for procedural pain in neonates. *Cochrane Database Systemic Review*, *12*, CD004950. https://doi.org/10.1002/14651858.CD004950.pub3

Silva, O. L. d. O., Rea, M. F., Sarti, F. M., & Buccini, G. (2020). Cost-effectiveness analysis of Baby-Friendly Hospital Initiative in promotion of breast-feeding and reduction of late neonatal infant mortality in Brazil. *Public Health Nutrition, 24*(8), 2365–2375. https://doi.org/10.1017/S1368980020001871

Singhi, S. C., & Chookang, E. (1984). Maternal fluid overload during labour; transplacental hyponatraemia and risk of transient neonatal tachypnoea in term infants. *Archives of Disease in Childhood*, *59*(12), 1155–1158. 10.1136/adc.59.12.1155

Smith, L. J., & Kroeger, M. (2010). *Impact of birthing practices on breastfeeding* (2nd ed.). Jones & Bartlett Learning.

Stellwagen, L., Hubbard, E., Chambers, C., & Jones, K. L. (2008). Torticollis, facial asymmetry and plagiocephaly in normal newborns. *Archives of Disease in Childhood*, *93*(10), 827–831. https://doi.org/10.1136/adc.2007.124123

Stuebe, A. (2020). Should infants be separated from mothers with COVID-19? First, do no harm. *Breastfeeding Medicine: The Official Journal of the Academy of Breastfeeding Medicine*, *15*(5), 351–352. https://doi.org/10.1089/bfm.2020.29153.ams

Takahashi, Y., Uvnäs-Moberg, K., Nissen, E., Lidfors, L., Ransjö-Arvidson, A.-B., & Jonas, W. (2021). Epidural analgesia with or without oxytocin, but not oxytocin alone, administered during birth disturbs infant pre-feeding and sucking behaviors and maternal oxytocin levels in connection with a breastfeed two days later [Original Research]. *Frontiers in Neuroscience*, *15,* 592. https://doi.org/10.3389/fnins.2021.673184

Tappero, E., & Honeyfield, M. (1993). *Physical assessment of the newborn*. NICULink Book Publishers.

U.S. Department of Health and Human Services. (2011). *The surgeon general's call to action to support breastfeeding*. U.S. Department of Health and Human Services, Office of the Surgeon General. http://www.surgeongeneral.gov/topics/breastfeeding/index.html

Uvnäs-Moberg, K., Ekström-Bergström, A., Buckley, S., Massarotti, C., Pajalic, Z., Luegmair, K., Kotlowska, A., Lengler, L., Olza, I., Grylka-Baeschlin, S., Leahy-Warren, P., Hadjigeorgiu, E., Villarmea, S., & Dencker, A. (2020). Maternal plasma levels of oxytocin during breastfeeding—A systematic review. *PLoS ONE*, *15*(8), e0235806. https://doi.org/10.1371/journal.pone.0235806

Vain, N. E., Szyld, E. G., Prudent, L. M., Wiswell, T. E., Aguilar, A. M., & Vivas, N. I. (2004). Oropharyngeal and nasopharyngeal suctioning of meconium-stained neonates before delivery of their shoulders: Multicentre, randomised controlled trial. *Lancet*, *364*(9434), 597–602. 10.1016/S0140-6736(04)16852-9

Victora, C. G., Bahl, R., Barros, A. J. D., França, G. V. A., Horton, S., Krasevec, J., Murch, S., Sankar, M. J., Walker, N., & Rollins, N. C. (2016). Breastfeeding in the 21st century: Epidemiology, mechanisms, and lifelong effect. *The Lancet*, *387*(10017), 475–490. https://doi.org/10.1016/S0140-6736(15)01024-7

Vidaeff, A. C., & Ramin, S. M. (2008). Potential biochemical events associated with initiation of labor. *Current Medicinal Chemistry*, *15*(6), 614–619. 10.2174/092986708783769786

Waddington, E. L., Snider, K. T., Lockwood, M. D., & Pazdernik, V. K. (2015). Incidence of somatic dysfunction in healthy newborns. *Journal of the American Osteopathic*

Association, *115*, 1945–1997 (Electronic)). 10.7556/jaoa.2015.136

Wall, V., & Glass, R. (2006). Mandibular asymmetry and breastfeeding problems: Experience from 11 cases. *Journal of Human Lactation*, *22*(3), 328–334. https://doi.org/10.1177/0890334406290096

Ward, R. C. (2003). *Foundations for osteopathic medicine* (2nd ed.). Lippincott Williams & Wilkins.

Widström, A.-M., Brimdyr, K., Svensson, K., Cadwell, K., & Nissen, E. (2019). A plausible pathway of imprinted behaviors: Skin-to-skin actions of the newborn immediately after birth follow the order of fetal development and intrauterine training of movements. *Medical Hypotheses*, 134. https://doi.org/https://doi.org/10.1016/j.mehy.2019.109432

Widström, A.-M., Lilja, G., Aaltomaa-Michalias, P., Dahllof, A., Lintula, M., & Nissen, E. (2011). Newborn behaviour to locate the breast when skin-to-skin: A possible method for enabling early self-regulation. *Acta Paediatrica, 100*(1), 79-85. https://doi.org/10.1111/j.1651-2227.2010.01983.x

Wiklund, I., Norman, M., Uvnas-Moberg, K., Ransjö-Arvidson, A. B., & Andolf, E. (2009). Epidural analgesia: Breast-feeding success and related factors. *Midwifery*, *25*(2), e31–e38. https://doi.org/10.1016/j.midw.2007.07.005

World Health Organization. (2018a). *Implementation guidance: Protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services–the revised Baby-Friendly Hospital Initiative*. World Health Organization.

World Health Organization. (2018b). *WHO recommendations: Intrapartum care for a positive childbirth experience*. World Health Organization. http://www.who.int/reproductivehealth/publications/intrapartum-care-guidelines/en/

World Health Organization (2020). *Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected*. World Health Organization.

World Health Organization & United Nations Children's Fund. (2003). *Global strategy for infant and young child feeding* (9241562218). World Health Organization. https://www.who.int/publications/i/item/9241562218

World Health Organization & United Nations Children's Fund. (2018). *Implementation guidance: Protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services: The revised Baby-Friendly Hospital Initiative*. World Health Organization. https://apps.who.int/iris/handle/10665/272943

World Health Organization & United Nations Children's Fund. (2020). *Protecting, promoting and supporting breastfeeding: the Baby-Friendly Hospital Initiative for small, sick and preterm newborns*. World Health Organization.

World Health Organization & United Nations Children's Fund. (2021). *The role of midwives and nurses in protecting, promoting and supporting breastfeeding*. World Health Organization.

Zanardo, V., Nicolussi, S., Carlo, G., Marzari, F., Faggian, D., Favaro, F., & Plebani, M. (2001). Beta endorphin concentrations in human milk. *Journal of Pediatric Gastroenterology and Nutrition*, *33*(2), 160–164.

Zhang, F., Xia, H., Li, X., Qin, L., Gu, H., Xu, X., & Shen, M. (2016). Intraoral vacuum of breast-feeding newborns within the first 24 hr: Cesarean section versus vaginal delivery. *Biological Research for Nursing*, *18*(4), 445–453. https://doi.org/10.1177/1099800416636687