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ABSTRACT

Birth and the newborn environment are stressful, especially for preterm infants who have to contend with medical conditions while adapting to the extrauterine world. Therefore, preterm newborns are excellent candidates for comforting measures. Skin-to-skin contact is the best way to provide comfort in several of the realms of Kolcaba's Comfort Theory. Evidence suggests that skin-to-skin contact between the mother and newborn changes the discomforting newborn environment into one that is profoundly comforting. Skin-to-skin contact promotes infant physiologic stability and warmth, helps in organizing infant sleep, reduces stress and pain, and makes breast milk readily available. Comfort to the newborn can be effectively accomplished by skin-to-skin contact.

Key words: Skin-to-skin contact; Kangaroo-mother-care method; Breastfeeding; Infant care; Pain; Cardiorespiratory stability; Premature infant; Stress; Warmth.

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Skin-to-Skin Contact: A Comforting Place With Comfort Food

Rafael Ben-Ari / Alamy

The purpose of the article is to provide a scenario of pregnancy and birth to show how stressful birth can be, and to relate the empirical evidence and explanatory mechanisms showing that skin-to-skin contact (SSC) can change stress to comfort by providing physiological, psychospiritual, and environmental comfort care using Kolcaba's Comfort Theory. Skin-to-skin contact is intermittent or continuous mother-infant skin-to-skin, chest-to-chest contact beginning at birth or later.

Pregnancy and Birth Scenario

Birth is a stressful change from fetal life. In the womb, the fetus floats in a dark pool of warm, massaging fluid in which the infant is effortlessly suspended in a flexed position. Warmth maximizes weight gain and promotes the sleep necessary for brain development (Scher, 2011). The mother's heart beat is a familiar and soothing background, her voice adds new sounds and cadence, her unique scent emanates from amniotic fluid, and the fetus is rocked with each maternal breath—these stimuli assist the fetus in recognizing mother. Self-consoling finger-sucking is easy. Needed nutrients are readily and continuously provided. Day–night light cycling supports fetal sleep. The nest of the womb fosters a sense of security. In all these ways, intrauterine life is usually good and the fetus is comfortable. Fetal comfort is signaled by lack of meconium staining, grimacing, agitation, and presence of relaxed tone, and easy movements; all of which have been seen on ultrasound and are criteria for "comfort" using the COMFORT Behavior Scale and Scoring Form (van Dijk, Peters, van Deventer, & Tibboel, 2005). Then birth happens, and birth is stressful. The sympathetic nervous system, the fight or flight stress-responding autonomic nervous system, is highly activated to deal with the stressors of birth (Ross & Young, 2009). The newborn is "biologically expecting to hear the mother's familiar voice and heartbeat, smell her scent, taste breast milk, and have warmth from her body" (Bergman & Bergman, 2013, p. 9). When expectations are not met, appropriate, adaptable, and comfort-fulfilling physiologic, behavioral, and developmental accomplishments are threatened.

Kolcaba's Comfort Theory

Comfort is the state of being relaxed, free of stress, and physiologically, emotionally, and socially content (Kolcaba & DiMarco, 2005). Kolcaba's Comfort Theory proposes that nurses should intervene in ways that reduce and/or eliminate patient stress and pain and foster comfort. Necessary adjustments required to adapt to extrauterine life and to being separated from mother are discomforting (Bergman & Bergman, 2013). The process of separation has been described as toxic (Shonkoff & Garner, 2012). After birth, skin-to-skin contact provides a means for infants and mothers to stay in contact with one another. The mother's body is the source for meeting the basic biologic needs of the newborn and provides "the buffering protection of adult support" to minimize stress and promote optimal adaptation to and development in extrauterine life (Shonkoff, Garner, Committee on Psychosocial Aspects of Child and Family Health, Committee on Early Childhood, Adoption, and Dependent Care, & Section on Developmental and Behavioral Pediatrics, p. e235, 2012). Optimal adaptation can occur when physiologic (e.g., stability, warmth, sleep), psychospiritual (e.g., removal of pain and stress), and environmental (breast milk) comforts have been maximized.

Skin-to-Skin Contact Effects and Mechanisms on Comfort

A review of the empirical evidence addressing the effects and mechanisms of SSC related to the physiologic, psychospiritual, and environmental realms of infant comfort is presented.

Physiologic Realm (e.g., Stability, Warmth, Sleep)

Physiologic Stability. Comfort in the physiologic realm means homeostasis, a relatively stable equilibrium between physiologic processes (Kolcaba, Tilton, & Drouin, 2006).

Table 1. Physiologic Stability Effects In Preterm and Term Infants With Primary Citations*

Stability in Variable:	Preterm Infant Citations
Heart rate	Azevedo, Xavier, & Gontijo Fde (2012); Heimann et al. (2010); Maastrup & Greisen (2010); Mitchell, Yates, William & Hall, (2013); Mori, Khanna, Pledge, & Nakayama (2010); Nimbalkar et al. (2014)
Respiratory rate	Heimann et al. (2010); Maastrup & Greisen (2010)
Oxygen saturation	Azevedo et al. (2012); Heimann et al. (2010); Maastrup & Greisen (2010); Mitchell, Yates, William & Hall, (2013); Mori et al. (2010)
Fractured inspired oxygen concentration	Maastrup & Greisen (2010); Tornhage, Stuge, Lindberg, & Serenius (1999)
Mean arterial blood pressure	Azevedo et al. (2012); Park et al. (2014)
Temperature	Chitty & Wyllie (2013); Heimann et al. (2013, 2010); Maastrup & Greisen (2010); Marin-Gabríel et al. (2013); Mori et al. (2010); Nimbalkar et al. (2014)
Autonomic nervous system	Cong et al. (2012)

*Lists are not all inclusive as many citations from 1972 through 2005 have been omitted due to a limit on references.


Phanie / Alamy

Skin-to-skin contact brings down the hind milk so preterm infants consume the most nutrient-rich milk first during a breastfeeding.

For homeostasis, each component of the physiologic system has to be within clinically acceptable range for each specific person so that compensation responses do not begin. Placement in SSC has physiologic stabilizing effects. A randomized controlled trial of SSC versus incubator care for the first 6 hours of life in low birthweight infants found that all 18 SSC subjects were stable in the sixth hour, whereas only 6 of the 13 incubator infants were stable (Bergman, Linley, & Fawcus, 2004). The authors concluded:

> *"Newborn care provided by SSC on the mother's chest results in better physiological outcomes and stability than the same care provided in closed servo-controlled incubators.*
> *…Newborns should not be separated from their mothers." (Bergman et al., 2004, p. 779).*

Studies of SSC after the first 6 hours of life have shown physiologic stability in preterm and term infants (Table 1). Cardiorespiratory and temperature stability have also been seen in extremely low birthweight infants (Karlsson, Heinemann, Sjörs, Nykvist, & Agren, 2012), in very low birthweight infants on continuous positive airway pressure and/or mechanical ventilation (Carbasse et al., 2013), and in infants with congenital heart defects (Gazzolo, Masetti, & Meli, 2000; Harrison & Ludington-Hoe, in press). A Cochrane meta-analysis has confirmed better cardiorespiratory stability in late preterm infants during SSC (Moore, Anderson, Bergman, & Dowswell, 2012).

Mechanisms of SSC on Physiologic Stability. Physiologic stability can be explained by SSC-induced oxytocin effects on autonomic nervous system control of the brain stem. In SSC's absence, the autonomic nervous system of the newborn is under sympathetic control (Bystrova, 2009). Sympathetic control is the fight/flight/stress system that accelerates heart and breathing rates, elevates blood pressures, and causes wide variation in these values over time. Sympathetic control is altered by the onset of SSC. Skin-to-skin contact stimulates the recently discovered c-afferent nerves on the chests of the infant and mother (Olausson, Wessberg, Morrison, McGlone, & Vallbo, 2010). In newborns, the c-afferent nerves are sensitive to only one type of touch: pleasing human touch that is constant, not phasic (as in massage or patting). The pleasing touch message goes to the central part of the limbic area of the brain, the part called the insular cortex (Olausson et al.). Then brain-based oxytocin (Olausson et al.) is released and travels to the brain stem and other areas of the brain (Uvnäs-Moberg, Arn, & Magnusson, 2005).

In the brain stem, oxytocin decreases sympathetic activity, minimizing activity of the hypothalamic-pituitary-adrenocortical axis and the sympatho-adreno-medullary systems (Bystrova, 2009), hormonal systems that sustain stress reactivity in the body. Oxytocin simultaneously activates vagal parasympathetic nervous system control. Parasympathetic control is a calm, connected system of brain-stem operation characterized by muscle relaxation, decreased cortisol, and decreased cardiovascular activity, which results in lower heart rate (HR), lower blood pressure (BP), and sustained HR and BP decreases at low, healthy levels, enhanced gastrointestinal activity that promotes digestion and anabolism, vital sign stability, enhanced healing, and improved nutrient storage (Bystrova 2009). Reduced arousal and calm prevail under parasympathetic control. Thus, SSC immediately initiates a sense of relaxation and well-being, contributing to comfort.

Warmth. In a randomized controlled trial of SSC versus incubator care for the first 6 hours of life in low birthweight premature infants, Bergman et al. (2004) found that 8 out of 13 incubator subjects experienced hypothermia, but none of the SSC newborns did. Infants, even extremely low birthweight infants, start warming up right away (Karlsson et al., 2012), showing temperature stability during SSC (Karlsson et al.). Warming and temperature stability have also been seen in term infants in SSC at birth (Bystrova et al., 2007).

Mechanisms of SSC on Warmth. The mother's chest is a warm environment because the skin temperature of her breasts and chest increase as soon as an infant is placed in SSC (Bystrova et al., 2007). Warmth is created by vasodilation of blood vessels in the chest and breast, and that warmth is conducted to the infant (Bystrova et al., 2007). Warmth also increases activation and sensitivity of the c-afferent nerves (Ackerley et al., 2014), so their stabilizing effects are further enhanced. Maternal breasts are also capable of thermoregulating the temperatures of 2 to 3 preterms on the chest at a time (Ludington-Hoe, Lewis, et al., 2006). Thermoregulation means that the mother's breasts increase heat conduction to a cool infant and withdraw heat conduction from an infant who is too warm (≥37.5 °C) (Bystrova et al. 2007), so infant temperature is maintained within each infant's neutral thermal zone (Heimann et al., 2010; Heimann et al., 2013). Clearly, SSC provides warmth and thermal stability in infants ≥ 26 weeks gestation/postmenstrual age. Provision of warmth is one dimension of comfort care (Wagner, Byrne, & Kolcaba, 2006).

Sleep. Sleep provides respite from any stressful and/or discomforting situation (Scher, 2011), so sleep can be considered a physiologic aspect of comfort (Kolcaba & DiMarco, 2005). Sleep is also necessary for brain growth and development, especially during the first 3 critical years of life (Scher, 2011). Sleep in SSC is profoundly different from sleep in an incubator or cot. Sleep in SSC is well organized, meaning Quiet Sleep is longer and less disturbed than sleep out of SSC. In any 3 hours of SSC, the preterm will complete three sleep cycles (Ludington-Hoe, Johnson, et al., 2006). In an incubator/cot, only one sleep cycle is completed and it is of poor quality (Ludington-Hoe, Johnson, et al., 2006). The predominance of poor quality incubator sleep leads preterm infants to have abnormal sleep patterns for the first 2 years of life (Scher, 2011). When SSC was given for 1.5 hours/day for 4 days/week from 32 to 40 weeks postmenstrual age in preterm infants, brain maturation and complexity were significantly more advanced than in control preterm infants (Scher et al., 2009). Term infants tested during 1 hour of cot sleep (separated from mother) had higher sympathetic control, a sign of brain-based anxious autonomic arousal, than when in SSC. Cot sleeping greatly decreased Quiet Sleep duration (Morgan, Horn, & Bergman, 2011); decreased Quiet Sleep duration is associated with delayed brain maturation (Scher, 2011). Preterm infants who received SSC in the newborn period still had better sleep at 10 years (Feldman, Rosenthal, & Eidelman, 2014). The good sleep of SSC may have affected the improved mental and motor development in SSC low birthweight infants as compared to control infants up to 1 (Bera et al., 2014) and 16 years of age (Schneider, Charpak, Ruiz-Peláez, & Tessier, 2012). Skin-to-skin contact sleep may raise concern of infant smothering, but good positioning and vigilant observation can reduce this risk (Ludington-Hoe & Morgan, 2014).

Psychospiritual Realm (Pain and Stress Reduction)

The psychospiritual realm encompasses psychological processes and spiritual beliefs and values. The psychological processes in infants influenced by SSC are pain and stress.

Pain Reduction. A basic tenet of comfort theory is relief from pain (Kolcaba et al., 2006). In newborn preterm infants, absence of pain is rare due to numerous invasive procedures and limited application of interventions to reduce or eliminate pain (Stevens et al., 2011). Skin-to-skin contact in full-term and preterm infants effectively reduces pain. Pain reduction from single heel lance (Cong et al., 2012), intramuscular injection (Vivancos, Leite, Scochi, & Dos Santos, 2010), and vaccination (Kostandy, Anderson, & Good, 2013) occurs with SSC. Skin-to-skin contact certainly works better in reducing pain than no intervention whatsoever (Chidambaram, Manjula, Adhisivam, & Bhat, 2014). When SSC has been combined with breastfeeding or oral dextrose to relieve pain, the combination is very effective (Marin-Gabriel et al., 2013), and SSC alone works better than dextrose alone (Freire, Garcia, & Lamy, 2008). The combination of breastfeeding + SSC is usually the most effective pain reducer, but SSC alone is as effective as breastfeeding alone (Gray, Miller, Philipp, & Blass, 2002) or expressed breast milk (Nanavati, Balan, & Kabra, 2013). Skin-to-skin contact also reduces nipple pain (Burkhammer, Anderson, & Chiu, 2004). Skin-to-skin contact alone is better than swaddling and facilitative tucking (Meek & Huertas, 2012) and better than adding singing, rocking, and suckling to it (Johnston, et al., 2009). When maternal SSC was compared to nurse SSC, no differences in pain scores at 30, 60, 90, and 120 seconds postlance were found, suggesting that a nurse, too, can give SSC to reduce pain (Johnston et al., 2012). Fathers are not as effective as mothers for the first 60 seconds following heel stick; but at 90 and 120 seconds postheel stick, fathers reduced infant pain as well as mothers (Johnston, Campbell-Yeo, & Filion, 2011). No matter what physiologic measure of pain, nor what pain assessment tool is used, SSC reduces pain. A recent Cochrane analysis of 19 studies with 1,594 infants confirms that SSC is effective and safe for pain reduction in single painful procedures (Johnston et al., 2014). Guidelines to ergonomically conduct painful procedures during SSC are available (Cong, Ludington-Hoe, Vazquez, Zhang, & Zafetti, 2013).

Mechanisms of SSC on Pain. Pain reduction effects of SSC are due to sensory saturation, the analgesic functions of central oxytocin itself, central oxytocin's ability to increase beta-endorphin levels, and c-afferent nerve

As soon as skin-to-skin contact begins, the newborn's brain changes due to oxytocin release in the brain.

activation. C-afferent nerve stimulation normally produces analgesic effects (Liljencrantz & Olausson, 2014).

Stress Reduction. Being comfortable also means being stress free and contented. Because the stress of birth is high (Bystrova et al., 2003), comfort measures should begin at birth. A randomized controlled trial of SSC compared with no SSC in the first 2 to 3 hours postbirth showed that the first 2 to 3 hours are a sensitive period for manifestation and control of stress. Skin-to-skin contact diminished infant stress in the first 2 to 3 hours; infants who did not receive SSC continued to have high stress levels throughout the same period. Stress reduction at birth promoted the SSC infants' abilities to better handle stress 1 year postbirth (Bystrova et al., 2009). Skin-to-skin contact for an hour a day from 32 weeks until discharge reduced stress reactivity at 3 months (Feldman, Weller, Sirota, & Eidelman, 2002) and at 10 years (Feldman et al., 2014). Within 20 minutes of the onset of SSC, preterm infant cortisol decreased by 70% (Gitau et al., 2002) and the infant's cortisol level became similar to the lower maternal cortisol level (Neu, Laudenslager, & Robinson, 2009). In another study, 79 preterm infants were held for 1 hour either in SSC or in swaddled holding after discharge to home. Infants in SSC had salivary cortisol levels the same as their mothers' at 30 and 60 minutes of SSC; the swaddled group's cortisol was higher than the mothers' (Neu, Hazel, Robinson, Schmiege, & Laudenslager, 2014).

Many caregiving activities are stressful for infants and SSC can help alleviate or minimize responses to these stressors. For example, diaper change is stressful to infants, especially preterm infants (Lyngstad, Tandberg, Storm, Ekeberg, & Moen, 2014). A randomized trial of 19 preterm infants who had the diaper changed while in SSC one day and while on the bed with the mother or in an incubator another showed much lower stress levels during the SSC diaper change (Lyngstad et al. 2014). Being moved into and out of SSC can be a stressor too, but preterm infants adapt to the move within 3 to 5 minutes and SSC produces tranquility (Collados-Gómez, Aragonés-Corral, Contreras-Olivares, García-Feced, & Vila-Piqueras, 2011). Sleeping alone is another stressor. For example, term newborns had a 300% increase in stress markers when sleeping in a cot beside their mothers as compared to sleeping in SSC with their mothers (Morgan et al., 2011). Similar to cot sleeping, being in an incubator is stressful for premature infants as cortisol can be 1,500 nmol/L in an incubator and only 150 nmol/L when in SSC (Modi & Glover, 1998). Newborn stress is related to elevated hypothalamic-pituitary-adrenal axis functioning years later (Shonkoff & Garner, 2012).

Mechanisms of SSC on Stress. Skin-to-skin contact quickly reduces stress because stress reduction begins when the c-afferent nerves on the chest are activated by the continuous, warm, pleasant human touch of SSC. The c-afferent nerves have an anxiolytic effect by stimulation of the hypothalamus and pituitary organs in the brain (Liljencrantz & Olausson, 2014), by release of central (brain-based) oxytocin that has anxiolytic effects (Uvnäs-Moberg et al., 2005), by release of oxytocin that elevates endorphins that in turn counter the effects of stress and cortisol (Henderson, 2011), and by the shift of the autonomic nervous system from sympathetic to parasympathetic dominance (Bystrova, 2009).

Environmental Realm (Breast Milk)

Comfort can be achieved when the environment provides the patient's needs. For newborns, a major need is nutrition. Access to breast milk is generic to meeting infants' nutritional needs. Increased initiation, duration, and exclusivity of breastfeeding is related to SSC. Bramson et al. (2010) found that the sooner after birth SSC is initiated and the longer the first SSC experience continues, the more likely the mother is to continue providing breast milk and the more likely she'll exclusively breast milk feed her infant. A randomized controlled trial showed that mothers who started SSC immediately after birth and continued during hospitalization had a much higher breastfeeding initiation rate and much higher breastfeeding self-efficacy scores than mothers who did not practice SSC after birth (Aghdas, Talat, & Sepideh, 2014). A population-based study of vaginally born healthy term infants in Australia revealed that women who had more than 30 minutes of SSC at birth had higher rates of breastfeeding initiation and breastfeeding at discharge than women with shorter durations of SSC (Redshaw, Hennegan, & Kruske, 2014). Interestingly, women who had cesarean births and early plus long durations of initial SSC did not have better rates of initiation and breastfeeding at discharge (Redshaw et al. 2014), suggesting that operative medications or endogenous operative-induced stress may have a strong negative impact on secretion of central oxytocin after c-afferent nerve stimulation. Women who give birth by cesarean commonly have more breastfeeding difficulties than women giving birth vaginally (Anderson, Chiu, Morrison, Burkhammer, & Ludington-Hoe, 2004) and may need even more SSC to compensate.

Skin-to-skin contact, when simultaneous with breastfeeding, shortens the time required to resolve severe latch-on problems in infants who started to latch (Svensson, Velandia, Matthiesen, Welles-Nyström, & Widström, 2013). A suggested mechanism for SSC's positive effects on latching was "…that skin to skin contact with the mother during breastfeeding may calm infants with earlier strong reaction to 'hands on latch interventions' and relieve the stress which may have blocked the infant's

Clinical Implications

Skin-to-skin contact should begin as soon as possible after birth and continue for as long as possible, and as uninterrupted as possible throughout the newborn period.
Nurses should increase the number and duration of SSC episodes to reduce infant stress and enhance physiologic stability in newborns. Providing guidance to the parents during early SSC sessions may increase SSC frequency.
Recognize that normative values for heart and respiratory rates and blood pressure may be altered during SSC due to central oxytocin effects on autonomic nervous system control. When vital signs exceed common limits, ascertain how the infant is doing and document infant values to justify continuing or ceasing SSC.
Educate parents about SSC's pain reduction abilities and how to tell comfort from discomfort during SSC, and encourage them to routinely provide SSC during common procedures. Parents should be a sustaining presence, especially in the early a.m. when blood draws are common. Parents want to help their infants be less stressed and pain free, and need to be there to make comfort possible.
Encourage mothers to provide SSC during endotracheal suctioning, painful examinations, and to prevent stress-related problems like seizures and infections.
Nurses can model SSC for pain reduction even when parents are not available because nurse SSC also helps reduce pain.
Sleep in SSC should continue for at least 1 full hour to complete one sleep cycle. The longer the SSC, the better the sleep.
SSC is essential for initiation and continuation of exclusive breastfeeding, so continue SSC as much as possible and after discharge.

inborn biological program to find the breast and latch on" (Svensson et al., p. 1). An infant needs to have a sufficient supply of breast milk, and as little as 20 minutes of SSC prior to any feeding increases milk production, according to a Cochrane meta-analysis (Conde-Agudelo, Belizán, & Diaz-Rossello, 2011). Skin-to-skin contact for 20 minutes before anticipated feedings brings the nutrient-rich hind milk forward so it is consumed first (Johnson, 2007). Premature infants need the hind milk first so they get maximum calories in any feeding (Charpak & Ruiz, 2007). The recommended first strategy to promote breast milk feedings in United States maternity and newborn care centers is SSC (Centers for Disease Control and Prevention, 2011). Breast milk is nature's choice for each newborn; thus, breast milk is the newborn's comfort food. Skin-to-skin contact with the mother is the key to providing natural nutritional comfort to the newborn infant.

Conclusion

In conclusion, the birth process is stressful, SSC is useful in reducing stress, and SSC is a comfort measure for most newborns and infants because it helps stabilize physiology, promotes warmth and organized sleep, reduces pain and stress, and provides access to breast milk. Nurses in the NICU know of SSC's benefits, but still do not routinely have parents provide SSC even though parents are eager to give SSC more often and for longer durations (Blomqvist et al. 2013). Once informed of the evidence-based benefits of SSC as discussed here, NICU staff nurses should conduct quality improvement projects to increase SSC practice. Nurses in all infant settings should also encourage breastfeeding during SSC to provide the best nutrition and comfort as well as to accelerate incorporation of the Baby Friendly tenets in all maternal–newborn care units. ✣

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The author declares no conflict of interest.

DOI:10.1097/NMC.0000000000000178

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