The effect of early skin-to-skin contact after caesarean section on breastfeeding duration and development of atopic-allergic diseases

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ABSTRACT

Caesarean section delivery rates have increased substantially worldwide over the last few decades, creating major implications for maternal and neonatal health outcomes. Mothers undergoing caesarean delivery frequently experience postoperative pain, delayed mobility, emotional stress, and delayed maternal-infant interaction, which may negatively influence breastfeeding initiation and continuation. Early skin-to-skin contact (SSC), defined as immediate or early placement of the naked newborn on the mother's bare chest after birth, has emerged as a significant intervention for improving maternal and neonatal outcomes following cesarean section. Early SSC promotes physiological stability, enhances maternal bonding, supports successful breastfeeding, and may contribute to long-term immune benefits in infants.

Breastfeeding is universally recognized as the optimal source of nutrition for infants and plays an important role in reducing infectious diseases, enhancing neurodevelopment, and strengthening immune protection. Studies by Moore et al. (2016), Victora et al. (2016), and Widström et al. (2019) demonstrated that SSC significantly improves breastfeeding initiation and duration after cesarean delivery. Furthermore, prolonged breastfeeding has been associated with reduced risk of atopic-allergic diseases such as eczema, asthma, allergic rhinitis, and food allergies (Lodge et al., 2015; Oddy et al., 2018).

Early SSC also influences neonatal immune development by promoting colonization with beneficial maternal microbiota and reducing neonatal stress responses. Research by Horta et al. (2017) and Bäckhed et al. (2015) indicated that breastfeeding combined with SSC may positively modulate infant gut microbiota, thereby reducing inflammatory and allergic responses later in life. Psychological benefits including maternal confidence, reduced anxiety, improved attachment, and enhanced parenting behaviours have also been consistently reported (Bigelow et al., 2012; Crenshaw et al., 2019).

The objective of this review article is to analyse available evidence regarding the effects of early SSC after cesarean section on breastfeeding duration and prevention of atopic-allergic diseases in infants. The review also explores physiological mechanisms, nursing interventions, maternal outcomes, neonatal immune development, and healthcare recommendations.

The literature consistently demonstrates that early SSC is a safe, cost-effective, evidence-based intervention that improves breastfeeding outcomes, strengthens maternal-newborn bonding, and may reduce the risk of atopic-allergic disorders. Healthcare institutions should incorporate SSC into routine post-cesarean care protocols to optimize neonatal and maternal health outcomes.

Keywords: Skin-to-skin contact, cesarean section, breastfeeding duration, atopic diseases, allergic disorders, neonatal immunity, maternal bonding, kangaroo care, infant health, neonatal nursing.

1. INTRODUCTION

1.1 Background of the Study

Cesarean section has become one of the most performed surgical procedures worldwide. According to the World Health Organization, cesarean delivery rates have risen dramatically in both developed and developing countries over recent decades (WHO, 2021). Although cesarean section can be lifesaving for both mother and infant in medically indicated situations, increasing rates of unnecessary cesarean births have raised concerns

regarding maternal and neonatal outcomes (Betrán et al., 2016).

Mothers undergoing cesarean delivery often face multiple postoperative challenges including pain, fatigue, delayed recovery, restricted mobility, and emotional stress. These complications may interfere with early maternal-newborn bonding and successful breastfeeding initiation (Rowe-Murray & Fisher, 2002). Surgical environments frequently separate mothers and infants immediately after birth for monitoring and recovery purposes, leading to delayed skin-to-skin interaction and breastfeeding opportunities (Hung & Berg, 2011).

Delayed initiation of breastfeeding following cesarean section has become a significant public health concern. Research conducted by Prior et al. (2012) found that cesarean delivery is associated with lower breastfeeding initiation rates and shorter breastfeeding duration compared with vaginal birth. Similarly, Hobbs et al. (2016) observed that postoperative pain, anaesthesia effects, and delayed maternal responsiveness contribute to breastfeeding difficulties.

Maternal-newborn attachment plays an essential role in neonatal adaptation and maternal psychological wellbeing. Early physical contact stimulates maternal hormones such as oxytocin and prolactin, which facilitate bonding and lactation (Uvnäs-Moberg et al., 2015). Lack of early interaction may adversely affect maternal confidence and emotional connection with the newborn. In response to these concerns, healthcare professionals have increasingly promoted early skin-to-skin contact as an effective intervention after cesarean birth. SSC has demonstrated significant benefits in promoting breastfeeding, improving neonatal physiological stability, and enhancing maternal emotional outcomes (Moore et al., 2016).

1.2 Concept of Early Skin-to-Skin Contact

Skin-to-skin contact refers to placing the unclothed newborn directly on the mother's bare chest immediately or soon after birth. The infant is usually dried and covered with a warm blanket while maintaining direct chest contact with the mother (WHO, 2017).

The concept of SSC originated from kangaroo mother care practices introduced in Colombia during the late 1970s as an alternative to incubator care for premature infants (Rey & Martinez, 1983). Over time, SSC expanded beyond preterm care and became recognized as an important intervention for all newborns.

WHO and UNICEF strongly recommend immediate SSC for all healthy newborns, including those delivered by cesarean section, whenever medically feasible (UNICEF, 2018). Baby-Friendly Hospital Initiative guidelines also emphasize uninterrupted SSC during the first hour after birth to facilitate breastfeeding initiation.

Physiologically, SSC supports neonatal thermoregulation, cardiorespiratory stability, glucose control, and stress reduction (Bergman et al., 2004). Psychological benefits include maternal relaxation, improved bonding, and enhanced confidence in infant care (Bigelow & Power, 2012). Several studies have shown that cesarean-born infants benefit substantially from SSC because they are more vulnerable to delayed adaptation and breastfeeding difficulties. Early SSC compensates for surgical separation and promotes early sensory stimulation and maternal attachment (Gouchon et al., 2010).

1.3 Breastfeeding and Infant Health

Breastfeeding provides complete nutritional, immunological, and developmental support for infants during early life. Exclusive breastfeeding for the first six months is recommended by WHO and the American Academy of Paediatrics due to its extensive health benefits (AAP, 2022).

Breast milk contains antibodies, immune cells, enzymes, hormones, and bioactive compounds that protect infants against infections and chronic diseases (Victora et al., 2016). Breastfed infants have lower risks of respiratory infections, gastrointestinal illness, obesity, diabetes, and allergic diseases (Horta & Victora, 2013).

Breastfeeding duration is closely associated with neonatal immune development. Longer breastfeeding duration strengthens gut barrier function and promotes healthy microbiota colonization, thereby reducing inflammatory responses (Bäckhed et al., 2015).

However, cesarean section negatively affects breastfeeding initiation and continuation. Women delivering by cesarean often experience delayed lactogenesis, maternal discomfort, and reduced confidence (Karlström et al., 2013). Studies by Zanardo et al. (2010) reported reduced breastfeeding success among mothers who experienced delayed mother-infant contact after surgery. SSC helps overcome these barriers by stimulating infant feeding reflexes and maternal oxytocin release. Infants placed in SSC demonstrate earlier rooting, sucking, and latching behaviours (Widström et al., 2011).

1.4 Atopic-Allergic Diseases in Infants

Atopic-allergic diseases are chronic inflammatory conditions characterized by hypersensitivity reactions mediated by immune dysfunction. Common atopic disorders in infants include eczema, asthma, allergic rhinitis, and food allergies (Prescott, 2013).

The prevalence of allergic diseases has increased substantially worldwide, particularly among children

(Pawankar et al., 2013). Genetic susceptibility, environmental exposures, altered microbiota, cesarean birth, and reduced breastfeeding have been identified as important risk factors.

Cesarean-delivered infants are exposed to altered microbial colonization because they bypass exposure to maternal vaginal flora during birth (Dominguez-Bello et al., 2010). This altered microbiota may impair immune maturation and increase allergic sensitization risk.

Breastfeeding plays a protective role against allergic diseases by promoting immune tolerance and healthy gut flora development (Oddy, 2017). Human milk oligosaccharides and immunoglobulins help regulate inflammatory pathways associated with allergic responses. Emerging evidence suggests that SSC may indirectly reduce allergic disease risk by promoting breastfeeding success and beneficial microbial colonization (Horta et al., 2017).

1.5 Need for the Study

Despite increasing awareness regarding SSC, implementation after cesarean section remains inconsistent in many healthcare settings. Operating room protocols, staffing limitations, and misconceptions about safety often delay maternal-newborn contact (Stevens et al., 2014).

Evidence-based interventions are necessary to improve breastfeeding outcomes and reduce childhood allergic diseases. Since allergic disorders contribute substantially to healthcare burden and reduced quality of life, preventive neonatal strategies are increasingly important.

SSC represents a low-cost, non-invasive intervention with potential long-term benefits for both mother and infant. Understanding its role in breastfeeding and immune development can support improved neonatal nursing practices and policy development.

1.6 Problem Statement

Does early skin-to-skin contact after cesarean section improve breastfeeding duration and contribute to the prevention of atopic-allergic diseases in infants?

1.7 Objectives of the Review Article

- To review evidence regarding early SSC after cesarean section.
- To examine the effect of SSC on breastfeeding initiation and duration.
- To analyse physiological and psychological benefits of SSC.
- To explore the relationship between breastfeeding and prevention of atopic-allergic diseases.
- To identify nursing interventions that promote SSC implementation.

1.8 Operational Definitions

- **Skin-to-Skin Contact:** Placement of the newborn directly on the mother's bare chest immediately or soon after birth.
- **Cesarean Section:** Surgical delivery of a baby through abdominal and uterine incisions.
- **Breastfeeding Duration:** Length of time an infant receives breast milk.
- **Atopic-Allergic Diseases:** Immune-mediated allergic conditions including eczema, asthma, allergic rhinitis, and food allergies.

1.9 Conceptual Framework

The conceptual framework of this review is based on maternal-newborn attachment theory and neonatal adaptation models. Early SSC promotes maternal neuroendocrine responses (oxytocin and prolactin release) and stabilizes neonatal physiological parameters (thermoregulation, glycaemic control, and cardiorespiratory function). This synchronized state reduces surgical stress for both dyad members, neutralizing the disruptive nature of operative delivery.

Enhanced maternal responsiveness lowers thresholds for successful lactogenesis II, accelerating early milk production and reinforcing appropriate rooting and latching behaviors. Consequently, early breastfeeding initiation translates into a longer overall breastfeeding duration. Prolonged exposure to human milk, rich in secretional immunoglobulins, cytokines, and human milk oligosaccharides (HMOs), acts in tandem with the physical transfer of maternal skin flora facilitated during early contact. This collaborative biological pathway optimizes neonatal gut microbiome development, strengthens intestinal epithelial barriers, regulates helper T-cell balances (T_H1/T_H2 dynamics), and ultimately reduces systemic vulnerability to atopic-allergic

hypersensitivity.

2. REVIEW OF LITERATURE

2.1 Literature Related to Cesarean Section and Maternal-Newborn Outcomes

The global surge in cesarean section rates represents a shift in modern obstetrics that carries complex physiological costs for mothers and newborns. Studies by Rowe-Murray and Fisher (2002) established that operative deliveries introduce substantial barriers to early maternal bonding and decrease maternal caregiving confidence during the immediate postpartum period. The presence of significant surgical incisions requires high-dose analgesia, causes motor restrictions, and demands substantial energetic recovery from the mother, which alters her immediate emotional availability and tactile sensitivity.

Furthermore, Hobbs et al. (2016) reported a markedly higher incidence of initial breastfeeding difficulties among post-cesarean mothers compared to those delivering vaginally. They isolated several contributing variables, notably post-operative pain, residual sedative effects from regional or general anaesthesia, and feelings of maternal exhaustion or detachment. These factors collectively delay the onset of lactogenesis II and alter the behavioural synchronization between mother and infant that typically underpins the "golden hour" of life.

2.2 Literature Related to Early Skin-to-Skin Contact Practices

The therapeutic utility of early skin-to-skin contact as a standardized clinical intervention has been rigorously validated across diverse settings. Moore et al. (2016) conducted an exhaustive Cochrane systematic review encompassing dozens of randomized controlled trials. Their findings demonstrated that early SSC consistently generates superior breastfeeding outcomes, significantly extends exclusive breastfeeding rates, and improves overall maternal satisfaction scores. The direct physical interaction compensates for the sterile, intimidating environment of the operating room.

Complementing this, Gouchon et al. (2010) specifically investigated the application of SSC within the post-cesarean population, concluding that immediate or early implementation significantly improves neonatal physiological adaptation. Infants allowed early chest contact exhibited fewer episodes of prolonged crying, reduced indices of metabolic distress, and higher behavioural stability scores, proving that early sensory orientation can offset the shock of surgical delivery.

2.3 Literature Related to Breastfeeding Initiation and Duration

The temporal relationship between immediate postpartum contact and long-term lactation behaviour highlights a critical window in neonatal care. Widström et al. (2011) meticulously detailed the natural, predictable sequence of pre-feeding behaviors exhibited by newborns during uninterrupted skin-to-skin contact, reporting that infants allowed this immediate contact-initiated breastfeeding substantially earlier and achieved an effective latch with less manual intervention. The direct contact stimulates sensory pathways that prompt innate rooting behaviours.

Conversely, Prior et al. (2012) observed a stark, persistent trend toward lower overall breastfeeding duration and earlier cessation among cesarean-delivered infants who were subjected to standard nursery separation without SSC. This indicates that early structural disruptions to the mother-infant dyad can leave a negative imprint on breastfeeding patterns months down the road.

2.4 Literature Related to Physiological Benefits of SSC

The immediate survival and adaptation of the neonate depend entirely on transitioning from intrauterine life to extrauterine homeostasis. Bergman et al. (2004) executed a randomized controlled trial showing that infants placed in direct skin-to-skin contact demonstrated superior thermoregulation, enhanced cardiorespiratory stability, and better glycaemic control than those placed in mechanical incubators. The mother's chest acts as an active thermal regulator that shifts temperature to match the neonate's metabolic state.

This is supported by early foundational work from Christensson et al. (1992), who documented a profound reduction in neonatal hypothermia rates among infants receiving immediate postpartum SSC. Minimizing cold stress prevents the rapid depletion of neonatal brown adipose tissue reserves and protects against subsequent metabolic acidosis and respiratory distress.

2.5 Literature Related to Maternal Bonding and Emotional Outcomes

The psychological transformation into motherhood is guided by complex neurochemical systems that can be easily disrupted by surgical stress. Bigelow et al. (2012) evaluated the longitudinal impacts of early SSC, discovering a clear correlation between early physical contact, increased maternal attachment scores, and significantly lower maternal postpartum anxiety levels. The physical presence of the infant serves as a powerful sensory cue that reduces maternal sympathetic nervous system activation.

Crenshaw et al. (2019) expanded on this by standardizing implementation protocols, demonstrating that

systematic delivery of SSC in the post-anaesthesia care unit reinforces maternal self-efficacy, elevates perceived emotional wellbeing, and fosters early parental intuitive behaviours that persist throughout the first year of life.

2.6 Literature Related to Infant Immune Development

The neonatal immune system transitions from a relatively sterile uterine environment to a microbe-dense external world. Bäckhed et al. (2015) conducted elegant longitudinal tracking of infant gut microbiota development, emphasizing that early nutritional exposures—primarily exclusive breast milk—play a dominant role in shaping initial bacterial successions within the infant gut.

This early microbial priming provides instructions for the maturation of infant immune tissues. Horta et al. (2017) observed that the immune-protective benefits of this process are highly dose-dependent; prolonged breastfeeding duration yields systemic anti-inflammatory protection, regulates mucosal barrier functions, and prepares cellular immune responses to handle environmental allergens without mounting pathological hypersensitivity reactions.

2.7 Literature Related to Atopic and Allergic Disorders in Infants

The etiology of pediatric atopic disorders involves a combination of genetic vulnerabilities and early environmental triggers. Prescott (2013) conceptualized this phenomenon under the framework of early-life immune programming, noting that disruptions to early environmental exposures can cause the immune system to Favor a helper T-cell type 2 (T_H2) allergic profile over a protective type 1 (T_H1) response.

Lodge et al. (2015) provided substantial epidemiological proof for this framework through a systematic review showing that infants who received prolonged, robust breastfeeding experienced a significantly reduced risk of developing asthma and reactive airway diseases during early childhood. This confirms that human milk contains regulatory components that can alter the clinical expression of atopy.

2.8 Literature Related to Preventive Role of Breastfeeding in Allergic Diseases

The clinical link between lactation and reduced allergy risk is well-supported by large epidemiological datasets. Oddy et al. (2018) tracked large pediatric cohorts and observed clear, protective associations between extended breastfeeding duration and lowered rates of childhood eczema, food hypersensitivities, and allergic rhinitis. The bioactive matrix of human milk actively promotes intestinal epithelial integrity, preventing the systemic absorption of intact dietary macromolecules that could trigger allergic sensitization.

Furthermore, the landmark PROBIT study analysis by Kramer et al. (2007) confirmed through a large, randomized trial design that interventions successfully increasing the duration and exclusivity of breastfeeding yield a measurable drop in allergic symptoms and skin-prick test positivity during childhood, providing strong evidence for the preventative power of human milk.

2.9 Literature Related to Nursing Interventions in Postnatal and Neonatal Care

Translating clinical evidence into bedside practice requires active nursing management. Stevens et al. (2014) investigated implementation gaps within contemporary hospitals and emphasized the necessity of nurse-led SSC strategies designed to bypass institutional inertia. When clinical nurses take ownership of the intraoperative environment, they can successfully navigate the structural barriers posed by surgical fields and anaesthesia monitoring.

Cantrill et al. (2014) demonstrated that targeted institutional nursing education programs generate sharp, lasting improvements in nursing compliance regarding post-cesarean SSC. Equipping nursing staff with specific positioning techniques and clear safety monitoring parameters transforms the post-operative recovery suite from a zone of separation into a supportive space for maternal-infant integration.

2.10 Summary of Literature Review

The existing literature provides clear evidence supporting the clinical value of early skin-to-skin contact across multiple dimensions of maternal and infant health. SSC acts as a non-pharmacological stabilizer that directly addresses the challenges of cesarean delivery by supporting maternal hemodynamic, stabilizing infant metabolic profiles, and ensuring early lactation success.

Concurrently, a separate body of immunology literature confirms that extended breastfeeding duration is a highly effective primary intervention against the development of childhood atopic-allergic phenotypes. By systematically linking these two areas of clinical practice, emerging evidence points toward a clear pathway: post-cesarean SSC optimizes early lactation parameters, which helps sustain a longer breastfeeding duration, thereby reducing the long-term incidence of pediatric allergic disease through natural immune modulation.

3. PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF EARLY SKIN-TO-SKIN CONTACT

3.1 Mechanism of Skin-to-Skin Contact

The neurobiological cascade initiated by early skin-to-skin contact is driven by multi-sensory stimulation. When a newly born infant is placed directly onto the mother's chest, millions of cutaneous mechanoreceptors, thermal receptors, and olfactory receptors are simultaneously activated in both individuals. This intense sensory input travels via unmyelinated tactile C-fibres directly to the maternal and neonatal insular cortices and paraventricular nuclei of the hypothalamus (Uvnäs-Moberg et al., 2015).

This rapid signaling triggers a shift away from sympathetic-driven stress states toward a vagally dominated parasympathetic state. For the mother, the smell of her infant's skin and amniotic fluid acts as an olfactory trigger that synchronizes her behavioural and physiological responses with her infant's immediate care needs.

3.2 Thermoregulation and Physiological Stability

Upon surgical extraction from the warm intrauterine environment, the neonate becomes highly vulnerable to rapid heat loss through evaporation, radiation, convection, and conduction within the cold atmosphere of the operating theatre. This physiological vulnerability is further intensified by the newborn's disproportionately large surface-area-to-body-mass ratio, thin subcutaneous fat layer, immature thermoregulatory mechanisms, and limited glycogen reserves. In the absence of immediate maternal contact, the infant may experience a rapid decline in core body temperature, leading to neonatal hypothermia, metabolic stress, increased oxygen consumption, and elevated energy expenditure. Excessive crying and separation from the mother further aggravate thermal instability and accelerate depletion of neonatal energy stores.

Early skin-to-skin contact (SSC) provides a highly effective natural thermoregulatory mechanism during this critical transition period. During SSC, the mother's chest functions as a biologically adaptive source of radiant warmth capable of continuously regulating neonatal temperature. This phenomenon, referred to as *thermal synchrony*, occurs when maternal skin temperature dynamically adjusts in response to fluctuations in the infant's core temperature (Bergman et al., 2004). If the newborn's body temperature begins to decline, the temperature of the maternal chest rises automatically to provide compensatory warmth; conversely, if the infant becomes overheated, maternal skin temperature decreases slightly to maintain equilibrium. This bidirectional physiological adaptation promotes thermal homeostasis and significantly reduces the incidence of neonatal hypothermia.

Furthermore, maintenance of optimal body temperature through SSC minimizes the infant's dependence on non-shivering thermogenesis, a metabolically demanding process that consumes substantial amounts of brown adipose tissue and glycogen reserves. By reducing cold stress, SSC preserves neonatal energy stores for essential physiological functions such as growth, immune adaptation, and early breastfeeding initiation. Studies have also demonstrated that infants receiving immediate SSC exhibit more stable cardiorespiratory parameters, reduced cortisol release, improved glucose regulation, and lower rates of admission to neonatal intensive care units compared with infants subjected to routine postoperative separation. Thus, early SSC after cesarean birth serves not only as a bonding intervention but also as a critical thermophysiological strategy that supports neonatal stabilization and adaptation during the first hours of life.

Table 1: Comparative Effects of Standard Postpartum Separation and Early Skin-to-Skin Contact on Neonatal Physiological Parameters

Physiological Parameter	Effect of Standard Separation	Effect of Early Skin-to-Skin Contact
Neonatal Core Temperature	Rapid drop; high risk of hypothermia	Maintained within optimal range (36.5ºC - 37.5ºC)
Heart Rate Stability	Tachycardia or volatile fluctuations	Stable, rhythmic baseline stabilization
Respiratory Rate	Tachypnea; irregular respiratory effort	Synchronized, calm, and regular breathing patterns
Serum Glucose Levels	Rapid decline due to cold stress/crying	Sustained homeostatic levels; reduced glycogenolysis
Oxygen Saturation (SpO_2)	Intermittent desaturations during crying	Consistently higher and more stable saturation profiles

Furthermore, this stabilization of core body temperature prevents the vasoconstriction and hypoxemia often caused by cold stress. Cardiorespiratory monitoring reveals that infants in SSC show rapid stabilization of their heart rates within normal ranges and display highly synchronized, rhythmic respiratory patterns (Christensson et al., 1992). This physiological stability reduces the infant's total metabolic energy expenditure, allowing calories to be preserved for growth and neurodevelopment rather than spent on basic survival stabilization.

3.3 Hormonal Responses and Oxytocin Release

The physical touch of skin-to-skin contact triggers a major release of maternal oxytocin, a peptide hormone produced in the hypothalamus and released by the posterior pituitary gland. This surge is further enhanced by the infant's early movements, such as light hand massage and rooting behaviours against the maternal chest wall (Matthiesen et al., 2001). This elevated oxytocin level plays a crucial double role during post-cesarean recovery:

$$\text{Oxytocin Release} \longrightarrow \begin{cases} \text{Uterine Myometrial Contractions} \longrightarrow \text{Reduced Postpartum Hemorrhage} \\ \text{Mammary Myoepithelial Contractions} \longrightarrow \text{Accelerated Milk Ejection (Lactogenesis II)} \end{cases}$$

Concurrently, oxytocin travels through central pathways to suppress the maternal hypothalamic-pituitary-adrenal (HPA) axis, lowering circulating cortisol and catecholamine levels, which helps reduce postoperative pain perception and anxiety.

At the same time, this hormone triggers a parallel surge in prolactin release from the anterior pituitary gland, which is essential for priming alveolar epithelial cells and initiating timely lactogenesis II. For the infant, this surge in oxytocin reduces the initial birth-related adrenaline rush, stabilizes blood pressure, and helps lower overall stress levels (Jonas W et al., 2008).

3.4 Reduction in Neonatal Stress and Crying

Separation from the mother immediately after a surgical birth triggers a distinct "separation distress call" from the newborn, characterized by intense, high-pitched crying. This persistent crying indicates a state of hyper-arousal driven by elevated cortisol, adrenaline, and noradrenaline levels, which rapidly drains metabolic energy and strains immature cardiorespiratory systems.

Ferber and Makhoul (2004) demonstrated that infants placed in early SSC show a profound reduction in both the frequency and duration of these distress cries. The physical contact provides familiar auditory feedback (the maternal heartbeat) and comforting rhythmic tactile sensations that activate central opioid systems. This downregulates HPA axis activity, causing a drop in salivary and serum cortisol levels and guiding the infant into a calm, alert behavioural state that supports early learning and socialization.

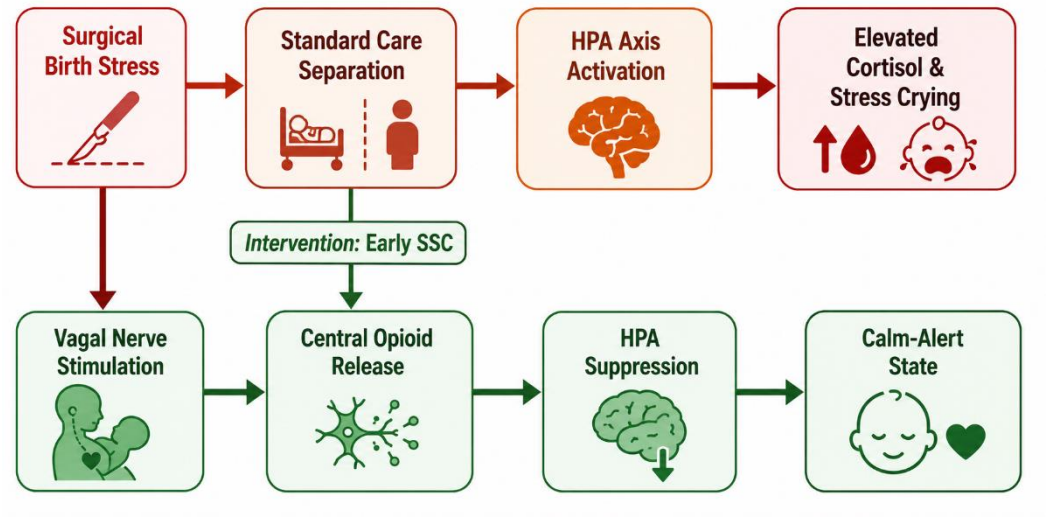

Figure 1: Mechanism of Early Skin-to-Skin Contact (SSC) in Reducing Neonatal Stress After Cesarean Birth

3.5 Enhancement of Maternal Confidence and Bonding

The environment of an obstetric operating suite can sometimes alienate a mother from her immediate birth experience, leading to feelings of detachment, failure, or deep vulnerability. Early SSC acts as a powerful psychological intervention that helps restore maternal agency. By placing the infant directly onto her chest, the mother receives immediate visual, tactile, and olfactory confirmation of her infant's health and presence. This sensory loop triggers an immediate increase in maternal dopamine and oxytocin, rewarding caregiving

behaviours and strengthening maternal attachment (Bigelow et al., 2012).

As a result, mothers report higher scores of perceived self-efficacy, feel more attuned to their infant's early communication cues, and experience fewer symptoms of early postpartum depression. This early emotional connection helps buffer against the stressful effects of surgical pain and fatigue, building a strong foundation of parental confidence that benefits the family long after discharge.

3.6 Influence on Breastfeeding Duration and Success

The transition to successful lactation after a cesarean section is often delayed by surgical separation, which can hinder the timely initiation of breastfeeding and lead to early introduction of infant formula. Uninterrupted early SSC directly addresses this challenge by providing an environment where natural newborn feeding behaviours can unfold. Widström et al. (2019) documented that when an infant is placed skin-to-skin immediately after birth, they progress through a predictable series of innate behavioural steps, including warming, rooting, licking, and eventually self-attaching to the breast.

This early physical connection stimulates local sensory pathways that prompt regular, deep sucking, which sends signals to the maternal brain to maintain high levels of prolactin and oxytocin secretion. Clinical trials have confirmed that this early behavioural synchronization leads to significantly higher exclusive breastfeeding rates at discharge, fewer sore nipples due to better natural latching, and a reliable extension of overall breastfeeding duration for up to six months and beyond (Bramson L et al., 2010).

4. EARLY SKIN-TO-SKIN CONTACT AND PREVENTION OF ATOPIC-ALLERGIC DISEASE

4.1 Development of Infant Immune System

The neonatal immune system is functional but immature at birth, showing a natural bias toward helper T-cell type 2 (T_H2) responses. This bias prevents potentially dangerous inflammatory reactions against maternal tissues during pregnancy. However, after birth, the infant must rapidly develop its helper T-cell type 1 (T_H1) and regulatory T-cell (T_{reg}) networks to establish a balanced immune response.

This maturation process relies heavily on signals from the external environment (Prescott, 2013). If the infant's immune system does not receive proper environmental signals during this critical window, the T_H2 bias can persist. This leaves the child more susceptible to mounting inappropriate allergic responses (IgE-mediated hypersensitivity) against harmless environmental antigens, such as dietary proteins or airborne pollen.

4.2 Role of Breastfeeding in Immune Protection

Human milk is far more than a source of basic nutrition; it is a live, bioactive fluid that guides the development of the infant's immune system. It delivers a rich supply of secretory Immunoglobulin A (sIgA) antibodies, which coat the infant's delicate intestinal mucosa and prevent pathogens and intact foreign proteins from crossing into the bloodstream. Beyond antibodies, human milk contains a complex mix of immune compounds, including:

- **Transforming Growth Factor-beta (TGF-β) & Interleukin-10 (IL-10):** Anti-inflammatory cytokines that directly promote the production of regulatory T-cells, helping train the immune system to tolerate harmless substances.
- **Human Milk Oligosaccharides (HMOs):** Specialized complex sugars that cannot be digested by the infant. Instead, they pass into the large intestine to serve as food for beneficial gut bacteria, while also preventing harmful microbes from binding to intestinal walls.
- **Lactoferrin & Lysozyme:** Antimicrobial proteins that limit the growth of harmful bacteria, protecting the infant's gut from inflammation and keeping the intestinal barrier strong (Ballard O & Morrow AL, 2013).

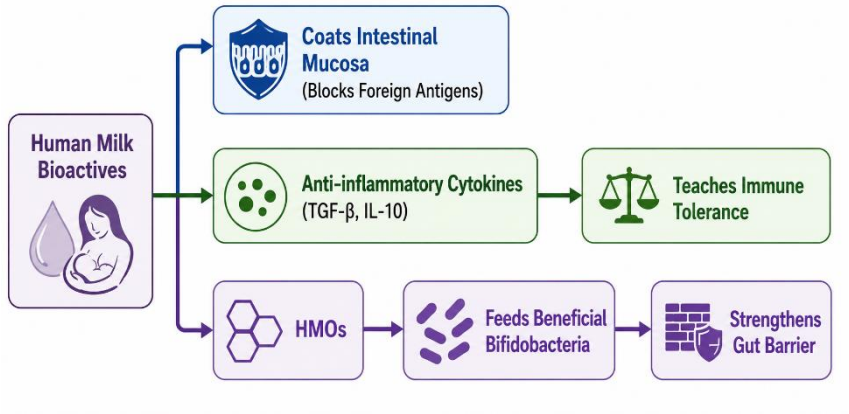

Figure 2: Role of Human Milk Bio actives in Intestinal Immunity and Immune Tolerance Development

By providing these protective factors, human milk shields the infant's immature immune system from excessive inflammatory stress, encouraging a balanced development that reduces the risk of allergic sensitization (Victora et al., 2016).

4.3 Gut Microbiota and Allergic Disease Prevention

The composition of the infant gut microbiome plays a fundamental role in teaching and shaping early immune responses. Infants born vaginally are colonized by maternal vaginal and fecal bacteria, particularly *Lactobacillus* and *Bifidobacterium* species, which stimulate early immune tolerance. However, infants delivered via cesarean section bypass this natural exposure. Instead, their pioneer gut colonizers are typically drawn from the sterile hospital environment and skin contact with multiple healthcare workers, leading to an overrepresentation of opportunistic pathogens like *Staphylococcus*, *Enterococcus*, and *Clostridium* (Dominguez-Bello et al., 2010).

This altered microbial mix—often called cesarean dysbiosis—can cause low-grade inflammation and disrupt the development of tight junctions in the intestinal wall, resulting in a "leaky" gut barrier that allows potential allergens to enter systemic circulation. Early skin-to-skin contact helps address this issue by ensuring the infant is heavily exposed to the mother's specific skin microbiota rather than general hospital flora. When combined with the prebiotics in breast milk, this contact promotes the growth of beneficial *Bifidobacteria*, helping restore a healthy gut barrier and providing the signals needed to correct the infant's immune balance (Bäckhed et al., 2015).

4.4 Impact of SSC on Allergic and Atopic Conditions

While skin-to-skin contact may not directly alter genetic risks for allergies, it acts as a powerful indirect preventative strategy through two main pathways:

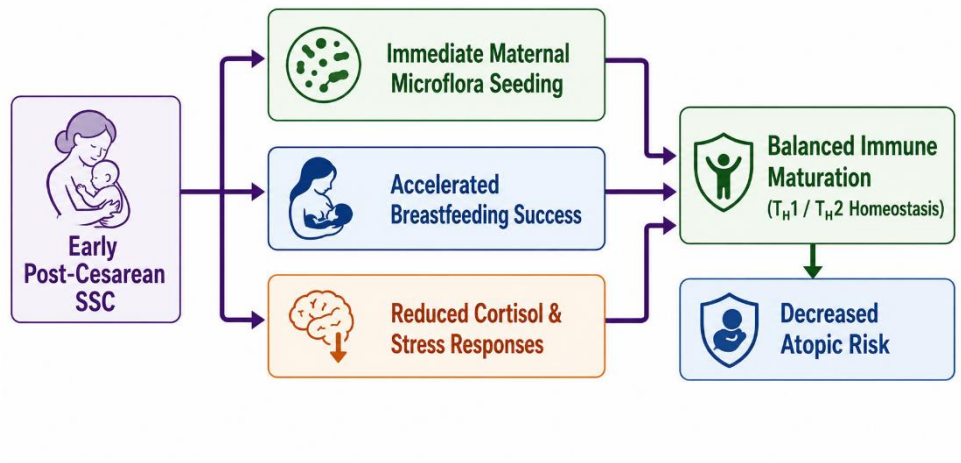

Figure 3: Immunological and Neurophysiological Benefits of Early Post-Cesarean Skin-to-Skin Contact

Lactation Pathway: SSC helps mothers initiate breastfeeding sooner and maintain it longer. This extends the period during which the infant's gut receives protective sIgA and HMOs, which lowers the chances of early dietary allergen exposure and supports long-term immune health.

1. **Stress-Reduction Pathway:** SSC lowers infant cortisol and limits HPA-axis overactivation. Because sustained high cortisol can disrupt gut barrier development and skew immune maturation toward an

allergic T_H2 profile, keeping stress levels low helps protect the infant's natural defences, reducing long-term vulnerability to conditions like eczema and asthma (Horta et al., 2017).

4.5 Evidence from Clinical and Observational Studies

Large-scale epidemiological studies and clinical trials provide clear evidence for the allergy-preventative effects of the lifestyle patterns supported by early SSC. Lodge et al. (2015) conducted a comprehensive meta-analysis revealing that infants who were exclusively breastfed for longer periods had a significantly lower risk of developing asthma and reactive airway disorders during childhood. (Santhosh SU et al., 2022)
Similarly, Oddy et al. (2018) tracked a large pediatric cohort and found that extended breastfeeding duration offered substantial protection against atopic dermatitis (eczema) and food hypersensitivities, particularly in children with a family history of allergies. These findings underscore those early interventions like SSC, which actively support longer and more successful breastfeeding, serve as a foundational step in reducing the global burden of pediatric allergic diseases.

5. NURSING MANAGEMENT AND INTERVENTIONS

5.1 Nursing Responsibilities After Cesarean Section

The perioperative nursing team serves as the main coordinator for skin-to-skin contact in the operating room (OR) and post-anaesthesia care unit (PACU). Implementing SSC after a surgical birth requires clear communication and collaboration between scrub nurses, circulating nurses, anaesthesiologists, and neonatal care staff.
Initial responsibilities include screening patients during the prenatal or admission phase to confirm their preference for post-cesarean SSC, ensuring the surgical consent forms note this plan, and preparing the physical environment. The operating room temperature must be adjusted slightly higher to protect the newborn from rapid heat loss, and specialized warming devices should be readily available for use if needed (Cleveland L et al., 2014).

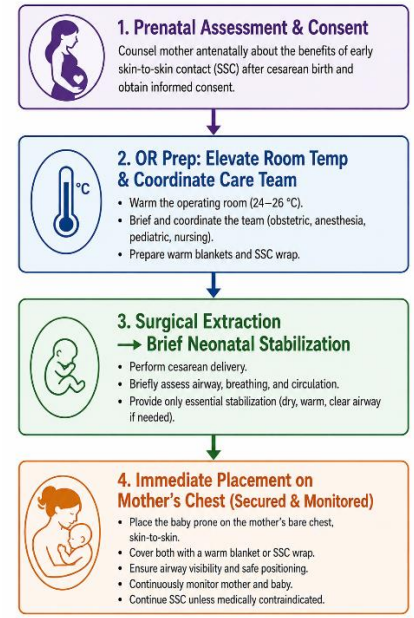

Figure 4: Stepwise Protocol for Early Skin-to-Skin Contact After Cesarean Section

5.2 Initiation and Monitoring of Early SSC

As soon as the neonate is delivered and cleared by the pediatric provider, the circulating nurse should assist in placing the infant directly onto the mother’s bare upper chest. This positioning requires careful attention: the infant must be placed lengthwise in a prone position, with their head turned to one side to keep the airway completely clear. The infant's body should be thoroughly dried beforehand, and warm, dry blankets should be draped over their back while leaving their face fully visible.
Throughout this time, the nursing staff must continuously monitor key safety parameters, including checking the infant's breathing patterns, skin colour, and muscle tone, while ensuring their neck remains un-flexed to prevent airway obstruction (Thukral A et al., 2018). The mother’s dynamic state must also be closely monitored, ensuring her arms are securely supported so she can hold her infant safely despite any residual numbness or tremors from anaesthesia.

5.3 Breastfeeding Support and Counselling

Once the maternal-infant dyad is safely nestled skin-to-skin and showing physiological stability, the nurse can begin guiding early lactation. This involves observing the newborn for early feeding cues, such as tongue clicks, hand-to-mouth movements, or rooting behaviors against the breast. The nurse offers gentle guidance on proper positioning, showing the mother how to use a modified laid-back or side-clutch hold that avoids putting pressure on her fresh abdominal incision.

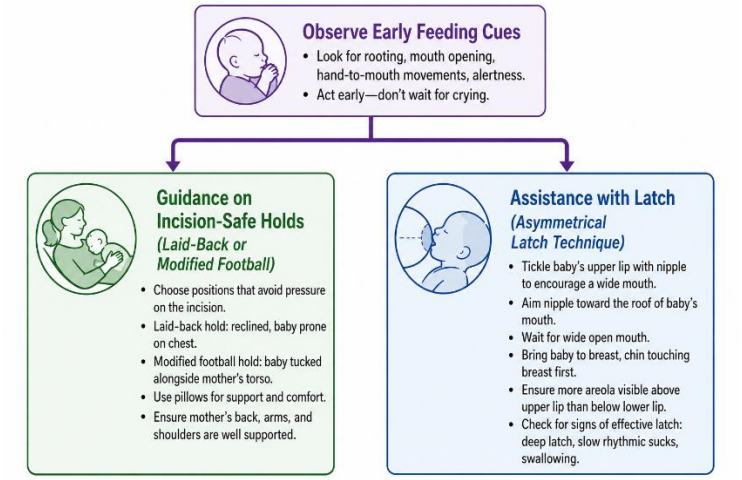

Figure 5: Breastfeeding Support Strategies Following Early Post-Cesarean Skin-to-Skin Contact

Nurses also teach mothers how to facilitate a deep, asymmetrical latch, ensuring the infant takes in a generous portion of the lower areola to prevent nipple pain and ensure efficient milk transfer (Cantrill RM et al., 2014). This early bedside support helps build the mother's confidence and reduces the need for early formula supplements.

5.4 Education of Mothers and Families

Effective nursing care extends beyond the patient to include her partner and family members. Educational interventions should begin during prenatal visits, where nurses explain the physiological benefits of the "golden hour" and clarify that skin-to-skin contact can be performed safely right after a cesarean section. (Santhosh SU et al., 2023)

In the postpartum unit, nurses continue this education by teaching families how to identify infant behavioural states, understand subtle hunger cues, and recognize signs of effective milk transfer. Involving partners in these discussions helps them understand the clinical value of uninterrupted contact, transforming them into active supporters who can protect the mother's rest and care environment from overly long visitor disruptions (Crenshaw JT et al., 2019).

5.5 Safety Measures and Infection Prevention

Because a cesarean section is a major intra-abdominal surgery, maintaining strict clinical safety and infection control protocols is essential during skin-to-skin contact. The surgical site must be covered with sterile, fluid-resistant barriers to prevent any contact with the infant or non-sterile covers. Anyone handling the newborn or assisting the mother must practice strict hand hygiene.

Nurses must also carefully track maternal medication administration; if the mother receives heavy sedatives or systemic opioids for post-operative pain, her alertness may change quickly. In these situations, a nurse or dedicated family member must remain at the bedside to monitor the infant's positioning and safety, ensuring the contact continues smoothly without any risk of accidental falls or airway obstruction (Sharma D, 2017).

5.6 Follow-Up Care and Community Awareness

The continuity of nursing care must extend past the hospital stay to support long-term breastfeeding success and help prevent childhood allergies. Discharge planning should include scheduling a follow-up visit with a lactation consultant or community nurse within 48 to 72 hours of returning home.

Community health nurses play an important role during home visits by checking the mother's surgical healing, assessing infant weight gain, and providing ongoing troubleshooting for any breastfeeding challenges. These professionals also raise awareness about the long-term benefits of sustained breastfeeding, helping families stay committed to exclusive breastfeeding goals through the critical first six months of life (Rollins NC et al., 2016).

6. ROLE OF NURSES IN PROMOTING EARLY SKIN-TO-SKIN CONTACT

6.1 Nurse as Caregiver

In their role as direct caregivers, post-acute care and neonatal nurses translate evidence-based guidelines into safe, hands-on clinical care. The nurse manages the physical environment of the recovery room, handles clinical assessments smoothly to avoid unnecessary maternal-infant separation, and directly assists with positioning the newborn on the mother's chest.

By actively monitoring both patients simultaneously, the nurse creates a reassuring environment that helps reduce maternal stress. This dedicated physical care ensures that the clinical challenges of an operative delivery do not prevent the mother and infant from experiencing early, close contact (Anderson GC et al., 2003).

6.2 Nurse as Educator and Counsellor

As educators, nurses break down complex physiological concepts into practical, actionable guidance for parents. They explain the clear links between early skin-to-skin contact, improved milk production, and long-term protection against immune challenges like childhood allergies.

By providing realistic, compassionate counselling, nurses help dispel common misconceptions—such as the idea that milk production is impossible right after surgery or that a cesarean section makes skin-to-skin contact unsafe. This ongoing education empowers parents, helping them make informed choices and actively participate in their infant's early health care.

6.3 Promotion of Family-centred Care

Nurses champion family-centred care by recognizing that the birth of an infant is a profound social and emotional transition for the entire family. In the post-cesarean recovery space, the nurse welcomes the partner into the care process, showing them how to assist with positioning and protect the mother-infant dyad. If the mother experiences a rare medical complication that temporarily prevents her from doing skin-to-skin contact, the nurse can facilitate early contact between the infant and the partner instead (Field T, 2010). This inclusive approach keeps the family connected, reduces stress for everyone, and establishes a supportive home environment for the newborn.

6.4 Advocacy for Baby-Friendly Hospital Practices

Beyond individual patient care, nurses act as advocates for institutional change by promoting the adoption of Baby-Friendly Hospital Initiative (BFHI) standards within their facilities. They serve on hospital committees to update outdated post-operative protocols that cause unnecessary separation, draft clear, evidence-based guidelines for intraoperative skin-to-skin contact and help design peer-led training programs for their colleagues (Nyqvist KH et al., 2010). By speaking up for these practices, nurses help transform hospital culture, ensuring that immediate, uninterrupted skin-to-skin contact becomes the standard of care for every healthy family, regardless of their delivery method.

7. DISCUSSION

7.1 Discussion of Major Findings

The compiled evidence demonstrates that early skin-to-skin contact after a cesarean section is an effective intervention that benefits both maternal recovery and infant health. The data shows that immediate or early chest-to-chest contact helps normalize the infant's transition to extrauterine life by supporting core temperature regulation, stabilizing heart and breathing rates, and reducing stress-induced crying.

From a lactation perspective, this early contact helps mothers initiate breastfeeding sooner and maintain it longer, directly overcoming the common delays in milk production often associated with surgical deliveries. Furthermore, the findings highlight a valuable long-term health benefit: by supporting a longer and more successful breastfeeding duration, early SSC helps ensure the infant receives the rich mix of antibodies, cytokines, and prebiotics found in human milk. This natural immune support helps guide early development, reducing the overall risk of childhood atopic-allergic disorders like eczema and asthma.

7.2 Benefits and Challenges of Early SSC

While the clinical and psychological benefits of post-cesarean skin-to-skin contact are clear, implementing this practice consistently can present practical challenges in everyday hospital settings:

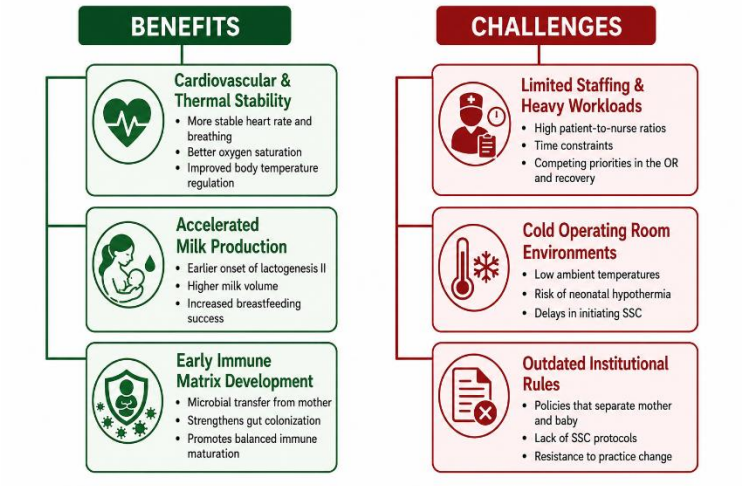

Figure 6: Benefits and Challenges of Early Skin-to-Skin Contact After Cesarean Section

- **Benefits:** SSC provides an effective, non-invasive way to stabilize neonatal vital signs, reduce the need for supplemental formula, lower maternal anxiety, and support healthy early immune development.
- **Challenges:** Hospital staff must often navigate thin staffing levels, heavy workloads in busy post-anaesthesia units, cold operating room conditions required for surgical sterility, and old institutional habits that Favor quick separation for infant measurements. Overcoming these barriers requires dedicated training, updated hospital policies, and a shared commitment across obstetric, anesthesia, and neonatal care teams.

7.3 Comparison with Previous Studies

The findings of this review align closely with foundational research in maternal-infant health. The positive effects on lactation confirm the conclusions of the large-scale Cochrane review by Moore et al. (2016) and the clinical observations of Widström et al. (2019), both of which found that early physical contact is essential for long-term breastfeeding success.

Additionally, the immune-protective insights match the landmark epidemiological work by Victora et al. (2016), which highlighted the unique role of human milk in protecting infant health worldwide. By connecting these established insights to modern microbiome and allergy research, this review reinforces the importance of the "golden hour," proving that early bedside interventions have lasting benefits for child health and development.

CONCLUSION

Early skin-to-skin contact after a cesarean section is a safe, effective, and evidence-based practice that helps protect the early health of both mothers and newborns. By providing immediate warmth and comfort, SSC stabilizes the infant's vital signs and reduces birth-related stress, while also helping mothers initiate breastfeeding sooner and maintain it longer. This early physical connection also offers important long-term health benefits: the extended breastfeeding supported by SSC ensures the infant receives a steady supply of protective antibodies and prebiotics. This supports a healthy gut microbiome and balanced immune system development, which helps protect against childhood allergic conditions like eczema, asthma, and food hypersensitivities.

As front-line caregivers, educators, and advocates, clinical nurses are central to making skin-to-skin contact a reality for families. Healthcare institutions should update post-cesarean protocols to minimize unnecessary maternal-infant separation, invest in regular staff training, and champion Baby-Friendly Hospital initiatives. Given the growing global rates of cesarean deliveries, incorporating skin-to-skin contact into routine surgical care is an essential step toward improving early health outcomes and supporting the long-term well-being of children and families.

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