

Diaper Dermatitis in Infant Skin: Causes and Mitigation

Josh Gregorio, PhD, and Karien Rodriguez, PhD

Introduction

Infants under the age of two, especially preterm neonates, are vulnerable to developing skin irritation in the diapered region. Overhydration or prolonged skin contact with urine and feces can result in breakdown of the skin barrier (the protective outer layer of the skin), leading to irritation and the appearance of a rash. This event is known as diaper rash or diaper dermatitis, general terms describing skin inflammation in the diaper region.

Diaper dermatitis is among the most common skin disorders of infancy. It accounts for 10-20% of all skin disorders treated by pediatricians and the highest incidence occurs in children between 9 and 12 months of age.^{1,2} If left untreated, progressive skin irritation in the diapered region can lead to secondary infections, including *Candida albicans* (candida dermatosis) and bacterial infections, that require additional treatment by a physician.

Types of Diaper Dermatitis

Although there are many types of diaper dermatoses (Table 1), most incidences arise from a nonallergic rash resulting from chemical, physical, or mechanical irritation called irritant contact dermatitis.

Table 1. Loosely defined categories of dermatitis occurring in the diaper area.³

Type of Rash	This category includes
Rashes that are directly or indirectly caused by the wearing of diapers.	Dermatoses: such as irritant contact dermatitis, miliaria, intertrigo, candidal diaper dermatitis, and granuloma gluteale infantum
Rashes that appear elsewhere but can be exaggerated in the groin area due to the irritating effects of wearing a diaper.	Atopic dermatitis, seborrheic dermatitis, and psoriasis
Rashes that appear in the diaper area irrespective of diaper use.	Rashes associated with bullous impetigo; Langerhans cell histiocytosis; acrodermatitis enteropathica (zinc deficiency); congenital syphilis; scabies; and HIV

Classifications of Diaper Dermatitis

Diaper dermatitis can be classified as mild, moderate, or severe, and is dependent on skin involvement and the degree of inflammation (Figure 1). Characteristics of mild diaper dermatitis include shiny erythema with or without scales, whereas more severe cases have intense erythema, ulcerations, and pustule and vesicle eruptions.

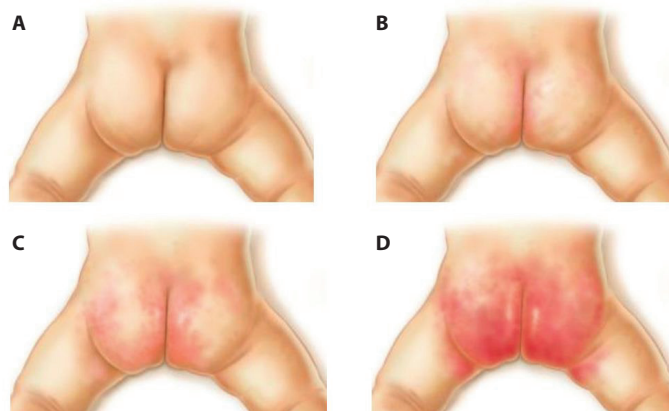


Figure 1. Representative images of diaper dermatitis severity range: (A) healthy skin, (B) slight, (C) mild, (D) severe.

Causes and Risk Factors

The exact cause or etiology of diaper dermatitis is not fully understood. However, we know that many factors within the diapered environment contribute to the manifestation of diaper dermatitis. Extensive research has demonstrated that factors including chemical and mechanical irritants, skin pH, diet, skin overhydration, skin occlusion, diarrhea, gestational age and medication contribute to the occurrence and severity of diaper dermatitis.⁴⁻⁷

Factors Contributing to Diaper Dermatitis

- skin overhydration
- skin occlusion
- feces and fecal enzymes
- infrequent diaper changes
- incomplete cleaning and drying of the skin in the diaper area
- infant's diet

Additionally, caretaker behavior and practices such as infrequent diaper changes, incomplete cleaning and drying of the skin in the diaper area, diet (breast fed babies have been shown to have

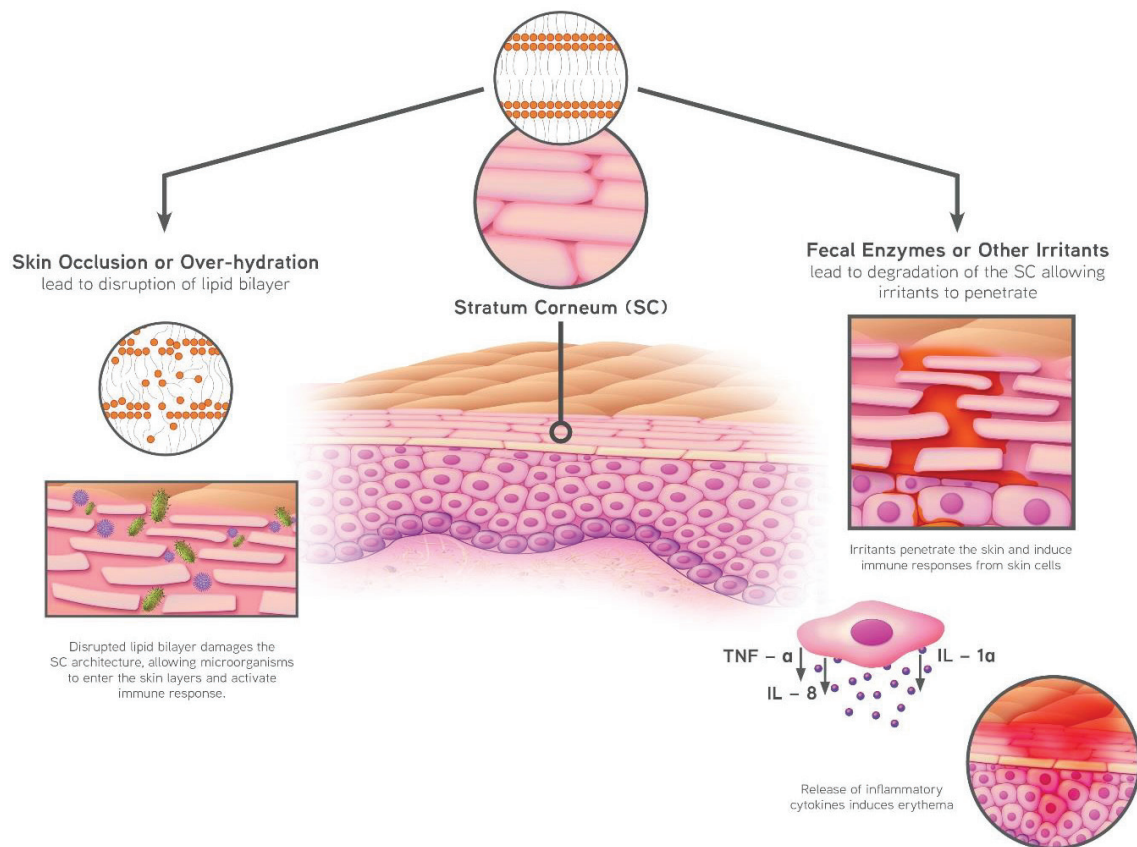


Figure 2: Factors involved in the initiation and elicitation of diaper dermatitis disrupt the stratum corneum (SC), resulting in activation of immune responses in skin.⁷

lower incidences of diaper dermatitis), and lack of or infrequent use of skin protectants also influence the occurrences of diaper dermatitis. Conceptually, diaper dermatitis is believed to develop from fecal irritants left on the skin that mix with urine to increase the pH of the skin.⁷

This also results in skin breakdown and infiltration of the irritants into the skin. Combined with increased skin hydration or wetness, mechanical rubbing of the diaper further weakens the skin barrier allowing additional irritants, bacteria, or fungi to enter the skin. Prolonged wetness can lead to infiltration and infection of the fungus *Candida albicans* leading to yeast

infections. An illustration of diaper dermatitis induction is depicted in Figure 2.

Preterm Infants

It is also known that preterm infants are at increased risk of developing diaper dermatitis because their skin barrier (stratum corneum) is not yet fully formed. In fact, infants born at gestational ages of less than 25 weeks only have half the thickness of both the stratum corneum and the underlying epidermis as compared with full term neonates (Figure 3).⁸⁻¹⁰ Moreover, premature infants skin is very permeable to both water and irritants.¹¹ Additionally, infants born at less than 28 gestational weeks lack an outer protective layer called the vernix caseosa and suffer from increased water evaporation from their skin.⁷ It is estimated to take 2-9 weeks after birth for the skin to fully form in preterm neonates.⁷

Mitigation

Although diaper dermatitis has not been shown to be completely avoidable, there is ample evidence that preventive care can be effectively implemented to reduce the incidence and severity of diaper dermatitis. Maintenance of dry skin in the diapered area can effectively reduce skin damage due to overhydration. Strategies including frequent diaper changes, airing out the skin in between diaper changes, and use of diapers with increased wicking and superabsorbent materials help in keeping the skin dry. Additionally, the use of creams and ointments that provide barrier protection between the skin and the external environment can help mitigate diaper dermatitis by preventing direct skin contact. Mechanical irritation due to overwiping can also lead to compromised skin and should be avoided. It is important to note that clinical studies have demonstrated the use

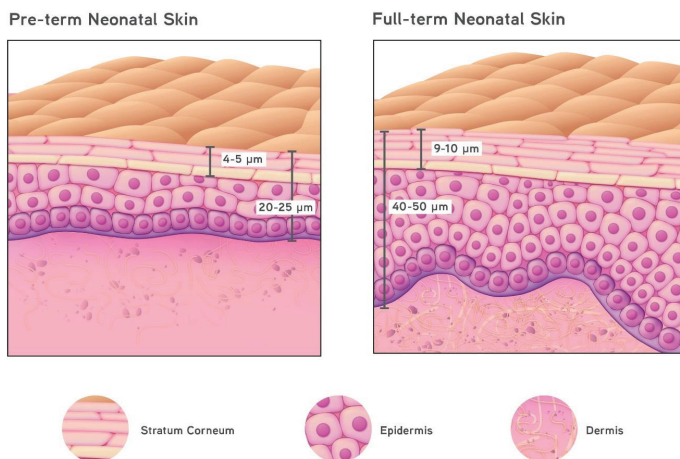


Figure 3: Stratum corneum and epidermis are incomplete in 25-week gestational age preterm neonates (left) compared to full-term neonates (right).

of disposable wipes that contain emollient cleansers to be less irritating on infant skin than water and cloth.¹²⁻¹³

Moreover, advances in diaper technology have helped mitigate the effects of elevated moisture retention and occlusion to address some of the moisture-induced skin irritation and keep baby more comfortable.¹⁴⁻¹⁶ Enhanced breathable outer cover materials allow air to pass into the diaper and minimize the moisture trapped inside. More hydrophilic and sophisticated materials are used to quickly take fluid in and channel it away from skin into moisture trapping regions. Advanced absorbent systems are now designed to be more thin and flexible, yet also retain more liquid and lock moisture away from the skin-diaper interface.¹⁴⁻¹⁶ A general diagram highlighting the balance of interacting forces between healthy and irritated diapered skin is shown in Figure 5.

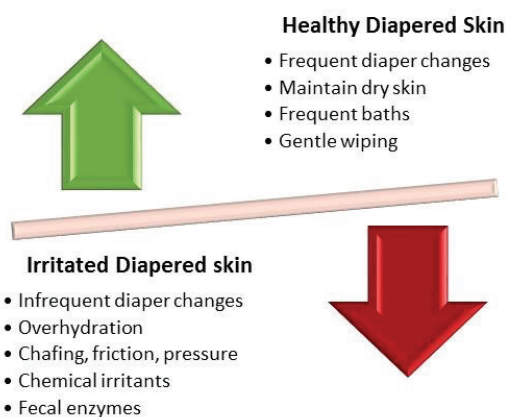


Figure 5: There is an intricate balance between healthy and compromised diapered skin. Environmental and caretaker practices heavily influence the incidence of diaper dermatitis.

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