

BENEFITS OF USING PROPERLY FORMULATED WIPES TO CLEAN PRE-TERM INFANT SKIN

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Human skin consists of three main layers: the epidermis, dermis, and underlying fat layer called the hypodermis. The dermis provides structural support for the epidermis and allows the skin to be resilient and absorb force.¹ The epidermis is the outer layer of the skin and can be further divided into multiple layers that serve different functions. Of particular interest is the outermost layer of the epidermis called the stratum corneum, or skin barrier, as it functions as the main barrier to the outside world. A functional stratum corneum is critical to health; it acts as a barrier to irritants and water loss, regulates heat and ion balance, prevents infection, resist mechanical trauma and provides immune surveillance and tactile sensation.¹⁻⁴ There are a number of factors that can contribute to skin barrier damage and disrupt its function. In infants, the diaper environment puts skin at a higher risk for skin barrier disruption and irritation.

How to maintain diapered skin health in premature infants

The skin of premature infants is under-developed and more fragile than full term infants. The skin barrier at around 25 weeks gestation is about half the thickness of full term infant skin (Figure 1),^{5,6} rendering premature skin more permeable to water and irritants. In addition, the dermis of premature infants contains fewer structural proteins which weakens the skin and puts them at higher risk of skin damage due to mechanical action like cleansing.^{1,7} Because of their under-developed skin, premature infants are at higher risk of diaper rash.

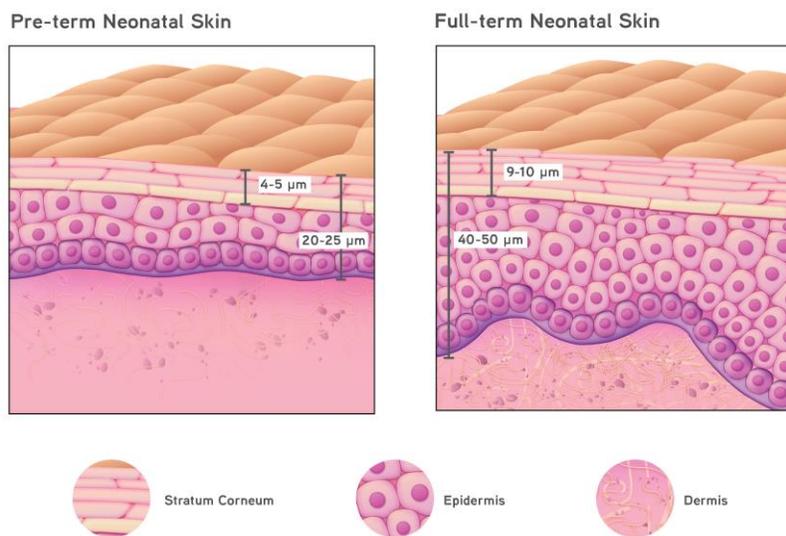


Figure 1. Pre-term infant skin (left) is thinner and under-developed compared to full term infant skin (right). The figure on the left depicts premature infant skin at around 25 weeks gestation. The figure on the right depicts full term infant skin. Adapted from Gregorio et al 2017.²⁶

While there is not one single cause of diaper rash, there are a number of factors in the diapered area that are known to be involved in skin break down and irritation which include skin over-hydration, exposure to irritants found in feces, increase in skin pH, mechanical abrasion, diet, loose/watery stool, and certain medications.⁸ One of the primary causes of diaper rash is the interaction of enzymes found in feces with the skin. Feces contains digestive enzymes that break down fat and protein consumed by the infant. Once these enzymes are excreted, they contact the outer layer of the skin and continue to digest the fat and protein of the skin barrier. This leads to breakdown of the skin barrier, allowing other irritants from feces to penetrate into deeper layers of the skin resulting in diaper rash onset.^{8,9} Therefore it is of utmost importance to thoroughly clean the skin to prevent damage caused by digestive enzymes and other irritants present in feces. Since the skin of premature infants is more fragile, it is also very important the cleaning process is as gentle as possible.

Formulated baby wipes have demonstrated to be gentle and effective to clean the delicate skin of premature infants

Appropriately formulated baby wipes are an ideal way to thoroughly and gently clean premature skin. Clinical studies over the last 15 years have demonstrated the safety and efficacy of using formulated baby wipes on infant skin. A summary of these studies is shown in Table 1. Baby wipes were found to be superior to water and cloth in four out of five published studies comparing cleaning with water and cloth to cleaning with formulated baby wipes. None of the studies found baby wipes to be inferior to water and cloth. A study published in 2009 demonstrated that, compared to water and gauze, use of baby wipes on infants in a Neonatal Intensive Care Unit (NICU) leads to better skin barrier properties including lower skin water loss, pH, and erythema scores.¹⁰ Two separate studies highlighted that even infants diagnosed with atopic dermatitis demonstrated excellent tolerance to cleaning with baby wipes.^{11,12}

Table 1. Review of literature comparing baby wipes with water and cloth.

Paper	Method	Highlights
Ehretsmann et al (2001) ¹¹	Study A: Investigator-blinded, parallel study comparing 117 full term infants cleaned with baby wipes versus water and cloth/implement.	Study A: Statistical improvement in diaper rash in the intertriginous folds with the baby wipes group.
	Study B: Clinical safety test for tolerance of baby wipes on 53 infants diagnosed with atopic dermatitis.	Study B: No cutaneous intolerance to the baby wipe was observed.
Lavender et al (2012) ¹³	280 full-term healthy newborn infants randomized to have the diaper area cleaned with baby wipes or cotton wool and water.	No difference between cotton wool and water and baby wipes in regards to pH, TEWL, hydration, erythema scores.
Adam et al (2009) ¹⁴	Study A: 32 full-term infants diagnosed with atopic dermatitis. Baby wipes were used on all infants.	Study A: No clinical signs of cutaneous intolerance was observed by the parents or the dermatologist.
	Study B: 15 full-term infants randomized to diapering cleaning with baby wipe or washcloth and water for 14 days.	Study B: Buttocks skin pH of infants cleaned with baby wipes was not statistically different than control site. Buttocks skin pH of infants cleaned

		with water and cloth was significantly higher than control site.
Visscher et al (2009) ¹⁰	130 NICU infants randomized to have their diaper area cleaned by a baby wipe or water and gauze.	Diaper area erythema, water loss, and skin pH were significantly lower in infants cleaned with one of the baby wipes tested.
Odio et al 2001 ¹²	82 subjects, around 15 months old, randomized to have their diaper area cleaned by a baby wipes or water and washcloth for 8 days.	Erythema scores were statistically lower in the perianal region of subjects cleaned with baby wipes. No differences in skin water loss were observed.

Attributes of a properly formulated baby wipe

Many modern baby wipes are formulated with infant skin health in mind. There are four main attributes of a properly formulated baby wipe.^{9,15}

Gentle Cleanser – Pre-term infants do not have a competent barrier at birth, thus they are at increased risk for irritation upon exposure to feces. Infant feces consist of both fat and water soluble components. Cleansing practices that only include water may not adequately remove fat soluble fecal material and can result in skin damage. The efficient removal of the fatty portion of feces requires surfactants to emulsify and trap them in droplets so they can be effectively removed.¹⁶ It has been shown that mild cleansers can be effectively used to remove these harmful substances without compromising skin health.^{17–21} Furthermore, several studies have shown that using water alone to clean skin leads to poorer skin health outcomes as compared to a properly formulated wipe that contains cleansers.^{10,11} Thus, almost all contemporary baby wipes contain low concentrations of mild surfactants to accomplish this important task.

Appropriately preserved – At birth pre-term infant skin does not have all the necessary defenses to protect against pathogens, thus it is of utmost importance to keep contaminants off of skin. Since microbial growth is enhanced in moist environments, baby wipes are at risk for microbial growth.²² Therefore, baby wipes should contain an approved preservation system to ensure a fresh product before and during use. Not surprisingly, many clinical and scientific experts recommend using baby wipes that contain a well-tolerated preservative as endorsed by agencies such as the US Cosmetic Ingredient Review or the European Union Cosmetics Directive.¹⁷

Acidic pH - Within a few days of birth, the pH of pre-term and full-term infant skin is slightly acidic around 5.5.^{4,23,24} The acidification process is a protective attribute of skin and vital to support maturation of the skin barrier, protect from pathogens, and inhibit digestive enzymes in feces that break down skin.^{1,25} Unlike water, most baby wipes are formulated to a slightly acidic pH to support healthy infant skin. A pH buffered formula also helps to neutralize irritants found in stool and supports the protective acidic nature of skin.^{9,10}

Emollient – When wiping the skin it is important to apply as little friction to the skin as possible to avoid mechanical damage to infant skin. This is especially true for premature infants because their skin has decreased structural support due to the underdeveloped dermis, in addition, they have an immature stratum corneum.^{1,7} Emollients are added to baby wipes to provide more glide across the skin thereby decreasing the risk of mechanical damage to the skin, another attribute cleansing which water alone lacks.

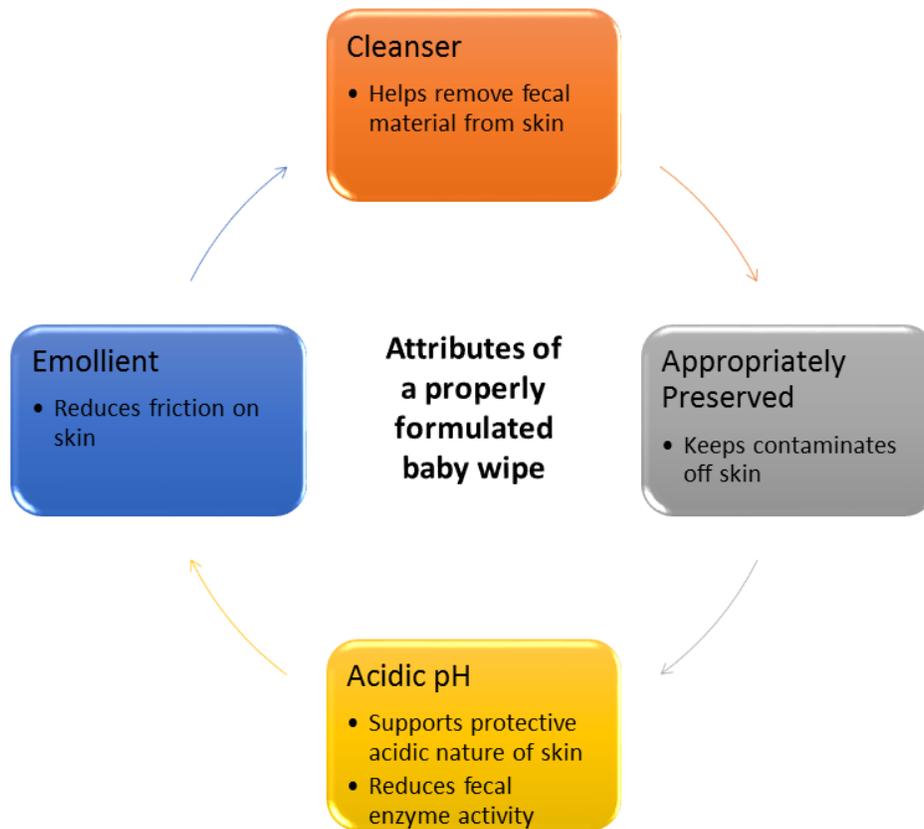


Figure 2. Attributes of a properly formulated baby wipe.

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