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PERSPECTIVES

Revisiting the Etiology and Management of Atopic Dermatitis: A Perspective on Skin Microbiota, Bathing Habits, and Surfactant-Free Skincare

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Abstract: The current consensus on the pathophysiology of atopic dermatitis (AD) involves Th2/Th22 inflammation, genetic predisposition such as filaggrin mutations, and skin barrier dysfunction. Meanwhile, AD has been hypothesized to be primarily caused by the defective formation of the commensal microbial community with insufficient skin regeneration as a secondary aggravating factor. AD presents with itchy, red, swollen, and cracked skin. Conventional treatments include emollients, topical corticosteroids, calcineurin inhibitors, and newer biologics. In Japan, moist wound healing techniques that promote autologous tissue regeneration have shown promising results, which have led to the development of novel, surfactant-free moisturizers designed to combat skin dryness. Based on these findings, this perspective proposes a new etiology of AD and considers suitable countermeasures. Recommendations include limiting newborn bathing to three times per week, discontinuing soap and shampoo applications, and using bathing additives containing petroleum jelly to neutralize the residual chlorine in tap water. Cognitive behavioral therapy strategies that substitute scratching with moisturizer application are also recommended. Additional measures, including smoking cessation by both patients and family members, and stress management, may reduce disease severity. This perspective article outlines hypotheses rather than established evidence. Some suggestions (eg, bathing frequency) are based on clinical experience or emerging findings that require further study.

Keywords: moist wound healing, skin regeneration, neonates, bathing additives, surfactant, microbiome

Introduction

The current consensus on the pathophysiology of atopic dermatitis (AD) involves Th2/Th22 inflammation, genetic predisposition such as filaggrin mutations,[1] and skin barrier dysfunction.[2] Conventional treatments include emollients, topical corticosteroids, calcineurin inhibitors, and newer biologics.[3] In Japan, atopic dermatitis affects 12–13% of the population,[4] making it a prevalent condition. It is now well known that frequent handwashing and the use of alcohol-based products, such as those recommended for infection prevention and control during the coronavirus pandemic, can exacerbate hand skin roughness. In Japan, surfactant-free moisturizers and moist wound healing methods to enhance autologous tissue regeneration have been developed.[5] Based on these findings, this perspective proposes several causes and countermeasures for AD. This perspective article focuses on bathing habits, surfactant use, and skin microbiota as central themes, including supporting literature, aiming to propose alternative or complementary perspectives to conventional approaches.

Etiology

AD has been hypothesized to be primarily caused by the defective formation of the commensal microbial community with insufficient skin regeneration as a secondary aggravating factor. This is supported by reports on the efficacy of transplanting indigenous microbiota from donors into the skin as an advanced AD treatment method.[6] The Mayo Clinic

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guidelines recommend bathing newborns only three times a week because frequent bathing promotes skin dryness.[7] However, in developed countries, daily bathing or showering has become increasingly common, and many newborns are bathed with similar frequency.

After neonates are discharged from the hospital, they are often bathed in warm tap water without bath additives. Concerning seborrheic dermatitis, the skin and hair are typically washed with foaming soaps and shampoos that can exacerbate skin dryness. Petroleum jelly is frequently recommended as a moisturizer in such cases, which is highly moisturizing and generally safe; however, it can be sticky and complicate care. Without the use of soap the following day after application, petroleum jelly residues may absorb dirt and debris, block the sweat glands, and contribute to the phenomenon known as the petroleum jelly paradox.[5] When the keratin and residual petroleum jelly with dirt adhering to skin, they become scaly and desquamate when scratched. This makes the continuous use of petroleum jelly challenging despite its effectiveness.

Recently, moist wound healing has gained popularity worldwide because the loss of sebum due to the use of surfactants is a contributing factor to delayed wound healing.[5,8] A combination of moist wound management, endovascular ablation, and compression therapy can heal intractable venous ulcers within approximately 2 months.[9] Furthermore, complete regeneration of amputated fingers and burned skin without the need for skin grafting is becoming increasingly feasible.[5] This perspective highlights moist wound healing as a new etiology and management for AD, offering distinct insights that differ from those presented in existing literature.

Notably, the skin sebum layer harbors approximately 1000 indigenous bacterial species, primarily anaerobes, as well as dozens of fungal species.[10] Disruption of this balance by soaps, detergents, and disinfectants can facilitate the overgrowth of aerobes, such as *Staphylococcus aureus*. This imbalance may lead to malodor, redness, itching, AD, and infections.[5] Additionally, sebum plays an important role in infection control.[9] Dry skin associated with AD can percutaneously absorb various substances,[11] sensitize the body, induce antibody production, and trigger allergic reactions to mites, mold, or wheat. In contrast, orally ingested substances are less likely to trigger antibody production.[12]

A common example of AD diagnosis is as follows: When dry skin, redness, and itching occur in newborns and infants due to daily bathing, steroids, petroleum jelly, or heparinoids may be used based on the diagnosis of infantile eczema. The application of steroids temporarily clears the skin, but the redness eventually returns, necessitating their reapplication. The patient subsequently develops AD and experiences difficulty weaning off the steroids.

Skin Barrier Management

To address these issues, limiting the frequency of baths during the neonatal period is recommended. The approach to bathing and moisturizing newborns proposed in this report is shown in Figure 1. When bathing, the use of a bath additive for neonates can be beneficial. After 3 months of life, when regular bathing practices are adopted, adding a bath additive containing petroleum jelly to lukewarm water can help neutralize traces of chlorine found in tap water,[13] while avoiding the use of soaps and body washes. Shampoo use should be limited; however, rinsing the hair is not discouraged. When the odor of dirt and sweat is a concern, bathing twice a day may be suitable after infancy.

Suppose dry skin persists despite the aforementioned measures; consideration may be given to using surfactant-free moisturizers recently developed in Japan.[5] Surfactants are substances that help mix water and oil; there are many types of surfactants, including soaps and detergents. In general, petroleum jelly is preferable to creams due to their higher residual rates of active ingredients and the base in the skin; however, they may still lead to the previously mentioned paradox. Applying creams that contain surfactants may provide a temporary moisturizing effect; however, they can also dissolve sebum, which may ultimately dry out the skin and produce the opposite effect. Surfactant-free moisturizers utilize a three-phase emulsification process to emulsify petroleum jelly, allowing water and oil to mix.[5] Surfactant-free moisturizers possess both moisturizing and emollient effects. Moisturizers should ideally be applied twice daily, although they may be used more frequently as needed. Moisturizers are lightweight creams that can be applied in a thin layer to the hands, face, and feet without the need to wash hands afterward. After application, they act as water repellents.

For individuals who wash less frequently, the moisturizing effects can be enhanced by taking a bath and applying a thin layer of petroleum jelly-containing bathing additives over the entire body, with surfactant-free moisturizers applied locally rather than solely relying on showering. Petroleum jelly applied to the nasal cavity can prevent dryness of the

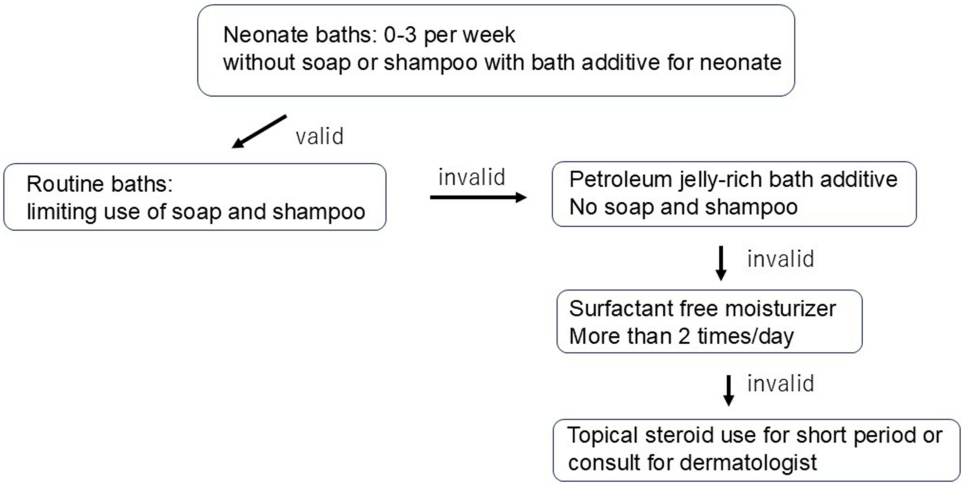

Figure 1 Proposed skincare approaches for infants Neonate bath habit: zero to three per week without soap and shampoo. Bath additive for neonate recommended. Valid indicates that normal skin is maintained. Invalid indicates the appearance or worsening of skin redness, itching. Arrows indicate the direction of changes or additions to interventions.

mucous membranes and serve as a countermeasure for allergic rhinitis, although there have been reports of rare occurrences of lipoid pneumonia. The new moisturizer can be applied very thinly, reducing the amount of petroleum jelly necessary.

Bathing in hot water should be avoided, as it can exacerbate allergies and lead to the loss of sebum. Particularly during cold winters, bath temperatures tend to be higher. If soap is necessary, a foaming product should be used while considering allergies and avoiding excessive amounts. Scrubbing the body with a sponge should also be avoided, even in the absence of soap. Activities such as shaving and cleansing after applying makeup may provide opportunities for sebum depletion. Shampoo-induced dandruff should also be considered, as switching shampoos may worsen dandruff due to changes in microbial balance.

Although the temporary use of steroids is generally acceptable, prolonged use should be avoided to prevent disruption of the skin's natural microbial balance. Steroids function by both regenerating and inhibiting epithelial cells. Consideration should be given to the possibility that even short-term use of steroids may exacerbate skin rashes caused by bacterial, fungal, or viral infections. One should be cautious about using topical steroids when the cause of the dermatitis has not been addressed. A week or more after the application of steroids, redness may recur, leading to a vicious cycle of reapplication. The use of germicidal or bacteriostatic agents, such as silver sulfadiazine and povidone-iodine, is contraindicated because they can destroy the indigenous bacterial flora. Moreover, topical antimicrobial agents should be avoided because they contribute to the development of resistant bacteria.[9] This skincare approach has reduced the reliance on conventional topical antibacterial agents, topical steroid, antihistamines, and antifungals, and may serve as an initial response to skin rashes and itching. Table 1 shows the differences between conventional standard AD management and the AD management proposed in this manuscript.

Severely damaged skin should be managed with moist wound healing techniques. Although hydrocolloids are beneficial when there is little to no exudate, in the presence of exudate, the risk of infection may increase if the dressing completely covers the wound. The use of irreversible membrane dressings and composite absorbent pads has improved the outcomes of moist wound healing techniques in Japan. Rinsing wounds twice daily, regardless of infection status, and covering them with functional dressings can create an optimal environment for tissue regeneration by promoting excess exudate absorption and maintaining a moist wound surface.[5]

Cognitive behavioral therapy, which aims to replace scratching behaviors with the application of moisturizers, is essential. Although scratching provides temporary stress relief, it ultimately damages the skin barrier. Patients should be advised to keep moisturizers in accessible locations such as by the bedside, in the bathroom, and in their bags, enabling prompt application for immediate relief whenever itching occurs. However, this treatment strategy is not without

Table 1 Summary of Differences Between Conventional vs Proposed Atopic Dermatitis (AD) Management The Proposed AD Management Methods Do Not Assume the Use of Topical Steroids

	Standard AD Management	Proposed AD Management
Neonate baths	Depending on facility policy	Zero to three times a week
Neonate bathing additive use	Usually only warmed tap water	Bathing additive for neonate
Moisturizer	Conventional cream or heparinoids	Surfactant free moisturizer
Routine bath additive	Free selection	Petroleum jelly-rich bath additives
Soap and shampoo	Usually used	No use
Topical steroid	Usually used	No or only short period (if needed)
Calcineurin inhibitors, newer biologics	Sometimes or more	No
Cognitive behavioral strategy	Almost none	Replace scratching with the application of surfactant free moisturizers

challenges, particularly because applying steroids in response to itching can lead to their overuse. Furthermore, petroleum jelly is not an optimal choice, as it may necessitate the subsequent use of soap and handwashing, which can aggravate itching. These issues have been addressed with the development of the new moisturizer.

Once a patient is weaned from steroids, skin pigmentation may remain, but redness and itching typically decrease. This approach to skin care is equally applicable to severe dermatitis, such as stasis dermatitis and is also beneficial for normal skin.

Environmental Triggers

Activities beyond daily bathing, including swimming in chlorinated pools, hot springs, and other bathing facilities, can exacerbate AD symptoms.[13] The body should be rinsed of chlorine and then moisturized. When washing dishes with detergent, individuals should either wear gloves or rinse their hands with water and then apply a moisturizer. Washing dishes with bare hands in hot water removes grease but also dissolves sebum. Individuals working in environments that require frequent hand exposure, such as healthcare or food handling, should use disposable gloves. Medical staff should not use a scrub during handwashing before surgery. The bacterial population on the fingers cannot, and should not, be reduced to zero. Additionally, the issue of alcohol-resistant bacteria has emerged.[14]

In addition to skincare, smoking cessation is vital for both patients and family members because second-hand smoke contains numerous allergens. For stress management, maintaining a synchronized body clock and avoiding sleep deprivation are recommended.[15] Cultivating a positive outlook and adapting to stressors may also help alleviate symptoms.[15] Comprehensive adherence to these measures is critical; omitting even one can result in skin roughness.

Infection Control

In AD, the integrity of the skin barrier is compromised, rendering the skin increasingly susceptible to infections. The imbalance of commensal bacteria allows *Staphylococcus aureus* and other pathogens to proliferate. The use of immunosuppressive drugs, such as steroids, also poses significant challenges. Since body temperature is related to immune status, the use of antipyretic analgesics should be avoided as a countermeasure. Appropriate antimicrobials must be employed.[15] Alcohol consumption may disrupt the balance of the oral and intestinal commensal flora.

Effectiveness Assessment Based on Clinical Practice

If one is unsure about the effectiveness of moisturizing, there are ways to determine if moist wound healing is beneficial for erythematous skin rashes. It is recommended that hydrocolloid be applied to an inconspicuous lesion site that has not been previously treated with steroids and removed after a period of several hours to two days. This allows for a comparison with the surrounding skin to assess its effectiveness. If moist wound healing is effective, erythema and itching will decrease, and the

Table 2 Proposed Countermeasures and Hypothesis Regarding Atopic Dermatitis (AD) Almost All Proposed Countermeasures for AD are Based on Clinical Observations

	Rationale or References	Evidence Level
Limitation of bathing habits in neonate	Mayo clinic guideline, reference 7	5
Bathing additives with petroleum jelly	None	5
Surfactant free moisturizer	Reference 5,9	5
Moist wound healing	Reference 5,9	4
Hydrocolloid and moisturizer testing	None	5
Petroleum jelly paradox	Reference 5,9	5

skin surface will become smooth and flat compared to the surrounding skin, indicating that moisturizing is likely to be beneficial. Although there are concerns about sebum loss associated with the peeling of hydrocolloid, the test resembles a patch test. If the erythematous lesion is large, it may be advisable to divide the lesion into several areas, attach hydrocolloids with a diameter of 1–2 cm, vary the attachment time and other conditions, and assess the effect after peeling them off. If the effectiveness of the hydrocolloid is confirmed, widespread attachment of the hydrocolloid to areas of severe dermatitis (around ankle joints or elbow joints) may help reduce the dermatitis, although there are concerns about contact dermatitis. Various hydrocolloids are available; however, a hydrocolloid bandage is recommended because it can be easily trimmed and has strong adhesion. The hydrocolloid should be gently peeled off after soaking in moisturizer.

In some cases, the effects of petroleum jelly and surfactant-free moisturizers are compared. The body is divided into left and right sides, with petroleum jelly applied to one side and a surfactant-free moisturizer to the other. If there is a difference in the skin's condition after 1–2 days, the cause should be investigated. If the dermatitis worsens when using a surfactant-free moisturizer, it may be necessary to temporarily discontinue its use, as it is rare but possible that an allergic reaction is occurring. If there is a lack of moisture, increasing the frequency of applying surfactant-free moisturizers. If petroleum jelly worsens the condition, it is possible that various substances, including allergens, are being absorbed and exacerbating the dermatitis.

The skin of infants and young children metabolizes quickly; thus, its condition can change rapidly. If a previously stable skin condition suddenly worsens, it is necessary to assess the cause, including the effects of foods, viral infections, post-steroid administration rebound, and others. The dryness and low humidity of indoor environments, especially in winter, can also impact skin condition. The effectiveness of the skincare regimen should be assessed, considering that epidermal regeneration occurs in approximately 1 month.[5] If the above measures do not improve the condition, consultation with a reputable dermatologist may be necessary.

Controversies

In refractory cases, adjusting the intestinal microbiome through lactic acid bacterial preparations, such as *Lactobacillus reuteri*, may be necessary. Although vaccines are believed not to cause AD,[16] cases of dermatitis and skin ulcers of unknown etiology linked to mRNA vaccination have been reported.[17,18] Vaccines, whether inactivated or live attenuated, contain immunostimulants.[19] Future randomized trials should clarify whether vaccination worsens AD.

Although randomized trials, including those examining early interventions with moisturizers and supplemental diets for AD, have been conducted, ways of inhibiting disease onset remain unknown.[20,21] A potential oversight in these studies may involve the surfactants present in moisturizers and the use of soaps.

Limitations

This study has a number of limitations, primarily that it was not a comparative study. There is absence of data, lack of control group, and potential for bias. The evidence level for AD management and hypotheses proposed in this report is presented in Table 2. Almost all proposed countermeasures for AD are based on clinical observations. Therefore, randomized, double-blind studies are warranted to ascertain the precise causes and treatment effects. Possible pitfalls

include the use of bath additives and moisturizers while still using soap or shampoo. Although the level of evidence for this study is quite low, it presents relatively inexpensive and feasible methods, which could be easily implemented and whose efficacy could be confirmed, supporting dermatological practice. These practices may be verified in trials and standardized in practice in the future.

Conclusion

The first few months of life, particularly the first month, may be critical in determining whether a child will develop AD or an allergic predisposition. As maternal immunity shields an infant during the early stages,[22] it may be important to promote the development of the skin and intestinal microbiota.[23] To achieve this, excessive cleanliness could be avoided by minimizing the use of soaps and shampoos containing surfactants. The use of bathing additives containing petroleum jelly and surfactant-free moisturizers, regardless of age, may be advisable. By minimizing factors that contribute to the progression of AD, it may be possible to develop therapeutic strategies that do not rely heavily on pharmacological interventions. This study presents a set of hypotheses and clinical observations, which should not be considered equivalent to findings from observational or experimental studies. Randomized, double-blind studies are warranted to ascertain the precise causes of AD and treatment effects.

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References

1. Gittler JK, Shemer A, Suarez-Farinas M, et al. Progressive activation of T_H2/T_H22 cytokines and selective epidermal proteins characterizes acute and chronic atopic dermatitis. *J Allergy Clin Immunol*. 2012;130(6):1344–1354. doi:10.1016/j.jaci.2012.07.012
2. Beck LA, Cork MJ, Amagai M, et al. Type 2 Inflammation contributes to skin barrier dysfunction in atopic dermatitis. *JID Innov*. 2022;2:1000131.
3. Wollenberd A, Ehmann LM. Long term treatment concepts and proactive therapy for atopic eczema. *Ann Dermatol*. 2012;24(3):253–260. doi:10.5021/ad.2012.24.3.253
4. Takeuchi S, Esaki H, Furue M. Epidemiology of atopic dermatitis in Japan. *J Dermatol*. 2014;41(3):200–204. doi:10.1111/1346-8138.12331
5. Yamamoto K, Miwa S, Yamada T, et al. Major impact of moist wound healing on autologous tissue regeneration: a review of ulcer treatment. *Health Sci Rep*. 2023;6(1):e1029. doi:10.1002/hsr2.1029
6. Myles IA, Castillo CR, Barbian KD, et al. Therapeutic responses to *Roseomonas mucosa* in atopic dermatitis may involve lipid-mediated TNF-related epithelial repair. *Sci Transl Med*. 2020;12(560):eaaz8631. doi:10.1126/scitranslmed.aaz8631
7. Mayo Clinic Staff. Baby-bath basics: a parent's guide [Internet]. Mayo Clinic Publications. 2022. Available from: https://www.mayoclinic.org/healthy-lifestyle/infant-and-toddler-health/in-depth/healthy-baby/art-20044438. Accessed April 30, 2025.
8. Seweryn A. Interactions between surfactants and the skin - theory and practice. *Adv Colloid Interface Sci*. 2018;256:242–255. doi:10.1016/j.cis.2018.04.002
9. Yamamoto K, Miwa S, Yamada T, et al. A strategy to enable rapid healing and prevent recurrence of venous ulcers. *Wounds*. 2022;34(4):99–105. doi:10.25270/wnds/2022.99105
10. Gao Z, Perez-Perez GI, Chen Y, Blaser MJ. Quantitation of major human cutaneous bacterial and fungal populations. *J Clin Microbiol*. 2010;48(10):3575–3581. doi:10.1128/JCM.00597-10
11. Smith AR, Knaysi G, Wilson JM, Wisniewski JA. The skin as a route of allergen exposure: part I. immune components and mechanisms. *Curr Allergy Asthma Rep*. 2017;17(1):6. doi:10.1007/s11882-017-0674-5
12. Lack G. Update on risk factors for food allergy. *J Allergy Clin Immunol*. 2012;129(5):1187–1197. doi:10.1016/j.jaci.2012.02.036
13. Perkin MR, Craven J, Logan K, et al. Association between domestic water hardness, chlorine, and atopic dermatitis risk in early life: a population-based cross-sectional study. *J Allergy Clin Immunol*. 2016;138(2):509–516. doi:10.1016/j.jaci.2016.03.031
14. Pidot SJ, Gao W, Buultjens AH, et al. Increasing tolerance of hospital *Enterococcus faecium* to handwash alcohols. *Sci Transl Med*. 2018;10(452):eaar6115. doi:10.1126/scitranslmed.aar6115
15. Yamamoto K. Five important preventive measures against exacerbation of coronavirus disease. *Anaesthesiol Intensive Ther*. 2021;53(4):358–359. doi:10.5114/ait.2021.108581
16. Ayasse M, Ahmed A, McCullum C, Espinosa ML, Paller AS, Silverberg JI. Vaccines do not cause atopic dermatitis: a systematic review and meta-analysis. *Vaccine*. 2021;39(13):1805–1811. doi:10.1016/j.vaccine.2021.02.036
17. Bellinato F, Maurelli M, Gisondi P, Girolomoni G. Cutaneous adverse reactions associated with SARS-CoV-2 vaccines. *J Clin Med*. 2021;10(22):5344. doi:10.3390/jcm10225344

18. Aoki N, Saruta Y, Tanaka S, Nakajima R, Sano H, Sano S. Skin ulcer at the injection site of BNT162b2 mRNA COVID-19 vaccine. *J Dermatol*. 2021;48(12):e596–e597. doi:10.1111/1346-8138.16163
19. Yamamoto K. Need for validation of vaccination programs. *Discov Med*. 2025;2(1):71. doi:10.1007/s44337-025-00274-0
20. Skjerven HO, Rehbinder EM, Vettukattil R, et al. Skin emollient and early complementary feeding to prevent infant atopic dermatitis (PreventADALL): a factorial, multicentre, cluster-randomized trial. *Lancet*. 2020;395(10228):951–961. doi:10.1016/S0140-6736(19)32983-6
21. Horimukai K, Morita K, Narita M, et al. Application of moisturizer to neonates prevents development of atopic dermatitis. *J Allergy Clin Immunol*. 2014;134(4):824–830.e6. doi:10.1016/j.jaci.2014.07.060
22. Lawrence RM, Lawrence RA. Breast milk and infection. *Clin Perinatol*. 2004;31(3):501–528. doi:10.1016/j.clp.2004.03.019
23. Houghteling PD, Walker WA. Why is initial bacterial colonization of the intestine important to infants' and children's health? *J Pediatr Gastroenterol Nutr*. 2015;60(3):294–307. doi:10.1097/MPG.0000000000000597