BIODERMA

LABORATOIRE DERMATOLOGIQUE

INFLUENCE OF WATER EXPOSURE

ON ATOPIC SKIN & PATIENTS' QUALITY OF LIFE

NAOS ECOBIOLOGY | AT THE HEART OF DERMATOLOGY

1 CAPSULE SUMMARY

Atopic Dermatitis (AD), characterized by chronic inflammation and impaired barrier function of the skin, presents unique challenges for individuals, particularly concerning water-related activities. ***Patients face potential environmental exposures that contribute to the breakdown of the skin barrier, such as domestic water hardness, chlorine concentration, salts, pH, and temperature of water.*** *These factors pose a significant risk for irritation and exacerbation of symptoms.*

Despite the evident impact on patients' lives, there are notable gaps in the scientific literature, with no high-quality evidence available regarding the relationship between swimming exposure and AD outcomes. This lack of research leaves healthcare professionals and patients with uncertainties about the specific effects of swimming on the condition.

The consequences of AD extend beyond physical discomfort, significantly affecting the quality of life for individuals dealing with the condition. The visual impact of eczematous skin in social situations can lead to self-consciousness and embarrassment. Moreover, the condition imposes restrictions on daily activities, making it challenging for individuals to engage in essential life skills, such as swimming.

Recognizing the multifaceted challenges posed by AD and addressing the gaps in the understanding is key for developing comprehensive strategies to manage the condition effectively. Future research endeavors should focus on investigating the intricate relationship between water exposure, particularly in the context of swimming, and the outcomes of AD. This holistic approach will not only contribute to advance scientific knowledge but also aid in developing practical recommendations for patients seeking to incorporate water-related activities into their lives while managing their skin condition.

2 HOW CAN WATER COMPONENTS AFFECT ATOPIC SKIN?

The environment plays an important part in the etiology of atopic eczema[1], and there is a complex interplay between the different exogenous factors. Regular contact with water in daily activities, whether for hygiene purposes or during swimming, can impact the skin barrier and may trigger and/or flare disease in predisposed individuals.

WATER HARDNESS

WHAT DEFINES HARD WATER?

The formation of hard water occurs as minerals dissolve in water during the filtration process through sedimentary rocks. The primary mineral responsible for hard water is calcium, present in calcium carbonate ($CaCO_3$), commonly associated with calcareous rocks and limestone[2]. As per the World Health Organization (WHO), domestic water is qualified as hard when the concentration of $CaCO_3$ exceeds 200 mg/L[3].

Skincare practices play a pivotal role in the management of AD, especially in infants and young children[4]. The influence of household water quality, specifically the concentration of dissolved calcium (Ca^{2+}), in household water supplies can be important. The hardness of water, shaped by local geological factors and the proportion of groundwater in residential water sources, can vary, potentially impacting the skin barrier.

Research, initiated by a significant study in 1998, suggests **a connection between water hardness and the prevalence of AD in primary-school children.** The study, conducted in Nottinghamshire, brought attention to regional variations in water hardness associated with differing rates of AD prevalence. The primary suggested mechanism revolves around the potential harm caused by calcium in hard water to the skin barrier, leading to heightened dryness and irritation, thus predisposing children to AD or exacerbating existing symptoms[5]. Since then, international studies from the UK, Spain, and Japan consistently reveal positive associations between household water hardness (range: 76 to > 350 mg/L $CaCO_3$) and AD risk among schoolchildren[6]. **Skin contact with hard water has been associated with increased TEWL (TransEpidermal Water Loss), particularly in patients with AD and filaggrin mutations[7].**

Elevated levels of calcium carbonate in domestic water have also been linked to an increased risk of AD in adults. A large population-based cohort showed that exposure to higher concentrations of domestic hard water is associated with an increase in eczema prevalence in adults aged 40–69 years, especially in individuals with AD and filaggrin mutations, resulting in a more pronounced effect[8].

Various proposed mechanisms shed light on the **impact of high levels of calcium on skin integrity.** Disruption of the natural calcium gradient in the epidermis could result in abnormalities in keratinocyte differentiation.

A finely controlled calcium gradient is necessary to the formation of the bilayer lipid water barrier, and its disruption is considered a crucial step in the early development of AD. Calcium and magnesium may act as direct irritants or modify the effects of other chemicals, potentially causing mucocutaneous barrier defects, which in turn allow invasion of antigens. Additionally, the alkalinity of hard water, compared to soft water, can alter skin surface pH, influencing skin barrier function[9].

The choice of cleansing products is also important, and even more when the water is hard.

The effectiveness of soap is intricately linked to the water hardness. The use of mild surfactants that neutralize hard water helps reduce mineral deposits on the skin, mitigating the adverse effects of hard water on the skin. While soap reacts with hard water, its delipidating nature compromises the skin's barrier function[1].

CHLORINE

Chlorine, universally added to tap water and often added to pools for its antiseptic activity, is a potential skin irritant[10].

Chlorine is usually added to water as a sodium hypochlorite solution (NaClO), while an acid is also added to balance the increasing pH (basification). Its irritant potential could be linked to the exposure to low concentrations of the chlorine derivatives: free chlorine reacts with substances containing nitrogen (e.g. sweat and urine) to form byproducts that can be detrimental. The most important of these byproducts seems to be nitrogen trichloride, a trichloramine. Compared to monochloramine and dichloramine, it is much more volatile and turns into a gas that is highly irritating to the respiratory tract, eyes and skin [11, 12].

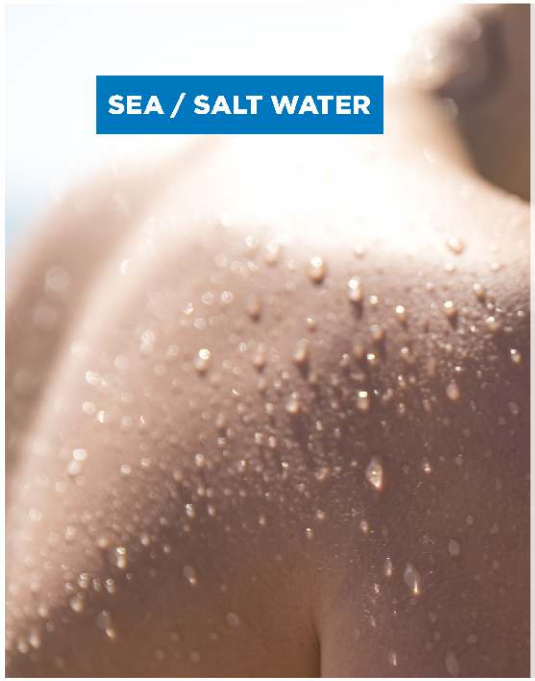
These multiple chemicals may dry out or irritate atopic skin, triggering or exacerbating a flare-up of eczema[6]. Exposure to chlorine in swimming pools has been associated with the development of irritant contact dermatitis ("pool dermatitis") or allergic contact dermatitis ("pool water dermatitis") in sensitive individuals[13].

The influence of water pH on atopic skin is an important aspect to consider. Swimming pool water, with a slightly alkaline pH ranging from 7.2 to 7.4, contrasts with the natural acidic pH of the skin, which typically ranges from 4.1 to 5.8.

The skin's acid mantle plays an essential role in preserving moisture and essential lipids, while also serving as a barrier against pathogens, irritants, and allergens. Excessive alkalinization of the skin may disrupt this acid mantle, causing the skin to become dry and irritated, and may contribute to the development or exacerbation of AD symptoms[6].

Beyond recreational exposure, chlorine is a common disinfectant in household water, with concentrations typically ranging from 0.2 to 1 mg/L according to WHO guidelines[14]. This exposure, albeit at lower levels, underscores the pervasive nature of chlorine in our daily lives and its potential influence on atopic skin.

Interestingly, despite the potential irritant effects, there is evidence suggesting that controlled exposure to chlorine, specifically in the form of bleach baths may have therapeutic benefits for individuals with AD reducing the microbial load on the skin[6,15].



SEA / SALT WATER

The impact of sea water on atopic skin remains a topic of interest within the realm of dermatological discussions.

Despite reports of the potential for sea water to cause skin irritation in patients with AD and documented correlations with staphylococcal skin infections, there is a noticeable dearth of concrete evidence regarding the overall impact of saltwater on AD outcomes[6,16].

The complex interactions between skin and water, whether it is hard, salty or chlorinated, underscore the necessity for additional research to unravel the nuances of their impact on atopic eczema.

3 WHAT IMPACT ON PATIENTS' QUALITY OF LIFE?

The constraints imposed by AD condition extend to various facets of a patient's life, including clothing choices, social interactions, ownership of pets, and participation in sports. Swimming, often considered a source of joy and physical activity, can unfortunately have a substantial negative impact on the quality of life for individuals with AD.

First of all, the exposure to water poses the risk of triggering a flare-up of AD, leading to pain and itching that significantly affects daily life, especially sleep quality[17].

Lifestyle restrictions dictated by AD, such as recommendations to avoid swimming during severe flare-ups or in the case of impetiginisation, not only limit the therapeutic benefits of swimming as a form of exercise but also contribute to a sense of exclusion from peer activities.

The discomfort and visible symptoms may result in patients, particularly children, feeling ashamed of their skin's appearance, potentially leading to isolation or becoming targets for ridicule. The social consequences, such as peer rejection and bullying, can lead to a profound sense of social isolation, loss of confidence, mood changes, and even depression[17].

Beyond the emotional toll, there's a risk that individuals with AD may not experience the health benefits of swimming or miss out on the opportunity to learn this essential life skill[6]. Managing the challenges associated with swimming in the context of AD is crucial for preserving the overall well-being and mental health of affected individuals.

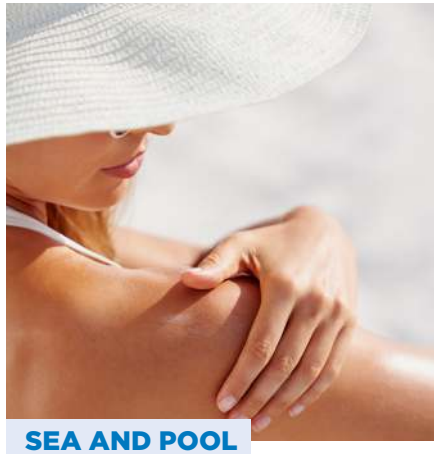
Recognizing and addressing the multifaceted impact of AD on the quality of life is crucial for preserving the overall well-being and mental health of affected individuals and for holistic management.

4 WHAT ARE THE RECOMMENDATIONS FOR PATIENTS?

Restoring and maintaining skin integrity, as well as acid mantle homeostasis, is crucial for atopic skin, which is susceptible to external factors such as water exposure. Several easy-to-implement measures can be adopted to prevent flare-ups and enjoy the benefits of water and swimming[6,15]:

AT HOME

- Thoroughly clean the skin with gentleness and care.
- Use a cleanser with or without antiseptics with adequate pH values (between 5 and 6) and lipid content. Surfactants with calcium-dispersing properties are recommended for use in hard water.
- Use a lukewarm water (27–30°C) and keep bath/shower times short (approx. 5 min) to prevent skin dehydration.
- Apply topical emollients directly after a bath or shower, following gentle drying, when the skin is still slightly moist.



SEA AND POOL

- Apply emollient before swimming (or use appropriate sunscreen if outdoors).
- Pro-active use of topical anti-inflammatory treatments in the days before swimming can help reduce disease activity and reactions to water.
- Change clothes and rinse immediately to remove chlorine/salt water, using lukewarm water (27–30°C).
- Apply topical anti-inflammatory treatments and emollients immediately after rinsing.

KEY MESSAGES

- **Water type can have an influence on atopic skin and patient's quality of life.**
- **There is a substantial knowledge gap regarding the impact of water exposure on AD and optimal advice for concerning exposure to water hardness, chlorine, or salt.**
- **Some recommendations based on current knowledge and expert opinions can enhance eczema control in the context of water exposure.**
- **Future studies should explore the impact of water types on atopic skin, and the potential benefits of dermo-cosmetic products to protect from and/or counteract water negative effects on skin, that could allow atopic patients to live their lives to the fullest.**

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