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Racial/Ethnic Variations in the Skin Barrier of Canadians: Implications for Skincare Recommendations Promoting a Healthy Skin Barrier and Mitigation of Atopic Dermatitis

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ABSTRACT

Background: Skin barrier differences and variations in the presentation of common dermatoses such as xerosis and atopic dermatitis (AD) have been reported in racial/ethnic Canadian patients. This review discusses skin barrier differences and explores the role of ceramide-containing skin care in promoting a healthy skin barrier and mitigating AD.

Methodology: A literature review and panel discussions followed by an online review were used to adopt five statements and recommendations to promote a healthy skin barrier in various racial/ethnic Canadian AD populations.

Results: The multifactorial pathogenesis of AD includes genetic and environmental factors that may vary among racial/ethnic and geographic populations. Studies comparing ethnic groups have reported variations in transepidermal water loss, skin lipid levels, and stratum corneum pH. However, these studies frequently have flaws. The panel agreed that essential skincare principles apply to all AD-affected patients regardless of racial/ethnic background.

Conclusion: Robust comparative studies are needed to help clinicians to tailor patient education and recommend routine skincare with gentle cleansers and moisturizers containing lipids for AD management regardless of disease severity and prescription treatment.

Keywords: Racial/ethnic skin barrier variations, skincare, atopic dermatitis

Background

Genetic and environmental factors influence the structure and function of the stratum corneum (SC) barrier.[1] Approximately 30% of Canadians are estimated to be part of a fast-growing racial/ethnic population by 2031.[2] However, morphology and descriptions of dermatoses are based on White patients and the historic assumption that most residents of Canada and the United States are of Northern European descent.[2]

Differences in the skin barrier properties and function and the presentation of common dermatoses such as xerosis and atopic dermatitis (AD) have been observed in subjects with richly pigmented skin compared to White subjects.[1-6] Several studies have investigated SC differences between racial/ethnic skin, comparing SC properties of self-identified Black, White, and Asian skin.[1] In one such study, White subjects had an intermediate barrier strength as evidenced by tape strippings, and Asians have been demonstrated to require the least number of tape strippings to disrupt the SC barrier.[1] This finding indicates a weaker barrier strength and slower recovery from barrier damage in the Asian

population, supporting the observation of sensitive skin seen in Asians.[1]

There are significant disparities in the prevalence and treatment of skin conditions across Canadian populations.[2-6] The burden of AD is higher in racial/ethnic populations, and numerous barriers to treatment exist, including systemic and institutional racism, poverty, crowded housing conditions on reserves, access and cost of basic skincare regimens, and clean water access.[2-4] Promoting a healthy skin barrier remains a particular challenge for Indigenous groups, who lack access to appropriate treatments and skincare.[2-6]

This review discusses skin barrier differences in various racial/ethnic Canadian populations and explores the role of ceramide-containing skin care in promoting a healthy skin barrier and mitigating AD.

Methods

A group of dermatologists assembled during the Dermatology Update conference on November 13, 2021, in Montreal, Quebec. The panel (advisors) [four Canadian dermatologists and one dermatologist from the US] reviewed skin barrier differences in various racial/ethnic Canadian groups exploring dermatology issues related to skin barrier integrity. Additionally, the advisors determined the relevance of skincare-containing ceramides comprising cleansers and moisturizers for these populations to promote a healthy skin barrier and mitigate AD. Finally, the advisors looked into patient and clinician education tools to promote a healthy skin barrier in various racial/ethnic Canadian populations.

The project used a modified Delphi process comprising face-to-face discussions followed by an online follow-up.[7-9]

Literature Review

Structured literature searches on PubMed and Google Scholar as secondary source of the English-language literature (2010 – September 2021) were conducted before the meeting on September 21 and 22, 2021. We searched for guidelines, consensus papers, clinical studies, and reviews describing skin barrier properties in various racial/ethnic Canadian populations and current best-practice in promoting a healthy skin barrier and mitigation of AD using ceramides containing non-prescription skincare cleansers and moisturizers. Excluded were papers with no original data (unless a review article was deemed relevant), or not dealing with racial/ethnic Canadian or skincare, and publication language other than English.

The Nomenclature Used for the Searches

Searches were performed for the main ethnic Canadian groups [Black, White, Asian and Indigenous populations] and ethnic regions in Canada.[2-6] Indigenous is a preferred term within Canadian communities. It is an umbrella term that covers Aboriginal, Metis, and Inuit populations. The publications collected a range of demographic data, including ethnic origin. Demographic factors referred to the quantitative data relating to the study population and its composition, which allowed portions of the population to be broken down into subgroups for closer examination.[2-6] Further searches included associations between these demographic factors and the biophysical nature of racial/ethnic skin, skin care practices, and AD treatment product use.

Search Terms

The searches explored present clinical guidelines, treatment options, and therapeutic approaches addressing racial/ethnic Canadian populations using the following terms:

Racial/ethnic Canadian populations AND AD prone skin, OR Black, White, Asian and Indigenous populations in Canada AND AD, OR racial/ethnic Canadians AND skin barrier physiology OR skin barrier function/dysfunction OR racial/ethnic Canadians AND depletion of stratum corneum lipids, OR racial/ethnic Canadians AND AD prevention, OR racial/ethnic Canadians AND AD treatment, OR Black, White, Asian and Indigenous populations in Canada AND mitigation of AD, OR racial/ethnic Canadian populations with AD/AD prone skin AND skincare, OR Black, White, Asian and Indigenous people in Canada AND cleansers OR moisturizers OR emollients OR ceramides OR ce¬ramide containing skincare OR racial/ethnic Canadian AD populations AND skincare efficacy OR safety OR tolerability OR skin irritation

The searches were performed by a dermatologist and a physician/scientist (reviewers). After selection, the publicatiodns were manually reviewed for additional resources.

Priority was given to studies on SC barrier function and the benefits of skincare using cleansers and moisturizers in racial/ethnic Canadian populations with AD or AD-prone skin.

The searches yielded 248 papers, and after excluding 173 articles [duplicates, poor quality, not about Canadian racial/ethnic AD populations or skincare], 75 remained, comprising 4 epidemiology, 4 quality of life (QoL) studies, 20 guidelines, consensus papers and systematic reviews, 19 reviews, 24 clinical studies, and 4 others.

Role of the Panel

The advisors used the literature review results, clinical experience, and expertise to adopt statements and recommendations. The results were integrated into the summary statements presented and discussed during the face-to-face meeting. For example, in a workshop, advisors divided into three groups to create a final set of summary statements about Canadians' racial/ethnic differences in SC barrier structure and function and skincare for this population, working with 12 draft messages. The final five statements integrate the combined output from the workshop groups and post-meeting online reviews from individual advisors.

Results

Statement 1: The properties and conditions of the skin vary with body site and can be influenced by factors such as skin type, ethnicity, gender, or lifestyle.

Epidemiological data indicate a higher prevalence and severity of AD in racial/ethnic Canadian populations.[6,10-13]

A three months population survey of all children aged 2-12 years in the community in the First Nations reserve of Natuashish, Labrador, Canada, showed that of 182 examined children, 30 (16.5%) mainly (20/30) had moderate to severe AD.[6] IgE levels in children with and without AD had average values at least ten-fold higher than other populations.[6]

A systematic review and meta-analysis extracted 21 studies [1990 to 2020] from three medical databases [Pubmed, Embase, and Web of Science] to examine the prevalence of AD, clinical manifestation, and risk factors among children and adolescents

in the Arctic.[10] The cumulative AD incidence was 23%, and the 1-year prevalence was 19%, with the highest incidence in Arctic Scandinavia, lower Greenland, and Russia.[10] The review indicated that the risk for AD in indigenous children living in rural Arctic areas seems slightly lower.[10] Although the systematic review looked at the Arctic regions and included indigenous peoples, it did not mention Canadians.

A further study [2018] showed an AD prevalence of 20.5%, with the highest prevalence recorded among grade-1 Inuit children at 25%, compared to 15.4% among mixed ethnicity and 14.3% among non-Inuit children.[11] The variations in prevalence and risk factors of asthma, allergic rhinitis, and AD among the different ethnicities living in the same subarctic environment may be related to genetic, gene-environment interaction, or lifestyle factors.[11]

An international study of asthma and allergies using written questionnaires included 8334 adolescents aged 13 to 14 in Vancouver, Saskatoon, Winnipeg, Hamilton, and Halifax, Canada.[12] Although AD was significantly more prevalent in Winnipeg (1.31; 1.01-1.69) and Vancouver (1.28; 1.04-1.58), the highest prevalence rates of allergic rhinoconjunctivitis or AD were not observed in the same regions as the highest prevalence rates of wheezing, suggesting dissimilar risk factors.[12]

A cross-sectional study in Europe and Canada on AD patient-reported burden of disease showed a substantial impact (pruritus, pain, loss of sleep, higher levels of anxiety and depression) which was highest in those with severe AD.[13]

A similar high burden of AD has been shown in studies from other countries.[14-18]

Statement 2: The literature suggests racial/ethnic variations in ceramide content, SC structure, and filaggrin mutations. Racial/ethnic differences in barrier structure and function have been observed between Black, White, Asian, and Indigenous populations. Differences in TEWL have also been reported, but data are conflicting, and further research is needed.

The multifactorial pathogenesis of AD includes genetic and environmental factors that may vary among racial/ethnic and geographic populations.[19] Genetic and immunophenotypic differences between racial/ethnic AD populations, such as lower rates of filaggrin gene mutations, have been described among Black populations.[20-33] Studies involving small groups of East Asian and African American patients have identified differences in cytokine expression compared to European-American patients.[20-33] A literature review on clinical and molecular features of AD found differences in filaggrin (FLG) loss-of-function mutations across various ethnic groups with AD.[29] The authors noted that studies in European American compared to Asian American AD populations have consistently shown a higher prevalence of FLG loss-of-function mutations in up to 50% of European and 27% of Asian American patients, respectively.[29,30] However, the association between FLG loss-of-function mutations and AD development in populations of African descent is unclear, and other genes may be involved in skin barrier dysfunction.[30]

A higher prevalence and persistence of AD has been noted in African American children and racial/ethnic disparities in health care utilization and access to therapies.[22-30]

However, most of the information on racial/ethnic and geographic AD population variations originates from the US and may only be partially applicable to Canadians.

Statement 3: Data on racial/ethnic differences in skin barrier structure and function are limited but suggest variations in some characteristics relevant to skincare.

A healthy skin barrier function depends on the complex interplay among SC pH, desquamation rate, and the appropriate ratio of intrinsic lipids.[37-40] The lipids comprise approximately twenty percent of the volume of the healthy stratum corneum (SC) and are composed of CERs (40–50%), cholesterols (20-33%), and free fatty acids (7–13%).[37-39] Further lipids include cholesterol-3-sulfate (0-7 %) and cholesteryl esters (0-20 %).[37-40]

The slightly acidic surface of healthy skin is required to mature and maintain the SC barrier, inhibiting the growth of pathogenic microorganisms.[39] Skin acidification plays an important role in SC barrier maturation and the activation of enzymes involved in the extracellular processing of SC lipids.[39] The SC pH influences barrier homeostasis, integrity and cohesion, and antimicrobial defense mechanisms.[39]

It is unclear why specific changes in CER composition do not seem to affect a healthy SC and why deficiency of specific CER species and alterations in fatty acid composition occur in certain skin diseases such as AD.[41-45]

There is some evidence that the skin barrier in Black skin contains fewer CERs and that the skin barrier in Asian skin is most vulnerable to disruption.[1,19] A less cohesive skin barrier in Asian skin might help explain differences in trans-epidermal water loss in this population.[1,19] The advisors suggested that studies correlating skin barrier structure to dysfunction in Asian skin (perhaps involving tape stripping) could provide insights. Skin barrier differences (lipids, less cohesive skin barrier) may contribute to ethnic differences in the prevalence of xerosis, pruritus, and AD.

Some individuals with AD may produce inadequate amounts of certain CERs.[31,41-45] Many with AD or AD-prone skin exhibit baseline increases in TEWL even within their unaffected, normal-appearing skin.[31,41-45] Racial and ethnic differences have been reported in the SC barrier function, including CERs content and TEWL.[45]

Conventional moisturizers contain occlusives, humectants, and emulsions.[39] Newer classes of moisturizers designed to restore skin barrier defects include distinct ratios of lipids that resemble physiological compositions, such as CERs, cholesterol, and essential fatty acids.[37-40]

CER-containing moisturizers were found to benefit AD patients when used as mono, adjunctive, and maintenance treatment.[19,37-39,46-52] Guidelines, algorithms, and consensus papers agreed that the use of moisturizers that contain lipids, such as CERs (or their precursors) reduces pruritus, helps control xerosis, and improve the dysfunctional skin barrier in AD patients.[34-39,53]

Other ingredients in moisturizers (i.e., virgin coconut oil, glycyrrhetinic acid, *V. vinifera*, shea butter, mineral water and hyaluronic acid) have also been recommended.[54-59]

A Canadian study including 47 patients with inflammatory dermatosis, applied thermal water and hyaluronic acid-containing

moisturizer for 4 weeks as an adjunct to treatment and found a markedly improved skin condition.[59]

A systematic review of 92 randomized controlled trials on the efficacy and safety of moisturizers for AD showed that those containing a mixture of substances (urea, glycerin or glycyrrhetinic acid, ceramides) seem to have greater effectiveness than basic emollients.[62]

Additionally, regular moisturizer use improves pruritus frequently caused by AD.[63]

As the mainstay of treatment, moisturizers should be liberally applied both in AD-prone skin and AD.[34-39, 53, 60-62] The moisturizer should be used at least twice daily directly after bathing and more frequently during acute flare-ups.[34-39, 53] Further moisturizers must be suitable for the patient's skin type, climate, humidity, and environmental conditions.[36-39,53-55]

The advisors agreed that focusing too much on minor ethnic variations in the skin barrier of AD-affected patients could interfere with essential skincare principles that apply to all skin types. Instead, concentrating on similarities while acknowledging the differences may be more helpful.

A Canadian algorithm for topical treatment of mild-to-moderate AD for adults and pediatric patients and US guidelines for topical treatment of AD include education and avoiding triggers.[34,35] Routine skincare with gentle cleansers and moisturizers is considered an integral part of AD management regardless of disease severity and prescription treatment (Table 1).[34-38]

Statement 4: Skin barrier differences between racial/ethnic populations may contribute to variations in the prevalence and severity of atopic dermatitis, xerosis, and, pruritus. Environmental issues and disparities in access to care may also play a role.

Although some authors reported a direct relationship between the severity of AD and the degree of SC lipid depletion[41-45], the evidence demonstrating an association between CER depletion and AD is inconclusive.[19] Other factors may play a role in SC lipid depletion, and the reduced CER could be an epiphenomenon of AD.[19]

Epidemiological data indicate a higher prevalence and severity of AD in racial/ethnic Canadian populations; while studies do not support the assumption that skin barrier differences are a factor.[26-31] It is presumed that the impact of the cold, dry climate throughout parts of Canada may play a role in skin barrier dysfunction amongst these populations at large.

Delays in diagnosis or underestimation of severity may occur in patients with richly pigmented skin due to knowledge gaps in recognizing morphologic features of AD across the spectrum of skin complexions and racial/ethnic populations.[19,64-66] Patients with richly pigmented skin may present with variations in the appearance of erythema (Figure 1). AD lesions may appear reddish-brown, violaceous, gray, or hyperchromic rather than bright red (Figure 2). Perifollicular accentuation, papules, scaling, lichenification, and pigmentary changes may be more prominent (Figure 3 and Figure 4). As a consequence, patients with SOC may present with a more advanced stage of AD severely impacting their QoL.[19]Aside from the above cAEs that are commonly observed with hormonal therapy for breast and prostate cancer, some of the individual medications can cause other skin toxicities.

Cleansers	• Use nonsoap cleansers (e.g., syndets, aqueous solutions), that are less allergenic, nonirritating, and fragrance-free with a pH between 4–6. • Soap-based cleansers should be avoided because they can cause xerosis and skin irritation. • Antiseptic-containing cleansers are not recommended due to the limited duration of action of antiseptics and limited clinical data regarding their effectiveness. • Consider a bleach bath for specific cases such as infections. • After bathing, gently pad the skin with a soft towel, avoiding rubbing. Next, apply moisturizer while the skin is still moist (within 3 min).
Moisturizers	• A moisturizer should be used at least twice daily and more frequently during acute flare-ups. • Consider patient tolerance and preferences for a moisturizer to enhance treatment adherence. • Cream-type moisturizers containing lipids are suitable, and during winter, higher lipid contents are preferred. • During acute flare-ups, moisturizers should be used more frequently in conjunction with anti-inflammatory treatment and continued as maintenance therapy.

Table 1: Cleanser and moisturizer use

Canadian Indigenous children and young adults continue to face higher rates of health disparities than their non-Indigenous counterparts.[2] In dermatology, this includes a high burden of AD and secondary skin infections.[2,3] Environmental factors and disparities in access to care could be a particular challenge for Indigenous groups, who frequently lack access to appropriate treatments.[2,3] A systematic review of the pediatric dermatology literature reported on systemic [finances, wait times, geography], sociocultural [culture beliefs and communication], and individual barriers [patient beliefs and health knowledge] to diagnosis, treatment, and maintenance approaches of AD and other skin conditions.[67] The identified barriers are interesting to explore further in Canadian AD populations. However, further research is needed to obtain insight into any interventions' impact on overcoming these barriers.

Awareness amongst AD patients and caretakers, specifically Indigenous groups, on the cause of AD, general treatment principles, available treatments and the role of moisturizers, and adherence to moisturizer regimens are inconsistent.[68]

Statement 5: Cultural perceptions of healthy skin impact the choice of skincare.

First Nations people have been using medicinal plants for AD treatment. Natural Indigenous medicinal discoveries [safrole, salicylic acid, and ascorbic acid derived from *Sassafras albidum*, genus *Salix* trees, and *Sassafras officinale*] by the Iroquoian and

Algonquian-speaking Peoples of North America for AD and other dermatologic conditions are mentioned in the European literature.[71] Further examples are Western red cedar's known principal active compound, β-thujaplicin, has shown efficacy in AD.[70] Another active principal compound (7-hydroxymatairesinol) of White spruce may offer benefits due to its anti-inflammatory activity.[70] Plants and algae such as hazel may also have benefits; however, studies need to confirm this.[71]

The effect of traditional treatments and natural remedies for AD may be of interest in managing racial/ethnic Canadian AD populations.[70,71] However, such AD treatments may result in adverse effects such as postinflammatory hyperpigmentation or keloid scarring at a higher rate than evidence-based treatment.[19]

Optimal management of AD is multipronged and includes patient education, prescription treatment, and skincare promoting a healthy skin barrier.[68,72-74]

Nurse practitioner or physician assistant interventions may significantly increase correct and frequent moisturizer use, reducing AD.[76]

The choice of skincare should be supported by evidence but is mainly a personal and individual choice.[34,36-38,61,75]

It is important to note that there are variations in skincare norms across diverse populations; therefore, these cultural variations when providing skincare recommendations need to be considered.[19] Integrating evidence-based recommendations

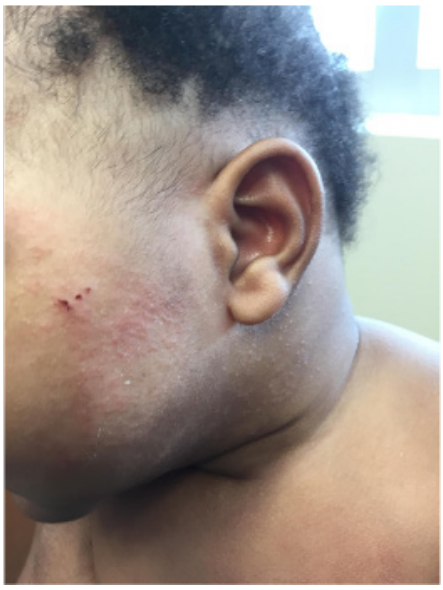


Figure 1: In richly pigmented skin the appearance of erythema may vary.

Photo courtesy of Dr. Rao

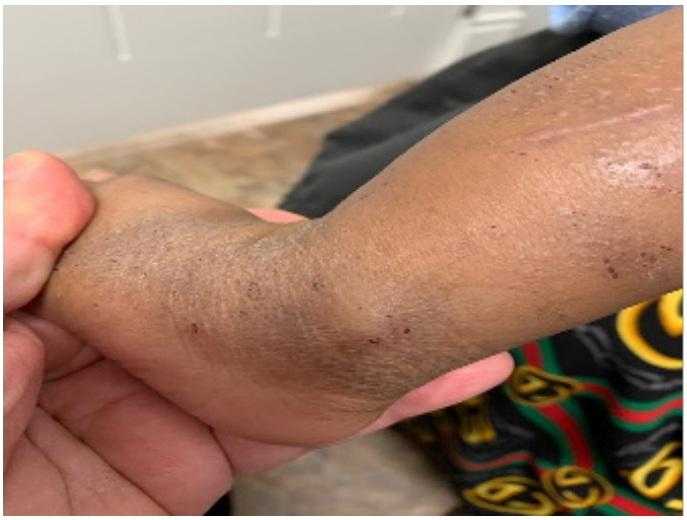
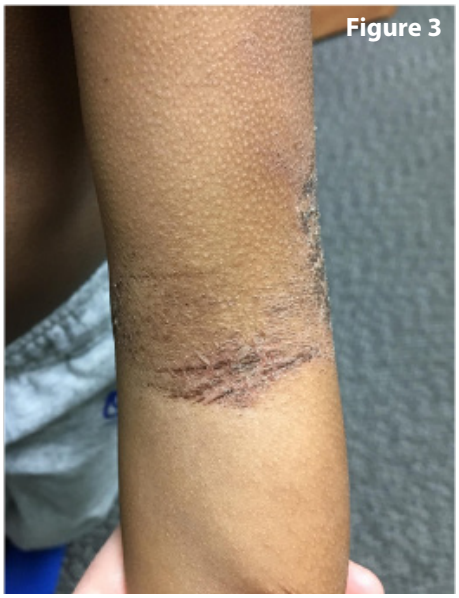


Figure 2: AD lesions may appear reddish-brown, violaceous, gray, or hyperchromic rather than bright red.

Photo courtesy of Dr. Rao



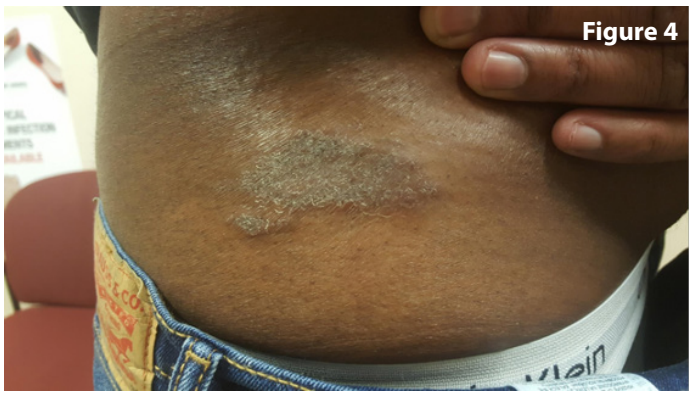


Figure 3 and Figure 4: In richly pigmented skin the appearance of erythema may vary.

Photo courtesy of Dr. Rao

for skin care in a culturally competent manner that aligns with the patient's norms/preferences is key to successful outcomes across diverse populations.[2,19] More research is needed to guide culturally appropriate recommendations better.

Limitations

A detailed discussion on genetic factors of racial/ethnic Canadian AD populations is outside the scope of the review. There is an overall lack of robust studies focusing on the prevention, treatment, and maintenance of AD in racial/ethnic Canadian AD populations.

Conclusions

The multifactorial pathogenesis of AD includes genetic and environmental factors that may vary among racial/ethnic and geographic populations. Available data suggest that skincare strategies to improve AD patients' outcomes should consider racial/ethnic differences, integrating recommendations for skin care in a culturally competent manner that aligns with the patient's norms and preferences. Future robust comparative studies will help clinicians to tailor patient education and recommend routine skincare with gentle cleansers and moisturizers as an integral part of AD management.

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