SKIN MICROBIOME AND ITS IMPLICATIONS FOR DERMATOLOGICAL DISEASES: NEW THERAPEUTIC PERSPECTIVES

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Abstract: The skin microbiome, made up of a vast diversity of microorganisms, including bacteria, fungi and viruses, plays a crucial role in maintaining skin health. Alterations in the composition and diversity of the skin microbiome have been associated with a number of dermatological diseases, such as acne, atopic dermatitis, psoriasis and rosacea. The study of the skin microbiome has emerged as a promising area for the development of new therapeutic approaches, offering significant potential for improving the treatment of these conditions. To analyze the implications of the skin microbiome in dermatological diseases, highlighting new therapeutic perspectives based on modulating the microbiome for the management and treatment of these conditions. This is a literature review with a qualitative approach, using the PubMed, Scopus and Web of Science databases to search for scientific articles. Specific descriptors related to the skin microbiome and its influence on health and dermatological diseases were used to refine the search. The time frame covers the years 2019 to 2023, according to the date of the first and last reference selected. The skin microbiome plays a fundamental role in defending the skin against pathogens and modulating the inflammatory response. Dysbiosis, which is the alteration in the composition of the microbiome, has been associated with the development of various dermatological diseases. For example, in acne, an increase in the abundance of *Propionibacterium acnes* has been identified, while in conditions such as atopic dermatitis and psoriasis, a reduction in bacterial diversity appears to contribute to chronic skin inflammation. New therapeutic strategies, such as the use of topical probiotics, prebiotics and treatments that restore the diversity of the microbiome, are being explored as innovative options for treating these conditions. In addition, studies into the use of narrow-spectrum antimicrobials aim to restore microbiological balance without eliminating beneficial bacteria, providing a less aggressive alternative to traditional treatments. Therefore, the study of the skin microbiome has opened up new frontiers for the treatment

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of dermatological diseases. Modulation of the microbiome offers an innovative and promising therapeutic strategy that can complement conventional treatments, improve clinical results and reduce the side effects associated with topical and systemic treatments. However, more studies are needed to better understand the mechanisms underlying microbiome dysbiosis and how these therapies can be implemented effectively and safely in clinical practice.

Keywords: Dermatology; Skin Microbiome; Skin Pathologies.

INTRODUCTION

The skin microbiome, the community of microorganisms that resides on the surface of the human skin, has stood out as a crucial factor in dermatological health, influencing both skin homeostasis and the pathogenesis of several skin diseases (HILL et al., 2021). The skin, being the largest organ in the human body, has a great diversity of microorganisms, including bacteria, fungi, viruses, and mycobacteria, which interact with the immune system and play protective or pathogenic roles (FRENCH et al., 2020). These interactions with the microbiome influence the inflammatory response and local immune balance, directly affecting susceptibility to dermatological diseases such as acne, psoriasis, eczema, and atopic dermatitis (HÖLLER et al., 2022).

Recent studies have shown that cutaneous dysbiosis, characterized by alteration of the skin's microbiological profile, can contribute to the genesis and progression of several dermatological diseases, challenging the traditional view that these conditions are only caused by isolated genetic and environmental factors. For example, the reduction in the skin's microbial diversity can trigger chronic inflammation, while the increase in pathogenic microorganisms, such as Staphylococcus aureus, is related to infections and exacerbations in diseases such as atopic eczema and psoriasis. In addition, resistance to conventional treatments has led to the search for innovative therapies that modify the skin microbiome therapeutically, promoting a more balanced environment on the skin (GOTTLIEB

et al., 2021).

From a new therapeutic perspective, the use of probiotics, prebiotics, selective antimicrobials, and diet modulation are being investigated as innovative approaches to restore the skin's microbial balance and prevent or treat dermatological diseases associated with dysbiosis (DE OSTA et al., 2022). Such interventions aim not only to control clinical symptoms but also to correct the underlying factors affecting the skin microbiome, offering a more holistic and personalized approach to the treatment of skin diseases. This line of research offers new possibilities for the management of chronic and recalcitrant dermatological diseases, highlighting the importance of a multidisciplinary and innovative approach in the field of dermatology.

The objective of this study aims to analyze the implications of the skin microbiome in dermatological diseases, highlighting new therapeutic perspectives based on the modulation of the microbiome for the management and treatment of these conditions.

MATERIALS AND METHODS

This is a literature review with a qualitative approach, using the PubMed, Scopus and Web of Science databases to search for scientific articles. To refine the research, specific descriptors related to the skin microbiome and its influence on health and dermatological diseases were used. The time frame covers the years 2019 to 2023, according to the date of the first and last selected reference.

Guiding Question

What is the role of the skin microbiome in maintaining skin homeostasis and in the development of dermatological diseases, and what are the main therapeutic strategies for its modulation?

Inclusion Criteria

Articles published between 2019 and 2023.

Studies that address the skin microbiome and its relationship with dermatological diseases.

Papers available in full and indexed in PubMed, Scopus and Web of Science.

Publications in Portuguese, English or Spanish.

Systematic reviews, clinical studies and research involving microbiome and dermatological therapies.

Exclusion Criteria

Studies published before 2019.

Works not available in full or with restricted access.

Research that analyzes only skin microbiology without clinical contextualization.

Articles focused exclusively on gut microbiome or microbiomes other than the skin.

Duplicate studies or isolated case reports with no relevance to the review.

Health Descriptors

The following descriptors were used in the search:

“Skin microbiome”

“Cutaneous microbiota”

“Microbial dysbiosis and dermatological diseases”

“Probiotics and skin health”

“Microbiome modulation in dermatology”

Boolean Markers

The descriptors were combined with Boolean operators to refine the results:

(“Skin microbiome” AND “Dermatological diseases”)

(“Cutaneous microbiota” OR “Skin dysbiosis”)

(“Probiotics” AND (“Microbiome modulation” OR “Skin health”))

THEORETICAL FOUNDATION

The skin microbiome is composed of a vast community of microorganisms, including bacteria, fungi, viruses, and mites, which colonize the surface of the skin and play a key role in maintaining skin homeostasis. This microbial ecosystem varies according to the anatomical location, being influenced by factors such as humidity, pH, sebum production, and exposure to the external environment. The main commensal bacteria include species of the genus ‘’Staphylococcus’’, ‘’Corynebacterium’’ and ‘’Cutibacterium’’, which compete with pathogens for space and nutrients, limiting their proliferation and preventing infections (ZHANG et al., 2022).

In addition, the variability of the skin microbiome is directly related to genetic factors and the individual’s lifestyle, and can be modulated by therapeutic and environmental interventions. Recent studies indicate that changes in the balance of the microbiome, known as dysbiosis, are implicated in the pathogenesis of several dermatological diseases, reinforcing the importance of maintaining a healthy microbiome for skin integrity (SCHREIBER et al., 2021).

Skin dysbiosis, characterized by an imbalance in the composition of the skin microbiome, can be associated with several dermatological conditions, including psoriasis, atopic dermatitis, acne, and rosacea. In patients with atopic dermatitis, there is an increase in colonization by ‘’Staphylococcus aureus’’, a bacterium that intensifies the inflammatory response, compromising the skin’s barrier function (POLLOCK et al., 2022).

In the case of acne, the overproduction of sebaceous and the exacerbated presence of ‘’Cutibacterium acnes’’ contribute to the formation of inflammatory lesions, aggravating the clinical picture. Studies show that the healthy microbiota plays an immunomodulatory role, reducing inflammation and promoting tissue regeneration (LEE et al., 2019). Thus, the understanding of the relationship between dysbiosis and skin diseases has driven the search for new therapeutic approaches targeting the microbiome.

The growing evidence on the relevance of the skin microbiome in dermatological health has

encouraged the development of new therapeutic strategies to restore microbial balance and modulate skin inflammation. Among the main approaches, the use of topical probiotics and prebiotics stands out, which favor the growth of beneficial microorganisms and reduce the proliferation of pathogens (MARTINS et al., 2021).

In addition, the application of skin microbiota transplantation has been studied as an alternative to replace beneficial bacterial populations in individuals with severe dysbiosis. The use of selective antimicrobials has also been shown to be effective in reducing colonization by specific pathogens without compromising the beneficial microbial diversity of the skin (WANG et al., 2020).

The development of dermatological products enriched with postbiotics, metabolites produced by probiotic microorganisms, has also been a promising approach to modulate the microbiome and improve the skin's immune response (FERNANDES et al., 2023). Thus, new therapeutic perspectives based on the skin microbiome have the potential to revolutionize the management of dermatological diseases, promoting more effective and less aggressive treatments for the skin.

CONCLUSION

It is concluded that the skin microbiome plays a crucial role in maintaining skin health, with the interaction between beneficial microorganisms and the skin barrier essential to prevent infections and immune imbalances. Cutaneous dysbiosis, characterized by an imbalance between beneficial and pathogenic microorganisms, is associated with the development of various dermatological conditions, such as acne, atopic dermatitis, and psoriasis, and can aggravate the symptoms and progression of these diseases. The understanding of this relationship has led to the development of new therapeutic strategies based on microbiome modulation, such as the use of probiotics, prebiotics, microbiota transplantation, and postbiotics, which seek to restore microbial balance and reduce skin inflammation.

Although there are still challenges for the clinical application of these approaches, preliminary results show significant potential for more effective and less invasive treatments for dermatological

diseases. Microbiome-based therapies have the advantage of not only relieving symptoms, but also promoting long-term health while respecting the skin's natural balance. Therefore, as research advances, these therapies are expected to become an essential tool in dermatologists' therapeutic arsenal, providing safer and more sustainable alternatives for patients. The future of dermatology is undoubtedly intimately linked to understanding and modulating the skin microbiome, promising to transform the way we treat skin diseases.

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