

Dietary Patterns and their Impact on Atopic Dermatitis: A Comprehensive Review



Amr Molla^{1,*} 

¹Department of Medicine, College of Medicine, Taibah University, Madinah, Saudi Arabia; Universities Road, P.O. Box: 344, Taibah Madinah 42353, Saudi Arabia

Abstract:

Background: Atopic dermatitis (AD) is a prevalent, chronic inflammatory skin disorder exacerbated by dietary factors, among other triggers. The disease involves complex interactions between genetic, environmental, and immunological factors, with the gut-skin axis illustrating how intestinal health impacts skin condition. This underscores the potential of dietary management in modifying AD outcomes.

Objectives: This review synthesizes current knowledge on the impact of dietary factors on AD. It explores the link between food allergies and AD, examines the gut-skin axis, and reviews dietary recommendations for managing AD.

Methods: A comprehensive review was conducted, focusing on observational and clinical trials published in the last decade. The studies reviewed encompass the role of various foods, including the impact of allergens, dietary patterns, and specific nutrients on the pathophysiology and management of AD.

Conclusion: Dietary factors significantly influence AD symptoms, with food allergies playing a pivotal role. Gut health, particularly the balance of gut microbiota, also significantly affects AD pathogenesis. Personalized dietary recommendations are essential for effective management. The review highlights research gaps in the understanding of food's role in AD, emphasizing the need for further trials and personalized dietary guidance.

Keywords: Atopic dermatitis, Nutrition, Food allergies, Gut-skin axis, Dietary management.

© 2024 The Author(s). Published by Bentham Open.

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International Public License (CC-BY 4.0), a copy of which is available at: <https://creativecommons.org/licenses/by/4.0/legalcode>. This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

*Address correspondence to this author at the Department of Medicine, College of Medicine, Taibah University, Madinah, Saudi Arabia; Universities Road, P.O. Box: 344, Taibah Madinah 42353, Saudi Arabia; Tel: +966504342992; E-mail: amolla@taibahu.edu.sa

Cite as: Molla A. Dietary Patterns and their Impact on Atopic Dermatitis: A Comprehensive Review. Open Dermatol J, 2024; 18: e18743722306189. <http://dx.doi.org/10.2174/0118743722306189240520075943>



Received: February 17, 2024

Revised: April 25, 2024

Accepted: May 15, 2024

Published: June 06, 2024



Send Orders for Reprints to reprints@benthamscience.net

1. INTRODUCTION

Erythematous dry skin, inflammation, and severe itching mark atopic dermatitis (AD), a chronic and recurrent inflammatory skin condition. Triggers like allergens, infections, seasonal and climate changes, or psychological stress can intensify these symptoms. Almost 50% of AD cases are identified by the age of 1 year, and over a third continue into adulthood [1-3]. AD is now one of the most prevalent skin disorders globally; however, it is often underestimated as a minor skin issue, leading to prolonged suffering for patients [4]. AD significantly

affects the quality of life at a personal level, more so than other common skin conditions, and this impact extends to the patient's family [5]. Its frequent association with asthma, allergic rhinitis, contact dermatitis, and food allergies underlines the importance of considering AD's potential complications [6]. The skin microbiota, a diverse group of microorganisms, plays a key role in modulating the innate immune response in AD. *Staphylococcus aureus*, often found in AD's active lesions, can worsen or maintain skin inflammation by releasing antigenic toxins, which activate T cells and other immune cells [7]. AD patients often have specific IgE antibodies against these

toxins, and basophils can release histamine when exposed to these toxins, leading to symptoms [8]. Staphylococcal superantigens might also trigger mast cell degranulation after breaching the skin barrier, causing itchiness and acute inflammation. The complexity and multifaceted nature of AD mean that its treatment depends on the disease's severity and patient compliance. There has been a significant effort to develop straightforward and effective treatment approaches for this condition with varying and recurring symptoms. Current AD management strategies focus on avoiding triggers, enhancing skin hydration, and reducing inflammation [9]. Due to patients often not adhering to prescribed drug therapies, there has been a shift towards integrating alternative medicine, which involves leveraging physiological and psychological resources. Studies have indicated that a balanced lifestyle, a nutritious diet, hydration, massage, aromatherapy, engaging in leisure activities like listening to classical music, socializing, and participating in cultural events can positively influence patients' immune cell behavior. This approach has shown promise in improving disease outcomes and reducing the frequency of exacerbations [10, 11].

2. METHODOLOGY

2.1. Objectives

The primary objective of this review is to explore and synthesize current knowledge on the role of dietary factors in the management and exacerbation of atopic dermatitis (AD). Specifically, the review aims to:

1. Assess the Impact of Diet on Atopic Dermatitis: Investigate how various dietary components, such as specific nutrients, food groups, and dietary patterns, influence the incidence and severity of AD.
2. Evaluate the Relationship between Food Allergies and AD: Examine the evidence linking food allergies to the exacerbation of AD symptoms, considering both immediate and delayed hypersensitivity reactions.
3. Explore Gut Health and its Relation to AD: Delve into the emerging research on the gut-skin axis, focusing on how gut microbiota and dietary interventions like probiotics and prebiotics might affect AD.
4. Review Dietary Recommendations for AD Management: Compile and analyze current dietary recommendations and guidelines for individuals with AD, aiming to provide practical insights for healthcare professionals and patients.
5. Identify Gaps in Current Research: Highlight areas where further research is needed, encouraging a deeper understanding of the complex relationship between diet and AD.

2.2. Study Selection

This review focused on both observational and clinical trials related to the role of food in atopic dermatitis. The studies included were published within the last 10 years, ensuring contemporary relevance and the inclusion of recent advancements in the field.

2.3. Data Sources

A comprehensive search was conducted across multiple databases and resources, including PubMed, Scopus, Web of Science, UpToDate, ScienceDirect, and various academic journals, to gather a broad spectrum of relevant literature.

Search Strategy: The search for pertinent studies was guided by key terms such as "Atopic Dermatitis," "Nutrition," "Food," and "Allergy." These terms were strategically combined to capture the intricate relationship between dietary factors and atopic dermatitis.

2.4. Data Extraction and Analysis

Given the nature of this review as a narrative synthesis, data extraction focused on identifying critical findings, methodologies, and conclusions from each study. The narrative approach allowed for a comprehensive understanding of the subject by integrating findings from various types of research, rather than focusing on quantitative synthesis.

2.5. Quality Assessment

For assessing the quality of the included studies, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were adopted. PRISMA provides a robust framework for evaluating the reliability and validity of research findings in systematic reviews.

2.6. Ethical Considerations

Ethical compliance was a prerequisite for the selection of studies. Each article included in this review was evaluated to ensure that it met ethical standards, particularly in terms of research methodology, participant consent, and data handling.

3. PATHOPHYSIOLOGY OF ATOPIC DERMATITIS

The pathophysiology of atopic dermatitis (AD) is complex and multifactorial, involving genetic predisposition, skin barrier dysfunction, immune dysregulation, and environmental factors.

A significant aspect of AD's pathogenesis is genetic predisposition. Mutations in the filaggrin gene, which play a crucial role in maintaining the skin barrier, are commonly associated with AD. This genetic alteration leads to a compromised skin barrier, resulting in increased transepidermal water loss and decreased skin hydration. The impaired barrier also allows for easier penetration of allergens and irritants, triggering immune responses and inflammation [12].

AD is marked by an imbalance in the immune system, particularly an overactive Th2 (T-helper cell type 2) response. This response leads to increased production of specific cytokines (such as IL-4, IL-13, and IL-31) that contribute to inflammation and the characteristic symptoms of AD. Additionally, there is often an increased IgE response to various allergens, which plays a crucial role in the disease's pathogenesis, especially where food allergens are concerned [3].

The relationship between food and AD primarily revolves around food allergens exacerbating AD symptoms. Ingestion of certain foods can trigger an immune response in predisposed individuals. Specific IgE antibodies against food proteins often mediate this response. The common food allergens associated with AD include cow's milk, eggs, peanuts, soy, wheat, nuts, and fish [13].

When an individual with AD consumes an allergenic food, the body recognizes these food proteins as foreign. This recognition triggers an immune response, leading to the release of various inflammatory mediators such as histamines. These mediators contribute to the exacerbation of AD symptoms like itching and skin inflammation [14].

Emerging research highlights the gut-skin axis, where gut health significantly influences skin conditions. An imbalance in gut microbiota (dysbiosis) can affect systemic immunity and inflammation levels, which in turn can influence the severity of AD. The gut-skin axis represents a major pathway through which diet impacts AD. The intestinal microbiome affects systemic immune responses and inflammation, which in turn influence skin health. Alterations in gut microbiota can lead to an increased intestinal permeability, allowing antigens to penetrate and provoke an immune response that may exacerbate skin inflammation associated with AD [15].

4. NUTRITIONAL IMPACTS ON ATOPIC DERMATITIS

This section provides an overview of the role of diet in Atopic Dermatitis (AD), emphasizing the influence of fatty acids, gut health, plant-based foods, the Dietary Inflammatory Index, food elimination diets, and essential vitamins in the management of AD.

4.1. Fatty Acids and their Impact on Atopic Dermatitis

The balance between omega-3 and omega-6 polyunsaturated fatty acids (PUFAs) is crucial in the pathogenesis and management of Atopic Dermatitis (AD). Omega-3 fatty acids, such as those found in fish oil and flaxseed oil, are known for their anti-inflammatory properties, reducing pro-inflammatory cytokines and eicosanoids, which are typically elevated in AD. These fatty acids influence cell signaling and inflammatory processes through their integration into cell membranes. In contrast, omega-6 fatty acids, which are more prevalent in the Western diet and found in corn oil and sunflower oil, tend to promote inflammation. An imbalanced ratio of these fatty acids can exacerbate AD symptoms. Recent research emphasizes the complex role of omega-3 in reducing skin inflammation and the prevalence of AD, underscoring the importance of a balanced intake of these essential nutrients for effective AD management [16, 17].

4.2. The Role of Probiotics and Prebiotics

The gut-skin axis theory suggests a significant connection between gut health and skin conditions such as

AD. Probiotics like *Lactobacillus* and *Bifidobacterium*, found in yogurt and fermented foods, improve gut flora diversity, which in turn reduces systemic inflammation and enhances skin barrier functionality. Prebiotics, present in foods like garlic, onions, and bananas, provide nourishment for these beneficial bacteria, promoting a balanced gut microbiome. This symbiotic relationship between gut health and skin health offers promising avenues for AD symptom management [18, 19].

4.3. Plant-Based Foods and Atopic Dermatitis

A dietary regimen rich in plant-based foods exerts a profound impact on Atopic Dermatitis. These foods are rich in antioxidants, vitamins, and minerals, thereby wielding the potential to combat oxidative stress and inflammation associated with AD. Fruits, vegetables, nuts, seeds, and whole grains provide essential nutrients that bolster the skin's barrier function, augment hydration, and alleviate inflammation. Furthermore, plant-based diets typically maintain lower levels of processed foods and unhealthy fats, which have the propensity to exacerbate AD symptoms. Prioritizing a plant-based diet not only contributes to a reduction in the severity of AD but also promotes overall health and well-being [20, 21].

4.4. Dietary Inflammatory Index and Elimination Diets

The Dietary Inflammatory Index (DII) quantifies the inflammatory impact of an individual's diet. Foods with a high DII score, such as processed meats and refined grains, possess the potential to worsen AD symptoms owing to their pro-inflammatory effects. Conversely, foods with a low DII score, including leafy greens and tomatoes, have the potential to mitigate AD flare-ups. Food elimination diets, which entail the exclusion of common allergens like dairy, gluten, or eggs, offer a means of identifying potential dietary triggers for AD. It is crucial to approach these diets with caution and under professional guidance to ensure nutritional adequacy and precise identification of triggers [22, 23].

4.5. Vitamins and their Influence on Atopic Dermatitis

Vitamins play a pivotal role in skin health and can exert a significant impact on the management and severity of Atopic Dermatitis. Key vitamins of particular relevance include:

4.5.1. Vitamin D

A growing body of evidence suggests that Vitamin D assumes an immunomodulatory role in AD. Deficient levels of Vitamin D are often correlated with more severe cases of AD. Supplementation of Vitamin D can enhance the skin's barrier function, diminish inflammation, and potentially ameliorate AD symptoms. Sources of Vitamin D encompass exposure to sunlight, fortified foods, and supplements [24].

4.5.2. Vitamin E

Renowned for its antioxidant attributes, Vitamin E

combats oxidative stress in the skin, a factor that can exacerbate AD symptoms. Vitamin E's anti-inflammatory properties contribute to reducing the severity of AD flare-ups. Dietary sources of Vitamin E comprise nuts, seeds, and green leafy vegetables [24].

4.5.3. Vitamin A

Essential for skin repair and maintenance, Vitamin A wields influence over AD through its role in skin integrity and immune function. It is imperative to strike a balance in Vitamin A consumption, as both deficiency and excess can worsen AD symptoms. Sources of Vitamin A include carrots, sweet potatoes, and leafy greens [24].

4.5.4. Vitamin C

Crucial for collagen synthesis and skin health, Vitamin C's antioxidant attributes aid in diminishing oxidative stress, and its involvement in immune function deems it a pivotal nutrient in AD management. Citrus fruits, strawberries, and bell peppers serve as rich sources of Vitamin C [24].

4.5.5. Vitamin B6

Also recognized as pyridoxine, Vitamin B6 contributes to skin health and immune response. Deficiencies in B6 have been associated with heightened AD severity. Whole grains, poultry, and bananas are reputable sources of Vitamin B6 [25-27].

The intricate relationship between diet and Atopic Dermatitis (AD) underscores the necessity for a comprehensive approach. Effective AD management necessitates a balanced intake of fatty acids, the preservation of gut health through probiotics and prebiotics, a focus on plant-based dietary choices, a comprehension of the Dietary Inflammatory Index, and the cautious implementation of food elimination diets. Furthermore, essential vitamins play a pivotal role in skin health and the management of AD. A diet rich in these vital vitamins, obtained from natural food sources or supplemented as required, can exert a substantial influence on the severity and progression of AD. These dietary strategies, combined with an understanding of their impact on skin health, are increasingly crucial in the holistic management of AD.

5. FOOD ALLERGIES AND ATOPIC DERMATITIS

Atopic Dermatitis (AD), a chronic inflammatory skin condition, has been increasingly associated with food allergies. This connection arises from the intricate interplay between the immune system and the characteristic dysfunction of the skin barrier in AD. Food allergies are primarily mediated by the immune system's aberrant response to harmless food proteins. The immunological mechanisms underlying food allergies can be categorized into two main types: IgE-mediated and non-IgE-mediated reactions.

5.1. Common Allergenic Foods in AD

Numerous foods are frequently linked to allergic reactions in individuals with Atopic Dermatitis (AD). The

most prevalent culprits include cow's milk, eggs, peanuts, soy, wheat, fish, and shellfish. These foods contain specific proteins, such as casein in cow's milk and ovomucoid in eggs, which are capable of triggering immune responses in susceptible individuals. These proteins interact with immune cells through molecular epitopes, leading to an immune reaction. For example, the protein casein in cow's milk can incite a significant immune reaction in certain children with AD, intensifying their skin condition. Recent research has focused on understanding how these allergens, through their molecular structures and epitopes activate the immune system in AD patients. This includes exploring how these specific food proteins initiate and exacerbate the immune response, thereby contributing to the severity of AD symptoms [14, 28].

5.2. Immune Responses to Food Allergens

The mechanisms by which food allergies influence Atopic Dermatitis (AD) are complex and multifaceted. In AD, the skin barrier is often compromised due to genetic variations in key proteins like filaggrin, making it more permeable and susceptible to allergens. This increased susceptibility allows for greater allergen penetration, leading to immune activation. As food allergens infiltrate the body, they stimulate an immune response involving the production of Immunoglobulin E (IgE) antibodies. These antibodies bind to the allergen and release inflammatory mediators such as histamines, evoking the classic symptoms of an allergic reaction such as redness, swelling, and itching, which are hallmark symptoms of AD.

In the context of AD, the immune system's response to food allergens is crucial. It involves a complex network of T-cells, B-cells, cytokines, and immune signaling, all contributing to the pathogenesis of AD. The interaction of these elements leads to typical inflammatory responses seen in AD, exacerbating the symptoms upon exposure to food allergens [29, 30].

Recent studies have also highlighted the significant impact of the gut-skin axis on AD. The gut microbiome, influenced by dietary choices, plays a vital role in modulating the body's immune response. An imbalance in gut flora can amplify the immune response to food allergens, exacerbating AD symptoms. Additionally, specific dietary components can directly influence skin inflammation through mechanisms that alter the balance between pro-inflammatory and anti-inflammatory factors in the body. This relationship between diet, gut bacteria, and skin immune responses underscores the importance of dietary interventions in managing AD and illustrates how the gut microbiome's influence extends to the body's overall response to food allergens [12].

5.3. Differentiating Allergies from Food Sensitivities

Atopic Dermatitis (AD) displays intricate connections with food allergies and sensitivities, each exerting distinct effects on the condition. Food allergies involve immune-mediated responses characterized by the immune system's vigorous reaction to specific food proteins, often resulting in immediate and potentially severe symptoms like hives,

itching, and swelling. Typically, this type of reaction involves Immunoglobulin E (IgE). In contrast, food sensitivities, also known as intolerances, entail non-immune reactions. These sensitivities tend to manifest more slowly and with less severity, often leading to gastrointestinal symptoms like bloating and diarrhea rather than acute allergic reactions. In the context of AD, food allergies are more prevalent and can significantly exacerbate the skin condition due to heightened immune system sensitivity and the compromised skin barrier [31].

5.4. Prevalence and Impact of Food Allergies in AD

Food allergies are notably more prevalent in individuals with AD, particularly in children. The prevalence of food allergies among AD patients can vary significantly but generally exceeds that of the general population. These allergies can worsen AD symptoms, resulting in more frequent and severe flare-ups. The presence of food allergies in AD patients frequently correlates with increased disease severity [28].

5.5. Diagnosis and Management of Food Allergies and Sensitivities

The diagnosis and management of food allergies in Atopic Dermatitis patients have evolved significantly with the advancement of techniques like component-resolved diagnostics. This sophisticated approach enhances the accuracy of identifying specific food allergens, thereby improving the overall management of AD in individuals with food allergies. In addition to these advanced diagnostic methods, traditional techniques such as skin prick tests and blood tests for Immunoglobulin E (IgE) antibodies specific to food allergens remain fundamental. Alongside these tests, the implementation of elimination diets plays a critical role. An elimination diet involves systematically removing suspected allergens from the diet and then gradually reintroducing them to observe any adverse reactions. While this method is effective in identifying triggers, it requires careful monitoring to avoid nutritional deficiencies [32].

5.6. Impact of Food Sensitivities on AD

While not as immediate or severe as food allergies, food sensitivities can still exert a notable influence on AD. These sensitivities may contribute to chronic inflammation and exacerbate AD symptoms over time. Identifying and managing these food sensitivities, though challenging, can constitute a crucial aspect of controlling AD [33].

5.7. Recent Advances in Understanding and Management of AD

Recent clinical trials on new therapeutic approaches for Atopic Dermatitis (AD) in the context of food allergies have been focusing on biologics that target specific immune pathways, as well as novel therapies aimed at repairing skin barrier function. These advancements are opening up promising avenues for the effective management of AD, particularly when it is related to food allergies. Alongside these medical advancements, recent research has deepened our understanding of the complex

interplay between diet, the immune system, and skin health in AD.

Current clinical guidelines emphasize the importance of a comprehensive approach to diagnosing and managing food allergies and sensitivities in individuals with AD. This approach extends beyond the mere identification and avoidance of allergens. It also encompasses addressing the nutritional needs and overall well-being of the patient. A thorough understanding of how diet affects the immune system and skin health is crucial in this context [34].

6. NUTRITIONAL CONSIDERATIONS IN ATOPIC DERMATITIS

In managing Atopic Dermatitis (AD), the role of a balanced diet is often underappreciated yet crucial. A balanced diet not only supports overall health but also plays a specific role in skin health. The skin, being the largest organ of the body, requires a range of nutrients for its maintenance, repair, and defense mechanisms. A diet that lacks essential nutrients can lead to impaired skin barrier function, increased susceptibility to infections, and exacerbation of AD symptoms. Conversely, a well-rounded diet can help in reducing inflammation, repairing the skin barrier, and thereby potentially reducing the severity and frequency of AD flare-ups [35].

6.1. Role of Balanced Nutrition

Fatty acids, particularly omega-3 and omega-6 polyunsaturated fatty acids (PUFAs), are vital for skin health. Omega-3 fatty acids, found in fish, flaxseeds, and walnuts, have anti-inflammatory properties that can help reduce the inflammation associated with AD. They also play a role in maintaining the skin's barrier function. On the other hand, excessive intake of omega-6 fatty acids, commonly found in processed foods and vegetable oils, can promote inflammation. Balancing the intake of these fatty acids is crucial in managing AD.

Additionally, as we mentioned earlier vitamins play diverse roles in skin health. For example, Vitamin D has immunomodulatory effects and can influence the severity of AD. Low levels of Vitamin D have been linked to worse AD symptoms. Vitamin E is an antioxidant that helps in reducing oxidative stress in the skin, which can exacerbate AD. Vitamin A is crucial for skin repair and maintenance, it helps in maintaining the skin barrier and immune function. Vitamin C is important for collagen synthesis, it supports skin structure and has antioxidant properties. Vitamin B Complex, especially B6, is important for skin health and immune response.

In addition, essential minerals like zinc and selenium also play a role in skin health. Zinc is involved in skin repair and has anti-inflammatory properties. Selenium, an antioxidant, helps in protecting the skin from oxidative damage [36].

6.2. The Impact of Diet on AD Management

A diet that is rich in fruits, vegetables, lean proteins, and whole grains, while being low in processed foods and sugars, can provide the necessary nutrients for

maintaining healthy skin. It is also important to stay hydrated, as water is essential for maintaining skin hydration and barrier function. Tailoring the diet to individual needs, especially considering any food allergies or sensitivities, is vital in the management of AD [37].

Nutritional considerations are an integral part of managing Atopic Dermatitis. A balanced diet, rich in essential nutrients, can help in reducing inflammation, maintaining skin barrier function, and overall, improving the symptoms of AD. It is important to consult with healthcare professionals for personalized dietary advice, especially in the context of managing a complex condition like AD.

7. INTEGRATING DIET INTO CLINICAL TREATMENT OF AD

In the comprehensive management of Atopic Dermatitis (AD), clinical strategies extend beyond topical treatments and pharmacotherapy to include a critical component: dietary management. The 'Clinical Management and Dietary Recommendations in Atopic Dermatitis' section delves into the pivotal role of diet in AD, outlining practical and evidence-based guidelines for both healthcare professionals and patients. This section emphasizes the importance of patient education in understanding the link between diet and AD, provides methodologies for identifying dietary triggers, and offers tailored dietary modifications to manage this complex condition effectively. It underscores the collaborative effort between patients, caregivers, and healthcare professionals in navigating the dietary landscape of AD, aiming to enhance patient adherence to dietary recommendations, improve symptom management, and ultimately, elevate the quality of life of individuals affected by AD.

7.1. Importance of Patient Education

Educating patients and caregivers about the relationship between diet and atopic dermatitis (AD) is paramount. When patients and their families understand how certain foods can affect AD, they are more likely to adhere to dietary recommendations and actively manage the condition. Healthcare professionals should provide clear, understandable information and encourage patients to ask questions, fostering an environment where patients feel supported in their journey to manage AD [38, 39].

7.2. Identifying Dietary Triggers

Identifying potential food triggers is a critical step in managing AD. Patients should be encouraged to keep a detailed food diary, noting what they eat and any corresponding changes in their AD symptoms. This practice can help in pinpointing specific foods that may exacerbate the condition. Allergy testing, under the guidance of a healthcare professional, can also be instrumental in identifying food allergies. It is important to differentiate between true food allergies, sensitivities, and intolerances, as each has different implications for AD [14, 40].

7.3. Dietary Modifications and Recommendations

General dietary recommendations for managing AD include:

1. Incorporating anti-inflammatory foods, such as omega-3-rich fish, fruits, vegetables, and whole grains.
2. Avoiding known irritants and allergenic foods, which might differ from one individual to another.
3. Ensuring a balanced diet to maintain adequate intake of essential nutrients, which are vital for skin health and overall well-being [41, 42].

Furthermore, the importance of dietary diversity cannot be overstated, as it is crucial for maintaining a healthy gut microbiome, which in turn affects the severity and management of AD. The role of specific nutrients, prebiotics, and probiotics in influencing gut flora is increasingly recognized for its potential to modulate skin inflammation. The interplay between diet, gut health, and skin inflammation highlights the need for a comprehensive dietary strategy in managing AD, emphasizing the balance of nutrient intake and the health of the gut microbiome [43].

7.4. Role of Healthcare Professionals

Consulting with healthcare professionals like dietitians or allergists is crucial in developing a personalized dietary plan. These experts can provide tailored advice considering individual allergies, sensitivities, nutritional needs, and lifestyle factors. They can also help in interpreting allergy test results and guiding on safe dietary changes [44].

7.5. Managing Expectations and Avoiding Misinformation

It is important to address common misconceptions about diet and AD. Healthcare providers should guide patients toward reliable sources of information and caution against following unverified dietary trends or fads that might do more harm than good [45].

7.6. Family and Community Support

The role of family and community in supporting individuals with AD is invaluable, especially for children. Tips for meal planning and preparation that cater to the dietary needs of someone with AD can be extremely helpful. Families should be encouraged to adopt these dietary changes as a unit, making the process more inclusive and less isolating for the patient [46].

7.7. Long-term Management and Follow-up

Regular follow-up with healthcare professionals is essential to monitor the condition and adjust dietary plans as needed. It is also important to encourage ongoing education and awareness about AD and its relationship with diet, as understanding and managing this condition is an evolving process [47].

Effective clinical management of AD through dietary recommendations requires a comprehensive approach involving patient education, identification of food triggers,

personalized dietary modifications, professional guidance, and strong family and community support. It is a collaborative effort aimed at improving the quality of life for individuals with AD.

8. FUTURE DIRECTIONS AND RESEARCH GAPS

Despite significant advancements in understanding Atopic Dermatitis (AD), several areas remain underexplored, offering opportunities for future research. One primary area is the intricate relationship between diet, gut microbiota, and skin health. Emerging evidence suggests a strong gut-skin axis, but the mechanisms through which diet influences this axis in AD need further elucidation [48].

8.1. Personalized Nutrition and AD

The management of food allergies and sensitivities is of fundamental importance in the treatment of Atopic Dermatitis (AD). A thorough and personalized approach to diagnosis and dietary management is pivotal for better controlling AD symptoms and improving the quality of life of affected individuals. This approach involves integrating advanced therapeutic options, such as biologics and therapies for skin repair, with dietary and lifestyle modifications. Together, these strategies offer a holistic treatment paradigm that not only alleviates symptoms but also targets the underlying factors contributing to AD. Complementing this, the concept of personalized nutrition, tailored to individual genetic, environmental, and lifestyle factors, holds significant promise for AD management. Future studies and treatment approaches should focus on how personalized dietary interventions could be more effective compared to general dietary guidelines. This would involve developing management strategies for AD that are more patient-specific and outcome-effective. By embracing the principles of personalized nutrition, healthcare providers can refine their approach to AD treatment, ensuring that each patient receives a regimen that is precisely attuned to their unique needs. This personalized approach, which combines cutting-edge medical treatments with customized dietary and lifestyle changes, could revolutionize the management of AD, offering more targeted and effective solutions for individuals suffering from this condition [49].

8.2. Long-term Impact of Dietary Interventions

The long-term effects of dietary changes on AD are not well-documented. Research is needed to understand the sustainability and long-term efficacy of dietary interventions in AD management. This includes studying the impact of early dietary interventions in childhood on the progression and severity of AD into adulthood [50, 51].

8.3. Potential of Emerging Nutrients

While the role of certain nutrients like fatty acids and vitamins in AD is increasingly recognized, the potential benefits of other nutrients and bioactive compounds in foods remain to be fully explored. Future research should investigate the role of lesser-known nutrients and their direct or indirect impact on AD [52].

The development of new technologies for monitoring dietary intake and its effects on AD can provide valuable insights. Wearable technology and mobile applications could be used to track dietary habits and correlate them with AD flare-ups, providing real-time data for better management [53].

Several gaps exist in the current research on diet and AD, such as limited large-scale clinical trials, variations in study designs, and a lack of standardized protocols for dietary interventions. Addressing these gaps is crucial for advancing our understanding and developing effective dietary guidelines for AD management.

CONCLUSION

This comprehensive review delves into the intricate relationship between diet and atopic dermatitis (AD). The evidence underscores a multifaceted interplay where specific dietary elements can exert an influence on the onset and severity of AD. The findings emphasize the significant role of food allergies in exacerbating AD symptoms and underscore the critical contribution of gut health to the disease's pathogenesis. Although dietary adjustments, such as the incorporation of probiotics, prebiotics, and selected nutrients, display promise in AD management, outcomes exhibit variability and often manifest as patient-specific responses.

Significantly, this review identifies existing gaps in current research, particularly underscoring the imperative for more expansive randomized controlled trials aimed at establishing robust causative connections between diet and AD. It further underscores the necessity for tailored dietary recommendations, acknowledging the diverse range of food responses observed among AD patients.

In summation, while diet emerges as a pivotal factor in the management of AD, it should be embraced as an integral component of a holistic treatment strategy. This strategy must be individually tailored to the unique needs of each patient and complemented by additional therapeutic interventions to comprehensively address the complexity of AD management.

LIST OF ABBREVIATIONS

AD	= Atopic Dermatitis
PRISMA	= Preferred Reporting Items for Systematic Reviews and Meta-Analyses
Th2	= T-helper cell type 2
IL	= Interleukin
PUFAs	= Omega-6 polyunsaturated fatty acids
DII	= The Dietary Inflammatory Index

AUTHORS' CONTRIBUTION

It is hereby acknowledged that all authors have accepted responsibility for the manuscript's content and consented to its submission. They have meticulously reviewed all results and unanimously approved the final version of the manuscript.

CONSENT FOR PUBLICATION

Not applicable.

FUNDING

None.

CONFLICT OF INTEREST

The author declares no conflict of interest financial or otherwise.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to all the authors and researchers whose studies have been helpful in writing this literature review. Special thanks to Dr. Muayad Albadrani, for his invaluable guidance and support throughout the research process. I also extend my appreciation to the College of Medicine, Taibah University in Madinah for providing the necessary resources and environment conducive to conducting this review. Lastly, I acknowledge my peers and colleagues for their insightful suggestions and constructive criticism, which significantly enhanced the quality of this work. This review article would not have been possible without the collaborative efforts and support of the above-mentioned individuals and institutions. Their contributions have greatly enriched the quality and significance of this work.

REFERENCES

- [1] Kim J, Kim BE, Leung DYM. Pathophysiology of atopic dermatitis: Clinical implications. *Allergy Asthma Proc* 2019; 40(2): 84-92. <http://dx.doi.org/10.2500/aap.2019.40.4202> PMID: 30819278
- [2] Kantor R, Silverberg JI. Environmental risk factors and their role in the management of atopic dermatitis. *Expert Rev Clin Immunol* 2017; 13(1): 15-26. <http://dx.doi.org/10.1080/1744666X.2016.1212660> PMID: 27417220
- [3] Wolff K. Fitzpatrick's dermatology in general medicine. McGraw-Hill New York 2008.
- [4] Solomon I, Ilie MA, Draghici C, *et al.* The impact of lifestyle factors on evolution of atopic dermatitis: An alternative approach. *Exp Ther Med* 2019; 17(2): 1078-84. PMID: 30679977
- [5] Paller A, Jaworski JC, Simpson EL, *et al.* Major comorbidities of atopic dermatitis: Beyond allergic disorders. *Am J Clin Dermatol* 2018; 19(6): 821-38. <http://dx.doi.org/10.1007/s40257-018-0383-4> PMID: 30168085
- [6] Silverberg JI. Comorbidities and the impact of atopic dermatitis. *Ann Allergy Asthma Immunol* 2019; 123(2): 144-51. <http://dx.doi.org/10.1016/j.anai.2019.04.020> PMID: 31034875
- [7] Luger T, Amagai M, Dreano B, *et al.* Atopic dermatitis: Role of the skin barrier, environment, microbiome, and therapeutic agents. *J Dermatol Sci* 2021; 102(3): 142-57. <http://dx.doi.org/10.1016/j.jdermsci.2021.04.007> PMID: 34116898
- [8] Bonyadi MR, Hassanzadeh D, Seyfizadeh N, Borzoueisileh S. Assessment of allergen-specific IgE by immunoblotting method in atopic dermatitis. *Eur Ann Allergy Clin Immunol* 2017; 49(5): 213-9. <http://dx.doi.org/10.23822/EurAnnACI.1764-1489.06> PMID: 28884988
- [9] Bolognia JL, Jorizzo JL, Schaffer JV. *Dermatology e-book*. Elsevier Health Sciences 2012.
- [10] Camargo CA Jr, Ganmaa D, Sidbury R, Erdenedelger K, Radnaakhand N, Khandsuren B. Randomized trial of vitamin D supplementation for winter-related atopic dermatitis in children. *J Allergy Clin Immunol* 2014; 134(4): 831-835.e1. <http://dx.doi.org/10.1016/j.jaci.2014.08.002> PMID: 25282565
- [11] Bath-Hextall FJ, Jenkinson C, Humphreys R, Williams HC. Dietary supplements for established atopic eczema. *Cochrane Database Syst Rev* 2012; 2012(2): CD005205. PMID: 22336810
- [12] Leung DYM, Guttman-Yassky E. Deciphering the complexities of atopic dermatitis: Shifting paradigms in treatment approaches. *J Allergy Clin Immunol* 2014; 134(4): 769-79. <http://dx.doi.org/10.1016/j.jaci.2014.08.008> PMID: 25282559
- [13] Otsuka A, Nomura T, Rerknimitr P, Seidel JA, Honda T, Kabashima K. The interplay between genetic and environmental factors in the pathogenesis of atopic dermatitis. *Immunol Rev* 2017; 278(1): 246-62. <http://dx.doi.org/10.1111/immr.12545> PMID: 28658541
- [14] Sicherer SH, Sampson HA. Food allergy: A review and update on epidemiology, pathogenesis, diagnosis, prevention, and management. *J Allergy Clin Immunol* 2018; 141(1): 41-58. <http://dx.doi.org/10.1016/j.jaci.2017.11.003> PMID: 29157945
- [15] Mahmud MR, Akter S, Tamanna SK, *et al.* Impact of gut microbiome on skin health: Gut-skin axis observed through the lenses of therapeutics and skin diseases. *Gut Microbes* 2022; 14(1): 2096995. <http://dx.doi.org/10.1080/19490976.2022.2096995> PMID: 35866234
- [16] Calder PC. Marine omega-3 fatty acids and inflammatory processes: Effects, mechanisms and clinical relevance. *Biochim Biophys Acta Mol Cell Biol Lipids* 2015; 1851(4): 469-84. <http://dx.doi.org/10.1016/j.bbalip.2014.08.010> PMID: 25149823
- [17] Berbert AA, Kondo CRM, Almendra CL, Matsuo T, Dich I. Supplementation of fish oil and olive oil in patients with rheumatoid arthritis. *Nutrition* 2005; 21(2): 131-6. <http://dx.doi.org/10.1016/j.nut.2004.03.023> PMID: 15723739
- [18] Guéniche A, Benyacoub J, Buetler TM, Smola H, Blum S. Supplementation with oral probiotic bacteria maintains cutaneous immune homeostasis after UV exposure. *Eur J Dermatol* 2006; 16(5): 511-7. PMID: 17101471
- [19] Kim J, Ko Y, Park YK, Kim NI, Ha WK, Cho Y. Dietary effect of lactoferrin-enriched fermented milk on skin surface lipid and clinical improvement of acne vulgaris. *Nutrition* 2010; 26(9): 902-9. <http://dx.doi.org/10.1016/j.nut.2010.05.011> PMID: 20692602
- [20] Flores-Balderas X, Peña-Peña M, Rada KM, *et al.* Beneficial effects of plant-based diets on skin health and inflammatory skin diseases. *Nutrients* 2023; 15(13): 2842. <http://dx.doi.org/10.3390/nu15132842> PMID: 37447169
- [21] Hall KD, Guo J, Courville AB, *et al.* Effect of a plant-based, low-fat diet versus an animal-based, ketogenic diet on ad libitum energy intake. *Nat Med* 2021; 27(2): 344-53. <http://dx.doi.org/10.1038/s41591-020-01209-1> PMID: 33479499
- [22] Shivappa N, Steck SE, Hurley TG, Hussey JR, Hébert JR. Designing and developing a literature-derived, population-based dietary inflammatory index. *Public Health Nutr* 2014; 17(8): 1689-96. <http://dx.doi.org/10.1017/S1368980013002115> PMID: 23941862
- [23] Werfel T, Ballmer-Weber B, Eigenmann PA, *et al.* Eczematous reactions to food in atopic eczema: Position paper of the EAACI and GA² LEN. *Allergy* 2007; 62(7): 723-8. <http://dx.doi.org/10.1111/j.1398-9995.2007.01429.x> PMID: 17573718
- [24] Schlichte MJ, Vandersall A, Katta R. Diet and eczema: A review of dietary supplements for the treatment of atopic dermatitis. *Dermatol Pract Concept* 2016; 6(3): 23-9. <http://dx.doi.org/10.5826/dpc.0603a06> PMID: 27648380
- [25] Amestejani M, Salehi BS, Vasigh M, *et al.* Vitamin D supplementation in the treatment of atopic dermatitis: A clinical trial study. *J Drugs Dermatol* 2012; 11(3): 327-30.

- PMID: 22395583
- [26] Javanbakht MH, Keshavarz SA, Djalali M, *et al.* Randomized controlled trial using vitamins E and D supplementation in atopic dermatitis. *J Dermatolog Treat* 2011; 22(3): 144-50. <http://dx.doi.org/10.3109/09546630903578566> PMID: 20653487
- [27] Nomura T, Kabashima K. Advances in atopic dermatitis in 2019-2020: Endotypes from skin barrier, ethnicity, properties of antigen, cytokine profiles, microbiome, and engagement of immune cells. *J Allergy Clin Immunol* 2021; 148(6): 1451-62. <http://dx.doi.org/10.1016/j.jaci.2021.10.022> PMID: 34756922
- [28] Flohr C, Mann J. New insights into the epidemiology of childhood atopic dermatitis. *Allergy* 2014; 69(1): 3-16. <http://dx.doi.org/10.1111/all.12270> PMID: 24417229
- [29] Wassmann A, Werfel T. Atopic eczema and food allergy. *Food Allergy: Molecular Basis and Clinical Practice*. Karger Publishers 2015; pp. 181-90. <http://dx.doi.org/10.1159/000371701>
- [30] Hill DJ, Hosking CS. Food allergy and atopic dermatitis in infancy: An epidemiologic study. *Pediatr Allergy Immunol* 2004; 15(5): 421-7. <http://dx.doi.org/10.1111/j.1399-3038.2004.00178.x> PMID: 15482517
- [31] Spergel JM. Role of allergy in atopic dermatitis (eczema). 2019. Available from: <https://www.uptodate.com/contents/role-of-allergy-in-atopic-dermatitis-eczema>
- [32] Panel NI-SE. Guidelines for the diagnosis and management of food allergy in the United States: Report of the NIAID-sponsored expert panel. *J Allergy Clin Immunol* 2010; 126(6 Suppl): S1-8.
- [33] Dhar S, Srinivas S. Food allergy in atopic dermatitis. *Indian J Dermatol* 2016; 61(6): 645-8. <http://dx.doi.org/10.4103/0019-5154.193673> PMID: 27904183
- [34] Boyce JA, Assa'ad A, Burks AW, *et al.* Guidelines for the diagnosis and management of food allergy in the United States: Summary of the NIAID-sponsored expert panel report. *Nutr Res* 2011; 31(1): 61-75. <http://dx.doi.org/10.1016/j.nutres.2011.01.001> PMID: 21310308
- [35] Silverberg NB, Lee-Wong M, Yosipovitch G. Diet and atopic dermatitis. *Cutis* 2016; 97(3): 227-32. PMID: 27023085
- [36] Mohajeri S, Newman SA. Review of evidence for dietary influences on atopic dermatitis. *Skin Therapy Lett* 2014; 19(4): 5-7. PMID: 25188523
- [37] Rustad AM, Nickles MA, Bilimoria SN, Lio PA. The role of diet modification in atopic dermatitis: Navigating the complexity. *Am J Clin Dermatol* 2022; 23(1): 27-36. <http://dx.doi.org/10.1007/s40257-021-00647-y> PMID: 34687433
- [38] Lee MK, Seo JH, Chu H, *et al.* Current status of patient education in the management of atopic dermatitis in Korea. *Yonsei Med J* 2019; 60(7): 694-9. <http://dx.doi.org/10.3349/ymj.2019.60.7.694> PMID: 31250584
- [39] Zhang A, Silverberg JI. Association of atopic dermatitis with being overweight and obese: A systematic review and metaanalysis. *J Am Acad Dermatol* 2015; 72(4): 606-616.e4. <http://dx.doi.org/10.1016/j.jaad.2014.12.013> PMID: 25773409
- [40] Narla S, Silverberg JI. The role of environmental exposures in atopic dermatitis. *Curr Allergy Asthma Rep* 2020; 20(12): 74. <http://dx.doi.org/10.1007/s11882-020-00971-z> PMID: 33047271
- [41] Nankervis H, Pynn EV, Boyle RJ, *et al.* House dust mite reduction and avoidance measures for treating eczema. *Cochrane Libr* 2015; 2016(5): CD008426. <http://dx.doi.org/10.1002/14651858.CD008426.pub2> PMID: 25598014
- [42] Zhang P. The role of diet and nutrition in allergic diseases. *Nutrients* 2023; 15(17): 3683. <http://dx.doi.org/10.3390/nu15173683> PMID: 37686715
- [43] Oykhman P, Dookie J, Al-Rammahy H, *et al.* Dietary elimination for the treatment of atopic dermatitis: A systematic review and meta-analysis. *J Allergy Clin Immunol Pract* 2022; 10(10): 2657-2666.e8. <http://dx.doi.org/10.1016/j.jaip.2022.06.044> PMID: 35987995
- [44] Sanders ME, Merenstein DJ, Reid G, Gibson GR, Rastall RA. Probiotics and prebiotics in intestinal health and disease: from biology to the clinic. *Nat Rev Gastroenterol Hepatol* 2019; 16(10): 605-16. <http://dx.doi.org/10.1038/s41575-019-0173-3> PMID: 31296969
- [45] Thomsen SF. Atopic dermatitis: Natural history, diagnosis, and treatment. *ISRN Allergy* 2014; 2014: 1-7. <http://dx.doi.org/10.1155/2014/354250> PMID: 25006501
- [46] Koszorú K, Borza J, Gulácsi L, Sárdy M. Quality of life in patients with atopic dermatitis. *Cutis* 2019; 104(3): 174-7. PMID: 31675393
- [47] Sidbury R, Tom WL, Bergman JN, *et al.* Guidelines of care for the management of atopic dermatitis. *J Am Acad Dermatol* 2014; 71(6): 1218-33. <http://dx.doi.org/10.1016/j.jaad.2014.08.038> PMID: 25264237
- [48] Lee SY, Lee E, Park YM, Hong SJ. Microbiome in the Gut-Skin Axis in Atopic Dermatitis. *Allergy Asthma Immunol Res* 2018; 10(4): 354-62. <http://dx.doi.org/10.4168/aaair.2018.10.4.354> PMID: 29949831
- [49] Gür Çetinkaya P, Murat Şahiner Ü. Childhood atopic dermatitis: Current developments, treatment approaches, and future expectations. *Turk J Med Sci* 2019; 49(4): 963-84. <http://dx.doi.org/10.3906/sag-1810-105> PMID: 31408293
- [50] Trikamjee T, Comberiat P, D'Auria E, Peroni D, Zuccotti GV. Nutritional factors in the prevention of atopic dermatitis in children. *Front Pediatr* 2021; 8: 577413. <http://dx.doi.org/10.3389/fped.2020.577413> PMID: 33585361
- [51] Fujii M. Current understanding of pathophysiological mechanisms of atopic dermatitis: Interactions among skin barrier dysfunction, immune abnormalities and pruritus. *Biol Pharm Bull* 2020; 43(1): 12-9. <http://dx.doi.org/10.1248/bpb.b19-00088> PMID: 31902917
- [52] Fishbein AB, Silverberg JI, Wilson EJ, Ong PY. Update on atopic dermatitis: Diagnosis, severity assessment, and treatment selection. *J Allergy Clin Immunol Pract* 2020; 8(1): 91-101. <http://dx.doi.org/10.1016/j.jaip.2019.06.044> PMID: 31474543
- [53] Sugita K, Akdis CA. Recent developments and advances in atopic dermatitis and food allergy. *Allergol Int* 2020; 69(2): 204-14. <http://dx.doi.org/10.1016/j.alit.2019.08.013> PMID: 31648922