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ATOPIC DERMATITIS AND THE INTERRELATIONSHIPS WITH GUT MICROBIOTA: MODERN PERSPECTIVES

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Abstract: Atopic dermatitis (AD) is one of the most common chronic and recurrent inflammatory dermatoses affecting both children and adults worldwide. It is characterized by immune system imbalance, activation of cytokines such as IL-4, IL-13, and IL-31, as well as disruption of the epidermal barrier. In recent years, growing attention has been directed toward the potential interplay between atopic dermatitis and the gut microbiota. Numerous studies have shown that intestinal dysbiosis may alter the balance of T-cell subsets, modulate cytokine expression, and increase allergic sensitization. In particular, the reduction of beneficial bacteria such as *Bifidobacterium* and *Lactobacillus* has been associated with a more severe course of atopic dermatitis. Epidemiological investigations confirm that the gut microbiota composition of patients with AD differs significantly from that of healthy individuals.

Moreover, the use of probiotics and prebiotics is increasingly recognized as a promising adjunctive strategy in the management of atopic dermatitis, with evidence suggesting improvement in clinical severity scores such as SCORAD. However, results remain heterogeneous due to differences in strains, dosages, and study populations. Therefore, further large-scale, multicenter, randomized controlled trials are necessary to establish standardized approaches and validate clinical efficacy.

This review aims to provide an updated overview of the complex interactions between atopic dermatitis and gut microbiota, summarize recent global findings, and emphasize the importance of conducting comprehensive clinical and laboratory investigations in Uzbekistan, where this area of research remains largely unexplored. Strengthening local scientific efforts in this field could have significant implications for improving national healthcare strategies and patient outcomes.

Keywords: Atopic dermatitis; gut microbiota; immune system; cytokines; probiotics; prebiotics; dysbiosis.

Introduction. Atopic dermatitis (AD) is one of the most common chronic inflammatory dermatoses in children, characterized by recurrent episodes, severe pruritus, impaired skin barrier function, and reduced quality of life. According to the World Health Organization (WHO), the prevalence of atopic dermatitis is estimated to be up to 15–20% in children and 3–10% in adults [1]. The European Academy of Allergy and Clinical Immunology (EAACI) has also identified atopic dermatitis as one of the most pressing allergic diseases worldwide [2].

In recent years, increasing attention has been directed toward understanding atopic dermatitis not merely as a skin disorder but as a complex disease affecting multiple body systems. In particular,

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the interplay between gut microbiota and the immune system has been highlighted as a potentially important factor in the pathogenesis of atopic dermatitis [3]. Studies suggest that intestinal dysbiosis may enhance Th2-type immune responses, leading to increased activation of cytokines such as IL-4, IL-13, and IL-31 [4]. This, in turn, exacerbates the symptoms of atopic dermatitis and increases the likelihood of comorbidity with food allergies. However, the literature presents divergent views: while some studies have demonstrated that probiotics and prebiotics significantly reduce the symptoms of atopic dermatitis, others have failed to confirm such beneficial effects [5]. Therefore, the mechanisms underlying the relationship between atopic dermatitis and gut microbiota remain incompletely understood.

In this context, the aim of the present review article is to elucidate the interrelationship between atopic dermatitis and gut microbiota, to summarize the findings from international scientific sources, and to outline potential future directions for research in this field.

Current Evidence on Atopic Dermatitis and Gut Microbiota. The pathogenesis of atopic dermatitis is complex and is based on the interaction of genetic, immunological, and environmental factors. Impairment of the skin barrier plays a crucial role in disease development. Mutations in the filaggrin gene increase transepidermal water loss, facilitate the penetration of allergens through the skin, and thereby trigger pathological activation of the immune system [1].

From an immunological perspective, the Th2-type immune response predominates. In particular, cytokines such as IL-4, IL-13, and IL-31 activate inflammatory processes, leading to pruritus and the development of eczema [2]. Recent studies have also demonstrated the involvement of the gut microbiota in this process. In conditions of dysbiosis, beneficial bacteria decrease while pathogenic flora increase, shifting the immune system toward a Th2 profile and exacerbating atopic symptoms [3,4]. Atopic dermatitis is widespread in children and often manifests in combination with food allergies. This condition is considered the initial stage of the so-called “atopic march” [5]. Clinical observations show that children with intestinal dysbiosis experience more severe atopic dermatitis and shorter remission periods [6]. In adults, atopic dermatitis frequently presents in a more severe clinical form. Recent studies have reported a high prevalence of intestinal dysbiosis among patients with severe AD [7]. Therefore, in the assessment of clinical manifestations, it is important to consider not only skin symptoms but also gut health. One of the main diagnostic criteria for atopic dermatitis is the Hanifin and Rajka criteria, which allow for a systematic evaluation of clinical features [8]. In addition, immunological markers—such as total and specific IgE levels, as well as cytokine profiles (IL-4, IL-13, IL-31)—are useful in refining the diagnosis [9]. In recent years, microbiota analysis has gained increasing importance in the study of atopic dermatitis. Techniques such as 16S rRNA sequencing and metagenomic analyses are being used to accurately assess the composition of gut microbiota and to demonstrate the association between dysbiosis and disease severity [10]. One of the major therapeutic advances in recent years has been the introduction of biologic therapy. Dupilumab, a drug that blocks the signaling pathways of IL-4 and IL-13, is being used effectively to control severe atopic dermatitis [11]. Microbiota-targeted approaches are also considered relevant. Probiotics (e.g., *Lactobacillus rhamnosus*, *Bifidobacterium longum*) and prebiotics have been shown in many reports to alleviate symptoms of atopic dermatitis by restoring intestinal balance [12]. However, not all clinical studies have confirmed these effects. Therefore, a comprehensive approach—including collaboration between dermatologists and

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gastroenterologists, as well as a combination of biologic and probiotic therapy—is regarded as promising [13]. The scientific literature presents divergent views on the relationship between atopic dermatitis and gut microbiota. Some authors report that probiotics significantly reduce the symptoms of AD [6], while others emphasize that the clinical effects are not as evident [7]. These discrepancies can be explained by differences in research methodology, bacterial strains used, and population characteristics.

In Uzbekistan, large-scale studies investigating the association between atopic dermatitis and gut microbiota have hardly been conducted. Therefore, new epidemiological and clinical research in this area is necessary. Several international studies and reviews have been published on this topic. In 2024, the article *"Hotspots and Development Trends of Gut Microbiota in Atopic Dermatitis"* was published in *Lippincott Journals*, highlighting the potential involvement of gut microbiota in AD through immune, metabolic, and neuroendocrine pathways. In 2023, a study conducted in Hong Kong by Y. Wang and colleagues analyzed alterations in gut microbiota among 234 adult AD patients using amplicon 16S rRNA sequencing. In 2022, Y. Liu and co-authors in China published a scoping review on atopic dermatitis and gut microbiota in children. In 2024, the article *"Mapping the Relationship between Atopic Dermatitis and Gut Microbiota"* was published, analyzing links between gut dysbiosis, IgE, eczema, and AD. In 2025, the article *"Skin Microbiome Dynamics in Atopic Dermatitis: Understanding Host ..."* was released, focusing on the role of skin microbiota dynamics in AD. Also, in 2025, H. Tang and colleagues from China published a review article entitled *"Gut Microbiota Modulation"*, dedicated to gut microbiota and atopic dermatitis.

Discussion. In recent years, diverse perspectives have emerged in the scientific literature regarding the interrelationship between atopic dermatitis (AD) and the gut microbiota. Numerous studies suggest that disruption of the gut microbiota contributes to the activation of the immune system along the Th2 pathway, leading to the excessive production of cytokines such as IL-4, IL-13, and IL-31. This process exacerbates the symptoms of atopic dermatitis and promotes the relapsing course of the disease [1,3]. Epidemiological observations have reported significant alterations in the composition of the gut microbiota in patients with AD compared with healthy control groups [4]. In particular, reductions in beneficial bacteria such as *Bifidobacterium* and *Lactobacillus* have been associated with more severe manifestations of atopic dermatitis. Furthermore, several randomized clinical trials have indicated that restoring intestinal balance through the use of probiotics and prebiotics may alleviate disease symptoms [5,6]. However, not all studies confirm these findings. Some systematic reviews and meta-analyses have emphasized that the clinical efficacy of probiotic therapy is inconsistent, with discrepancies likely explained by differences in bacterial strains, dosages, and study populations [7]. Moreover, the direct pathogenic mechanisms by which gut microbiota influence atopic dermatitis remain incompletely elucidated.

These inconsistencies highlight priority directions for future research. In particular, there is a need for large-scale, multicenter, and long-term prospective studies, as well as in-depth analyses of the interactions between microbiota composition, genetic predisposition, and environmental factors. Additionally, the development of standardized protocols for probiotic/prebiotic therapy and their potential combination with biologic agents may represent a promising strategy for clinical practice. Overall, the existing literature indicates a substantial interrelationship between

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atopic dermatitis and the gut microbiota; however, additional scientific evidence is required before reaching definitive conclusions.

Conclusion. Atopic dermatitis is a complex inflammatory disease that affects not only the skin but also multiple body systems [2]. Recent studies have demonstrated a direct relationship between this pathology and the gut microbiota [3,4,10]. Under conditions of dysbiosis, the reduction in beneficial bacteria and the overgrowth of pathogenic microorganisms lead to activation of the immune system along the Th2 pathway. This, in turn, results in excessive production of cytokines such as IL-4, IL-13, and IL-31, thereby aggravating atopic symptoms [2,8].

Probiotic and prebiotic therapy is considered a promising approach for alleviating the symptoms of atopic dermatitis, with numerous clinical trials reporting reductions in SCORAD index scores [6,12,13]. However, the outcomes are not consistent across all studies, which can be explained by differences in bacterial strains used, dosage regimens, and study populations [7,15]. Therefore, future large-scale, multicenter, randomized clinical trials are required [15].

In Uzbekistan, the relationship between atopic dermatitis and gut microbiota has been scarcely investigated. Thus, conducting comprehensive clinical and laboratory studies in this field is of both practical importance and high relevance for the national healthcare system.

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