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Probiotics in Pediatric Atopic Dermatitis: Prevention and Therapeutic Potential – A Literature Review

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Abstract

Introduction. Atopic dermatitis (AD) is a chronic inflammatory skin disorder characterised by impaired epidermal barrier and immune dysregulation. It is becoming increasingly prevalent in the pediatric population. Recent research highlights the role of the gut-skin axis and suggests that the intestinal microbiota may influence the development and course of inflammatory skin diseases, including AD.

Aim of the study. This review aims to evaluate the current evidence regarding the use of probiotics in the treatment and prevention of atopic dermatitis in the pediatric population.

Material and methods. A literature search was conducted using the PubMed database to identify relevant studies discussing the role of probiotics in treatment and prevention of atopic dermatitis in children. Meta-analyses, randomized controlled trials and systematic reviews were included.

Results. Included studies suggest that probiotic supplementation may reduce the severity of atopic dermatitis, as measured by the SCORAD index, particularly in moderate-to-severe AD, and when administered for longer durations. Moreover, they may be useful in prevention of AD in high-risk infants, especially during the prenatal period. However, results vary depending on study design, probiotic strain, population and duration of supplementation.

Conclusion. Probiotics may be a promising new strategy as an adjunct therapy in the treatment and prevention of pediatric atopic dermatitis. Nevertheless, further research, mostly well-designed randomized controlled trials are needed in order to determine optimal strains, dosage and duration of treatment.

Keywords: Atopic dermatitis; probiotics; microbiome; children; eczema

Introduction

Atopic dermatitis (AD) is a chronic inflammatory skin disorder characterised by the epidermal barrier dysfunction and immune dysregulation. The most important pathophysiological factor is that the skin barrier is impaired, resulting in increased permeability [1]. At the moment AD is becoming increasingly widespread in the population and it is affecting up to 20-25% [2] of children and 2-3% of adults [3]. AD presents with pruritus, xerosis and skin lesions.

In the pathogenesis of AD genetic, environmental, immunological, individual and microbial factors are of significant importance. In recent years more attention is given to the gut-skin axis and the microbiota, and it is suggested that the intestinal microbiota could influence skin health and the course of AD. The microbiome has many beneficial effects such as protecting against pathogens, maintaining the overall health and modifying the immune response of the host. According to the studies the skin is covered in about 10^{12} microbial cells and the intestines account for 10^{14} microbial cells [4].

There is emerging evidence suggesting that the intestinal microbiota could affect other organs, such as the skin, and modulate the immune responses. This suggests that the gut microbiota could influence the course of inflammatory skin diseases, including AD. Dysbiosis both in the intestines and in the skin have been connected to the AD pathogenesis [5].

Probiotics are defined as living microorganisms that can be ingested as a medical supplement, and could offer health benefits to an individual. The most commonly used probiotics include *Lactobacillus spp.*, *Bifidobacterium* [6]. These probiotics could benefit the gastrointestinal microbiota and improve health by modulating immune pathways. As it has been shown that the gut microbiome has the potential of immunomodulating distant organs, such as the skin [6], it is important to observe whether the oral intake of probiotics could modify the presentation and treatment of skin disorders, such as AD.

As in AD apart from the epidermal barrier dysfunction, there is a serious imbalance in the skin microbiome [7]. The cutaneous dysbiosis is described as possibly being one of the main factors in AD pathogenesis. Patients with AD have a smaller microbial diversity, they also have a prevalence of *Staphylococcus aureus*, whereas healthy individuals have equilibrium between the bacteria also including coagulase-negative staphylococci and *Cutibacterium acnes* [7]. The healthy skin microbiome provides for protection and a better barrier against pathogens. Because of this it has become essential to research whether improving the gut microbiome by oral probiotic intake may result in the alleviation of AD symptoms.

At present, the treatment of AD in children is mainly based on symptomatic control and immune system modulation, through the use of emollient creams, topical corticosteroids, and

phototherapy, primarily with narrowband UVB (311 nm). In more severe cases of AD, immunomodulatory therapy may be required, such as calcineurin inhibitors [8]. Some patients may also require antipruritic therapy. Furthermore, if the above methods of treatment are insufficient, a monoclonal antibody, dupilumab, may be considered. It is a biological drug targeting the T helper 2 (Th2) pathway [9], which helps to modify the immune response in AD patients. While these treatments are effective, they are associated with side effects, particularly with long-term use of corticosteroids. Therefore, there is a need for alternative or complementary therapies. In this context, probiotics have been considered a potential therapeutic approach, particularly due to their immunomodulatory properties and their role in the gut–skin axis.

Therefore, the aim of this literature review is to evaluate and critically assess the current evidence regarding the role of probiotics in the prevention and treatment of atopic dermatitis in children.

Methods

A literature search was conducted using the PubMed database to identify relevant studies on probiotics and atopic dermatitis in pediatric populations. The search strategy included combinations of keywords such as “atopic dermatitis”, “eczema”, “probiotics”, “microbiome”, “children”, and “pediatric”. Only articles published in English were included. Studies were screened based on title and abstract, followed by full-text review. Inclusion criteria comprised randomized controlled trials, systematic reviews, and meta-analyses evaluating clinical outcomes such as SCORAD. Studies not focusing on pediatric populations or lacking relevant outcomes were excluded.

Literature Review

SCORAD index

To compare the effectiveness in treatment of AD the SCORAD index (SCORing Atopic Dermatitis) is used. It is a clinical scoring tool used to assess the extent and severity of AD. It uses area to determine the extent and the body parts affected, the intensity and the subjective symptoms of a patient. It then sums the 3 categories to give a final score [10]. By using this clinical tool it is easier to evaluate the outcome of the treatments used, whether and by how much they alleviate the symptoms of AD of the patient.

Meta-analyses on the reduction of AD severity using probiotics

Several meta-analyses have shown a significant reduction in severity of AD following probiotic supplementation. For example Gaikwad et al. [11] reported in their study published in 2025 that probiotic supplementation can reduce the disease severity and the immunologic markers in children with AD. To do so SCORAD scores and serum IgE levels were evaluated. Eleven out of fourteen randomized trials reported a significant reduction of the SCORAD score. The authors also researched the IgE levels, yet this marker was not statistically significant, possibly due to short period of treatment. Similarly in their meta-analysis, from 2020 by Jiang, Wen et al. [12] observed a consistent decrease in SCORAD index across 25 studies, they have concluded that the probiotic supplementation may both reduce the risk of developing AD, as well as decrease the disease severity. The meta-analysis of randomized controlled trials by Huang et al. [13] involved children and infants with atopic dermatitis. The included studies used various probiotic strains. The results showed a moderate reduction in SCORAD scores; however, there was high heterogeneity across the studies. The issue with these meta-analyses is that multi-strain probiotic formulas were used. This creates an issue with identifying the most effective formula for treatment and supplementation in AD.

Single Probiotic Strains

In other studies such as in the randomized, double blind and placebo controlled clinical trial by Carucci et al. [14] a single strain of probiotics was used. The probiotic strain was *Lactobacillus rhamnosus* GG (LGG) in the dose of 1×10^9 CFU daily, in a 12 week long treatment period. After the treatment it has been concluded that the SCORAD scores improved in the probiotic group compared with the placebo, moreover, the quality of life improved. Children receiving probiotics had **more days without rescue medication**. These findings indicate that the probiotic strain LGG may be useful as adjunct therapy in AD in pediatric

patients, also of lower age. Zhao et al. in their meta-analysis also reported that probiotics containing *Lactobacillus spp.* were associated with greater reduction in SCORAD scores, suggesting a strain-dependent treatment effect. These are especially informative papers as they both provide information about the therapeutic effect of probiotics as well as identify a specific probiotic strain.

AD in infants, treatment and prevention

An important age group to be considered in the treatment of AD is infants. Both Zhao et al. and Chen et al. [15] have researched the infant population. Zhao et al. have concluded a significant improvement in moderate to severe AD in this age group. Chen et al. in their systematic review have mainly focused on the prevention of AD. They concluded that there was a significant reduction of AD risk (RR 0.76, around 24% of risk reduction) while supplementing probiotics. The strongest reduction was observed during the prenatal period- maternal supplementation of probiotics and the weakest effect was observed with infant supplementation. A recent review by Chu et al. [16] suggests that probiotic supplementation during pregnancy and early infancy may modestly reduce the risk of developing AD, nevertheless the clinical advantage remains limited and dependent on individual differences. They suggest that probiotics seem to be most effective when used prenatally or in early infancy. These studies show that probiotics can reduce the risk of developing AD in infants, nevertheless they do not specify the strain or the optimal dose to do so.

Older children and reducing the dose of corticosteroids in treatment

Older children also seem to benefit from probiotic supplementation as a part of AD treatment programme. In the retrospective study done by Colombo et al. [17] including 70 patients, aged 4-17 years, the probiotic strains of *Bifidobacterium lactis*, *Bifidobacterium longum* and *Lactobacillus casei* were used in the dose of 1×10^9 CFU daily. The duration of the supplementation was 12 weeks, and by that time 90% of patients in the probiotic group showed improvement of AD compared to 57.6% in the placebo group. Moreover, the probiotic group could decrease the use of topical steroids in order to control the AD symptoms. This research paper suggests that not only do probiotics help alleviate the symptoms of AD, they could also help in reducing the dose of corticosteroids in treatment.

The positive impact of probiotics in reducing the dose of corticosteroids in treatment was further supported in the randomized clinical trial done by Navarro-Lopez et al. [18] in 2018, they have observed that the probiotic group used fewer topical steroids to control the symptoms, compared to the placebo group. This is a very important observation as a long-term corticosteroid usage has many side effects, and it is beneficial in the long-term to be able to lower the dose.

Duration of Probiotic Intake

The duration of the probiotic treatment also seems to be important. The research paper by Zhao et al. from 2018 [19] included 8 randomized controlled trials including 741 infants to evaluate the significance of probiotics use in treatment efficacy on AD. The main strains used were *Lactobacillus spp.* The duration was variable between weeks to months, and the study has concluded that there was a strong clinical benefit of using probiotics, and the longer the period of supplementation, the better the results. The severity was once again measured using the SCORAD index. The mean SCORAD reduction was -5.71, which is statistically significant.

The meta-analysis by Kyunghoon et al. [20] of 25 randomized controlled trials further complements the evidence that the duration of the supplementation is of key value. The best results in alleviating the symptoms and improving treatment were obtained when probiotics were supplemented for the duration of over 3 months. If probiotics were used for 3 months and longer, significant results were obtained, whereas a period shorter than 3 months showed no significant results. Furthermore both Kyunghoon et al. and Zhao et al. seem to convey that probiotics containing *Lactobacillus spp.* have the best results in lowering the SCORAD index. These findings strongly suggest that probiotics can be beneficial in treating infantile AD, the effect is likely both strain dependant and duration dependant.

Older Evidence

In the older meta-analysis by Lee et al. [21] from 2008 many rct's were compared mainly involving children with already existing AD. Lee et al. claim the results of probiotics use in treatment and prevention of AD were weak and inconclusive. Mainly *Lactobacillus rhamnosus GG (LGG)*, other *Lactobacillus spp.* and *Bifidobacterium spp.* were used. Different trials used different strains, which gave a high heterogeneity and a difficulty with comparing results. Furthermore the duration of the studies varied greatly from a couple of weeks to a couple of months. As this meta-analysis was published in 2008, it is important to highlight how our knowledge and evidence progressed over time.

Table 1. Summary of Included Studies Investigating the Effects of Probiotics on the Prevention and Treatment of Pediatric Atopic Dermatitis

Author (Year)	Study Design	Participants (n, age)	Probiotic Strains	Duration	Prevention (P) / Treatment (T)	Outcome Measured	Key Results
Gaikwad et al. (2025)	Systematic review + meta-analysis (RCTs)	14 RCTs, young children	Mixed strains	Variable	T	SCORAD, IgE	↓ SCORAD in 11/14 studies; IgE not significant
Jiang et al. (2020)	Systematic review + meta-analysis (RCTs)	25 RCTs, Infants and children	Mixed strains	Variable	Both	SCORAD, incidence	↓ SCORAD + ↓ risk of AD
Carucci et al. (2022)	RCT (ProPAD trial)	100, 6-36 months	<i>L. rhamnosus GG</i>	12 weeks	T	SCORAD, QoL	↓ SCORAD, ↑ QoL, ↓ medication use
Huang et al. (2017)	Systematic review + meta-analysis	13 RCTs, infants, children	Mixed strains	Variable	T	SCORAD	Moderate improvement, heterogeneous
Chen et al. (2022)	Systematic review + meta-analysis	22 studies, infants	Mixed strains	Prenatal + postnatal	P	Incidence of AD	↓ risk (RR ≈ 0.76), strongest prenatal effect

Chu et al. (2024)	Narrative review	High risk infants	Various	Variable	P	Incidence of AD	Modest preventive effect
Colombo et al. (2023)	Retrospective observational study	70 children (4–17y)	<i>B. lactis</i> , <i>B. longum</i> , <i>L. casei</i>	12 weeks	T	SCORAD, steroid use	↓ symptoms, ↓ steroid use
Navarro-López et al. (2018)	RCT	50 children (4–17y)	Multi-strain (<i>B. lactis</i> , <i>B. longum</i> , <i>L. casei</i>)	12 weeks	T	SCORAD, steroid use	Large ↓ SCORAD (-19), ↓ steroid use
Zhao et al. (2018)	Systematic review + meta-analysis (RCTs)	8 RCTs, 741 infants	Mainly <i>Lactobacillus</i>	Variable	T	SCORAD	↓ SCORAD (-5.7), better in moderate–severe
Kim et al. (2025)	Systematic review + meta-analysis (RCTs)	25 RCTs, 1,382 patients, pediatric subgroup	Mixed strains	<3 vs >3 months	T	SCORAD	Effective if >3 months, multi-strain best
Lee et al. (2008)	Meta-analysis	Children with AD, and at high risk of AD	Mixed strains	Variable	Both	SCORAD, incidence	Inconclusive, high heterogeneity

Discussion

The current body of evidence suggests that probiotics may play a beneficial role in the treatment of AD and alleviating the symptoms in pediatric populations. Across the included studies, probiotics demonstrate a potentially beneficial role in both treatment and prevention of AD in children. While randomized controlled trials show clinically significant decrease in SCORAD scores, the meta-analyses provide with more heterogeneous and sometimes inconclusive results. Findings remain inconsistent, and highly heterogeneous due to probiotic strains, duration of the supplementation period, AD severity and age of the patient.

One of the key factors which contributes to the variability is the different strains of probiotics used. This may be due to the fact that they can act differently on immunomodulation. Moreover, the treatment duration is important, the research suggests that interventions longer than 3 months show greater efficacy.

Disease severity is also a key variable, patients with moderate to severe AD appear to demonstrate greater improvements.

A major limitation across the literature is the difference of the study designs, the age of the patients, the time of probiotic supplementation, the strains and the number of CFU all differ between the studies. Further research is necessary to determine the optimal probiotic strain, dosage and treatment duration.

Furthermore the evidence on prevention seems to be more consistent than the results on probiotics in treatment of AD, nevertheless this may be due to the fact that there is fewer studies on prevention compared to treatment.

Overall, while probiotics show promise as both a preventive and adjunctive therapeutic strategy in pediatric AD, their effectiveness is not universal. The effect seems to be strain and duration specific, but is not yet fully predictable. Future research should focus on identifying optimal strains, treatment durations, and target populations to better define their role in clinical practice. The heterogeneity observed across studies shows the need for standardized clinical trials in future research.

Conclusion

In conclusion, probiotics represent a promising approach in treatment and prevention of pediatric atopic dermatitis, this is across different age groups of the pediatric population. Current evidence suggests that probiotics may reduce the severity of AD, as measured using the SCORAD index and alleviate the symptoms. The best studied effect seems to be on the moderate-to-severe AD group, and the *Lactobacillus spp.* probiotic group seems to show the most promising effects. Moreover, probiotics seem to be useful in the prevention of AD in high-risk neonates, especially as maternal supplementation in the prenatal period.

Nevertheless, the effectiveness of probiotics is not universal, and is not consistent in all of the studies. This is as the results are dependent on factors such as probiotic strain, duration and individual population characteristics. The heterogeneity of the study designs makes it difficult to identify optimal strategy for treatment protocols.

Ultimately, while probiotics may serve as a useful addition to traditional therapy, further high quality, standardized randomized controlled trials are needed to identify optimal treatment and clarify the role of probiotics in real clinical treatment of AD in the pediatric population.

Disclosure

Author's contribution

Conceptualization, Z. Kamińska; methodology, I. Zydlewski and A. Zielińska; software, A. Jakimowicz; check, A. Malcher and M. Blecharczyk; formal analysis, M. Pacanowska-Trawnicka and M. Mrozek; investigation, M. Pacanowska-Trawnicka and A. Jakimowicz; resources, I. Zydlewski; data curation, A. Malcher and M. Blecharczyk; writing – original draft preparation, Z. Kamińska; writing - review and editing, M. Mrozek; visualization, A. Zielińska; supervision, Z. Kamińska; project administration, Z. Kamińska;

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