Targeting the Gut–Skin Axis

Oral and Topical Probiotics in Pediatric Atopic Dermatitis

Dr. rer. nat. Stephanie Ostermann



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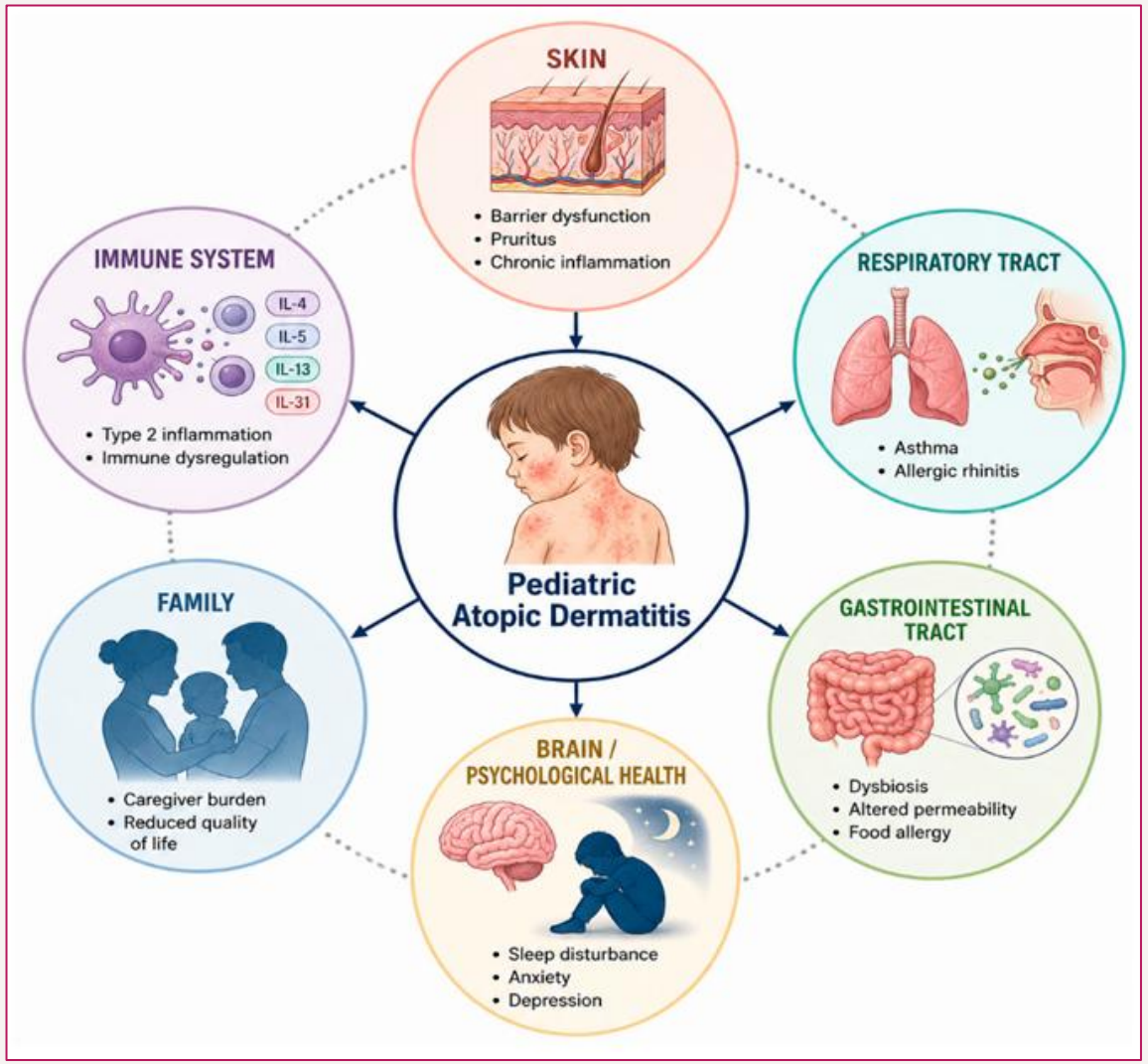

Atopic Dermatitis is a systemic disorder

- chronic inflammatory skin disease
- ~ 20 % of children are affected
- skin barrier dysfunction and immune dysregulation
- major impact on quality of life

Miulescu R-G, Costescu M, Marin R-C, Mușetescu A, Muntean C, Roşca I, Adam I-I, Ilici A, Coman OA. The Gut–Skin Axis in Pediatric Atopic Dermatitis: Nutritional Modulation, Microbiome Interactions, and Emerging Precision Approaches. Nutrients. 2026; 18(19):3138. https://doi.org/10.3390/nu18193138

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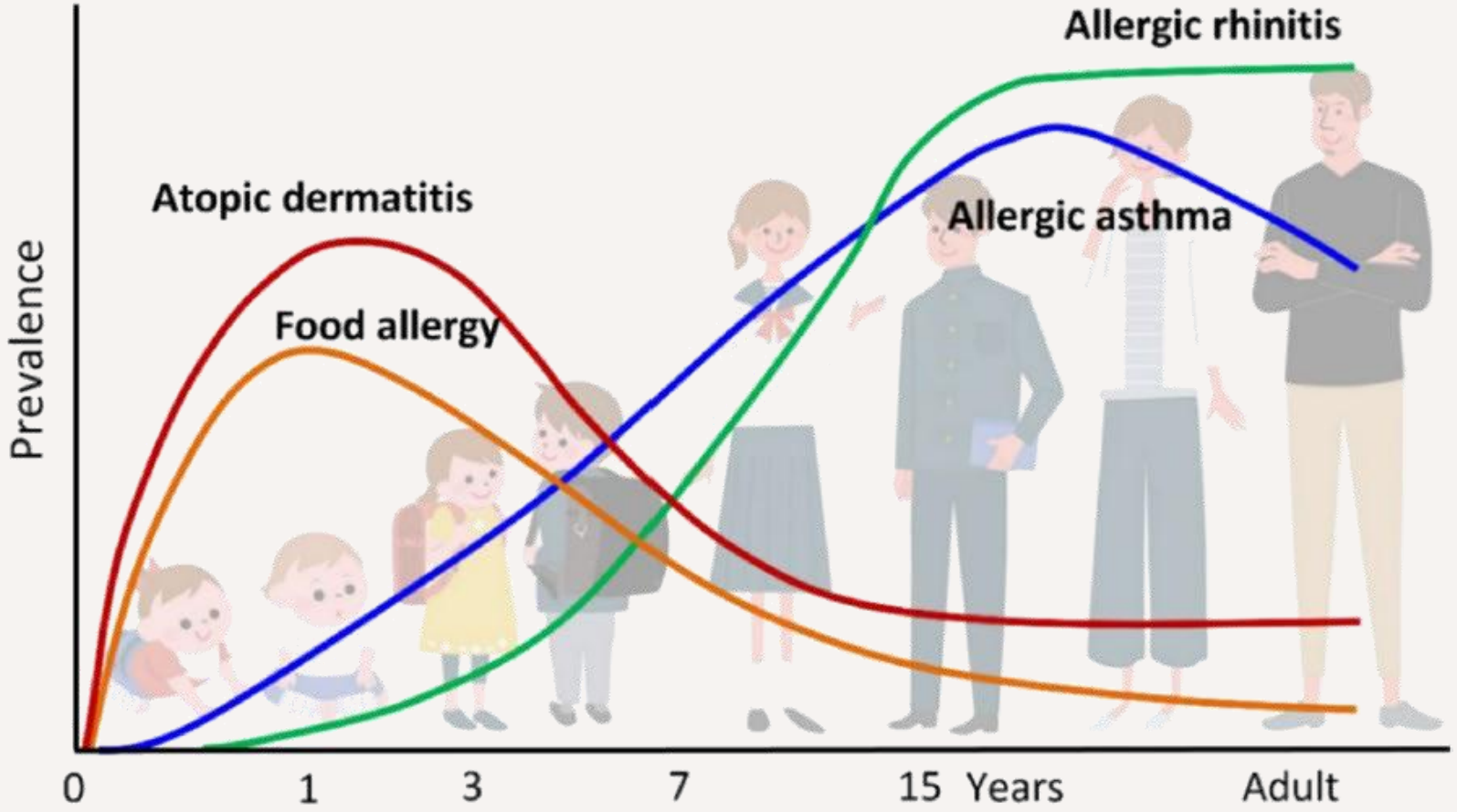
Typical development of allergic diseases – the atopic march



Tsuge, M.; Ikeda, M.; Matsumoto, N.; Yorifuji, T.; Tsukahara, H. Current Insights into Atopic March. Children **2021**, 8, 1067.

Microbial signals train the immune system

Immune tolerance

- Th1/Th2 balance
- T_{reg} expansion
- IL-10, TGF-β
- low inflammatory threshold



Allergic sensitization

- Th2 activation
- IL-4, IL-5, IL-13
- IgE + mast cells
- eosinophilic inflammation

Yu, L., Wu, M., Leung, T. et al. Early-life Gut Microbiota and Allergic Diseases: Immune Regulatory Mechanisms and Intervention Progress. Clinic Rev Allerg Immunol 69, 49 (2026). https://doi.org/10.1007/s12016-026-09174-2
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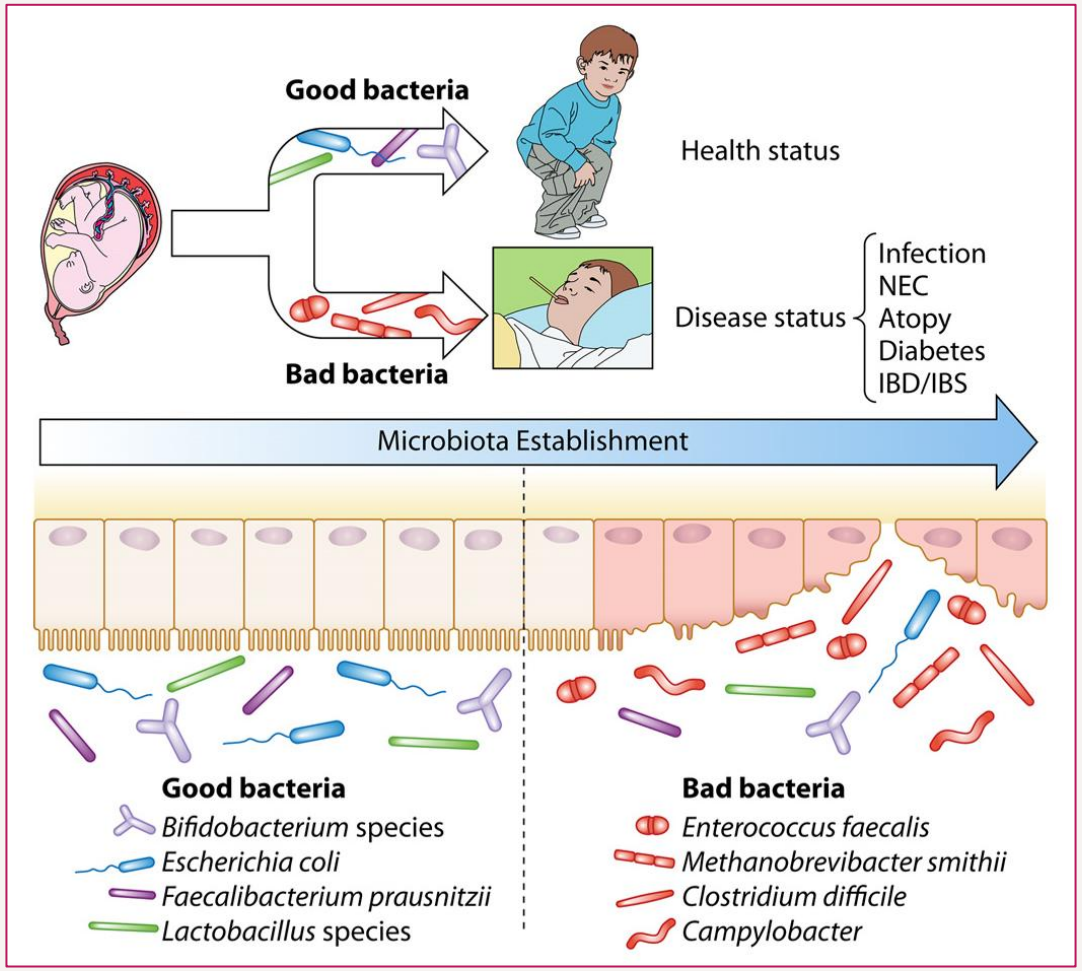
Gut Microbiome triggers Atopic Dermatitis



Milani C, Duranti S, Bottacini F, et al. The First Microbial Colonizers of the Human Gut: Composition, Activities, and Health Implications of the Infant Gut Microbiota. Microbiol Mol Biol Rev. 2017;81(4):e00036-17. Published 2017 Nov 8. doi:10.1128/MMBR.00036-17

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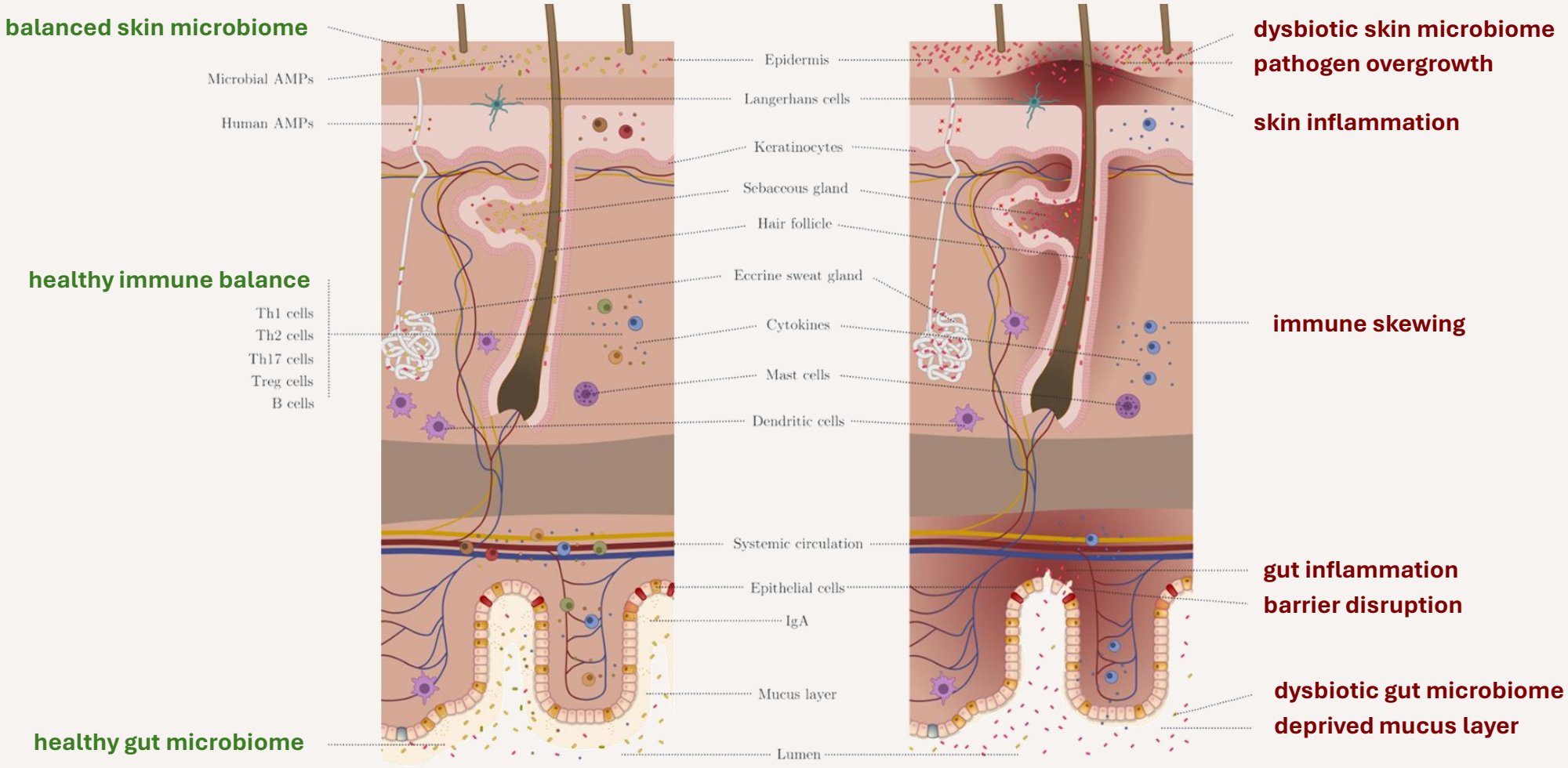
GUT-SKIN-AXIS:
Connecting the Gut, Immune System and Skin



De Pessemier B, Grine L, Debaere M, Maes A, Paetzold B, Callewaert C. Gut–Skin Axis: Current Knowledge of the Interrelationship between Microbial Dysbiosis and Skin Conditions. Microorganisms. 2021; 9(2):353. doi: 10.3390/microorganisms9020353

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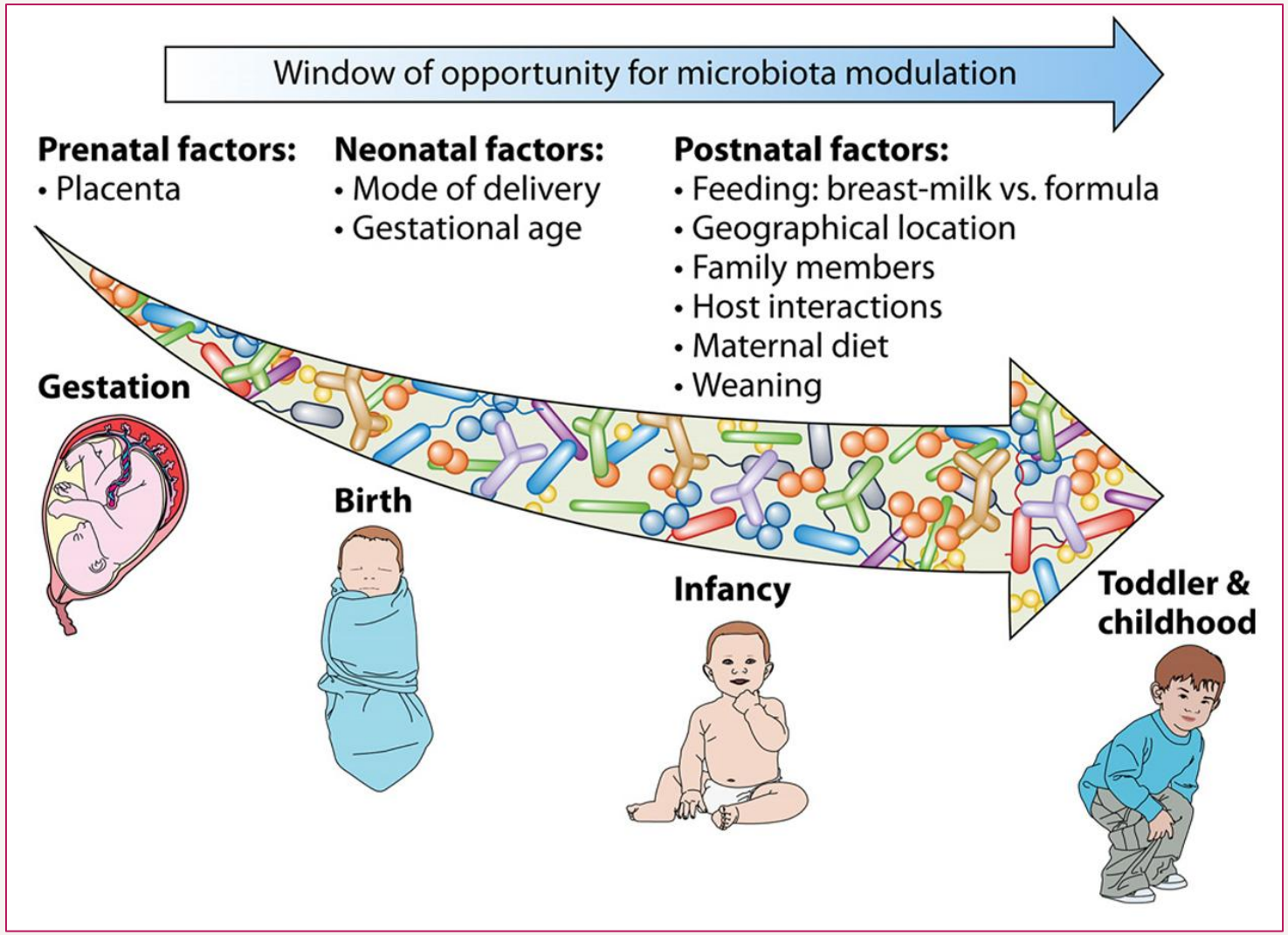

Window of opportunity for positive microbiome modulation via indication specific probiotics

Milani C, Duranti S, Bottacini F, et al. The First Microbial Colonizers of the Human Gut: Composition, Activities, and Health Implications of the Infant Gut Microbiota. Microbiol Mol Biol Rev. 2017;81(4):e00036-17. Published 2017 Nov 8. doi:10.1128/MMBR.00036-17

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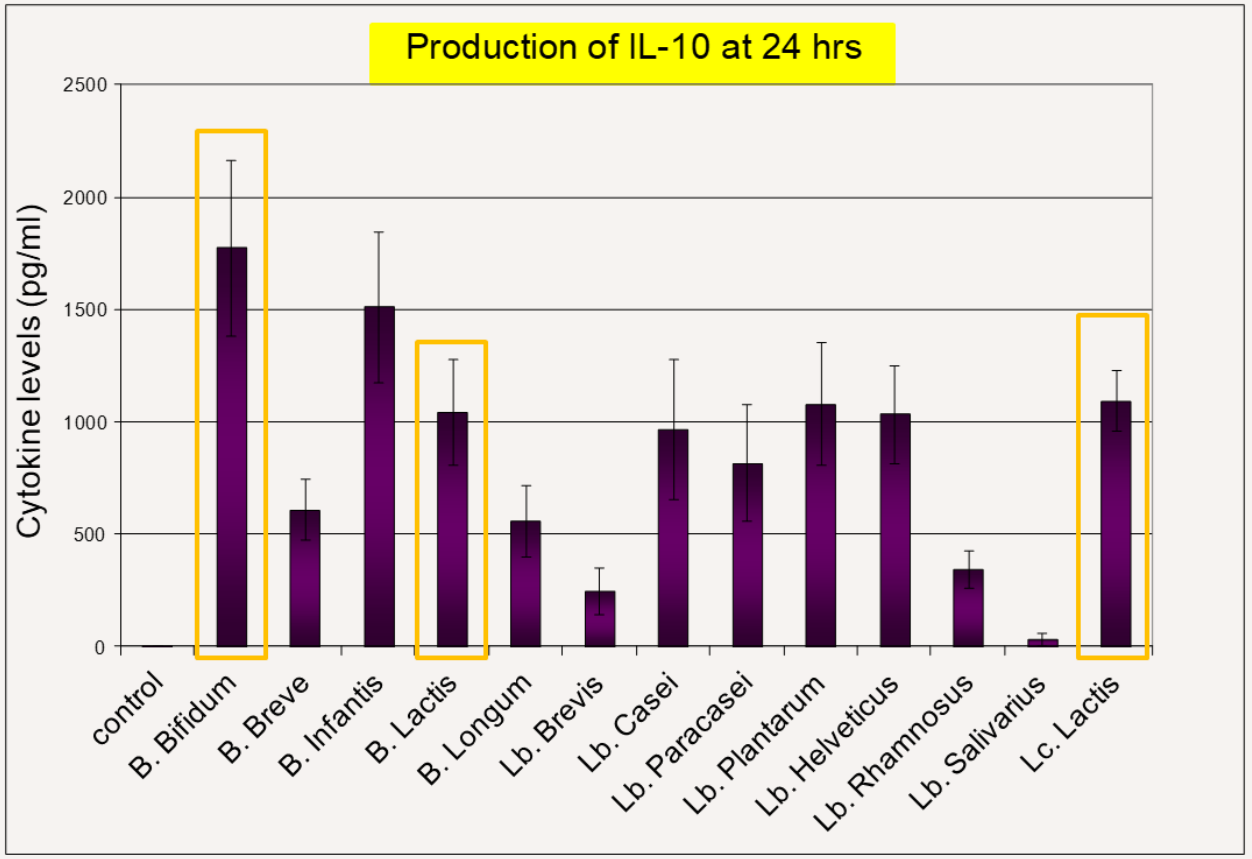
Selection of immunomodulating strains for an indication-specific multispecies probiotic



Probiotic strains in
OMNi-BiOTiC® PANDA

- induce the production of IL-10
- IL-10 protects against an excessive immune response

→ **balanced immune function**

Niers LEM, et al. (2005). Identification of strong interleukin-10 inducing lactic acid bacteria which down-regulate T helper type 2 cytokines. Clin Exp Allergy;35:1481–9.

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OMNi-BiOTiC® PANDA

- supports the **ideal colonization** of the baby‘s gut
- for **allergy prophylaxis** and **allergy therapy**



- **4 specifically selected bacterial strains:**

Lactococ. lactis ssp. lactis W58

Bifidob. animalis ssp. lactis W52

Bifidob. animalis ssp. lactis W51

Bifidobacterium bifidum W23

Allergy 2009 DOI: 10.1111/j.1398-9995.2009.02021.x

© 2009 John Wiley & Sons A/S

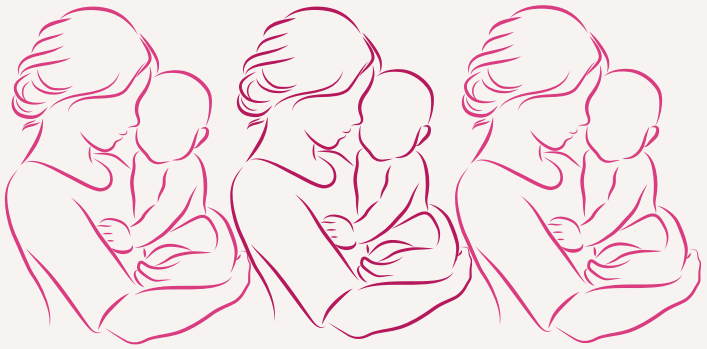
DOI: 10.1111/j.1398-9995.2009.02021.x

Original article

The effects of selected probiotic strains on the development of eczema (the PandA study)

STUDY DESIGN

Niers *et al.* 2009



Participants

- 156 pregnant women with family history of allergic disease and their „high-risk“ children

Study conduct

- double blind, randomized, placebo-controlled
- 1 x daily OMNi-BiOTiC® PANDA
- last 2 months of pregnancy & 1st year of child's life

Parameters

- development of atopic eczema
- production of cytokines

Niers, L. et al. (2009). The effects of selected probiotic strains on the development of eczema (the PandA study). Allergy;64:1349–58.

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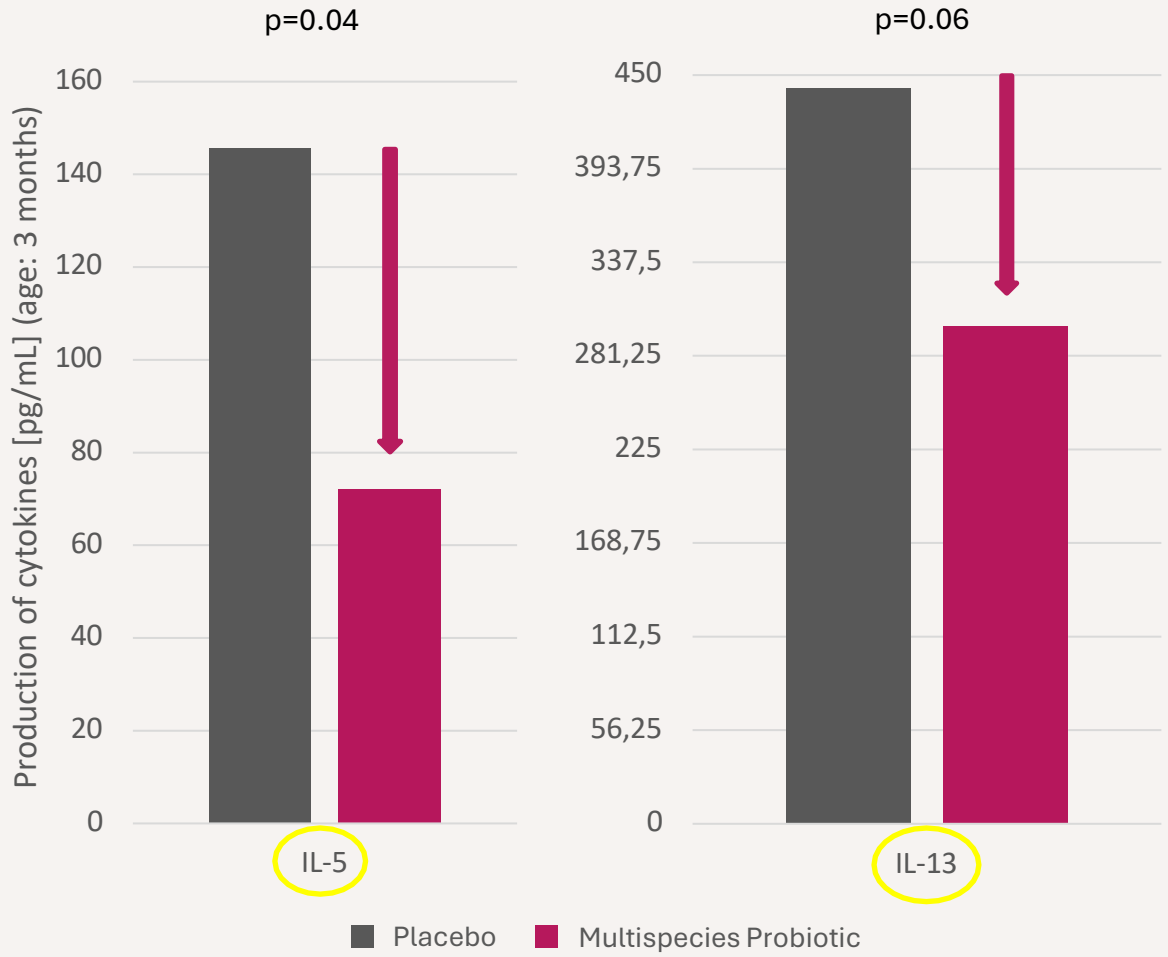
OMNi-BiOTiC® PANDA balances the immune system



Reduction of Th2 cytokines

- **IL-5** is reduced by half
- **IL-13** is reduced by a third

Niers L, et al. Hoekstra M, The effects of selected probiotic strains on the development of eczema (the PandA study). Allergy. 2009;64:1349–58.

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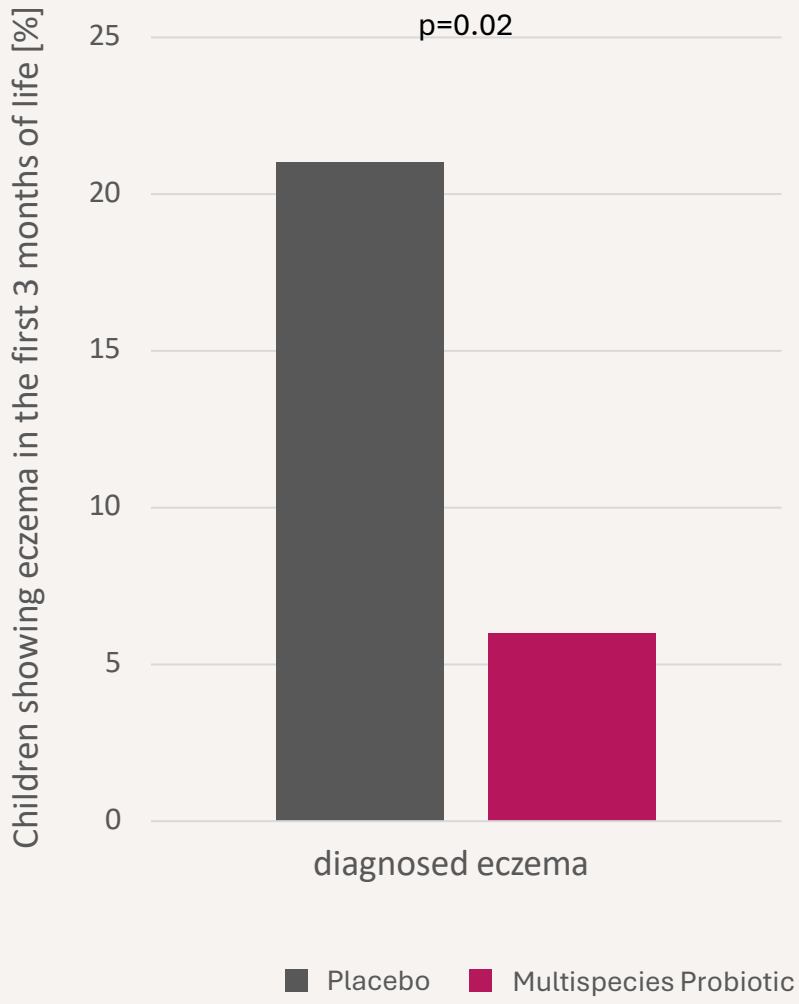
OMNi-BiOTiC® PANDA reduces eczema



71% less eczema due to OMNi-BiOTiC® PANDA

The beneficial effect of OMNi-BiOTiC® PANDA occurs already **within the first 3 months of life.**

Niers, L. et al. (2009). The effects of selected probiotic strains on the development of eczema (the PandA study). Allergy;64:1349–58.

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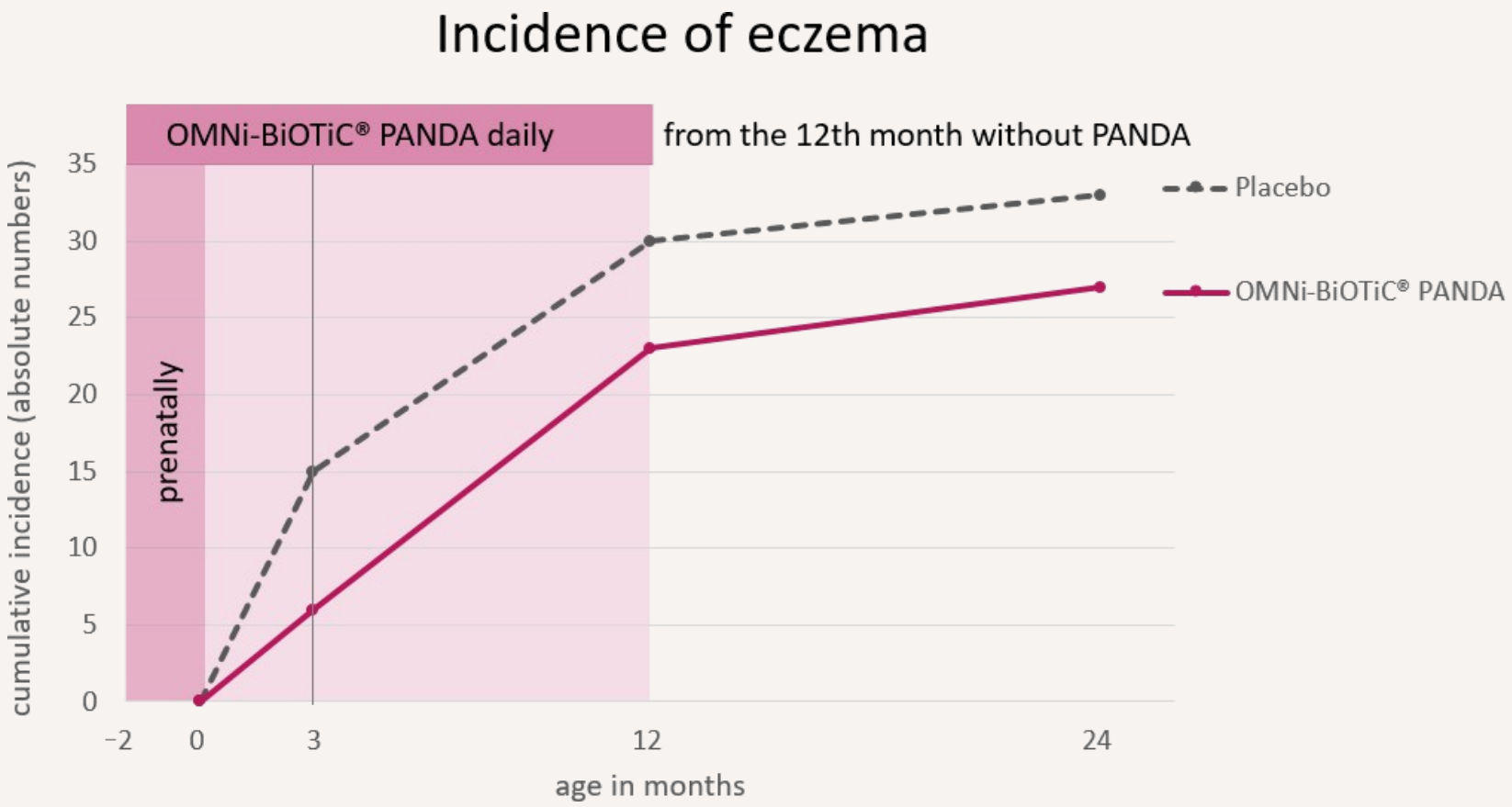
Positive effect persists even after stopping the intake of OMNi-BiOTiC® PANDA



Niers L, et al. Hoekstra M, The effects of selected probiotic strains on the development of eczema (the PandA study). Allergy. 2009;64:1349–58.

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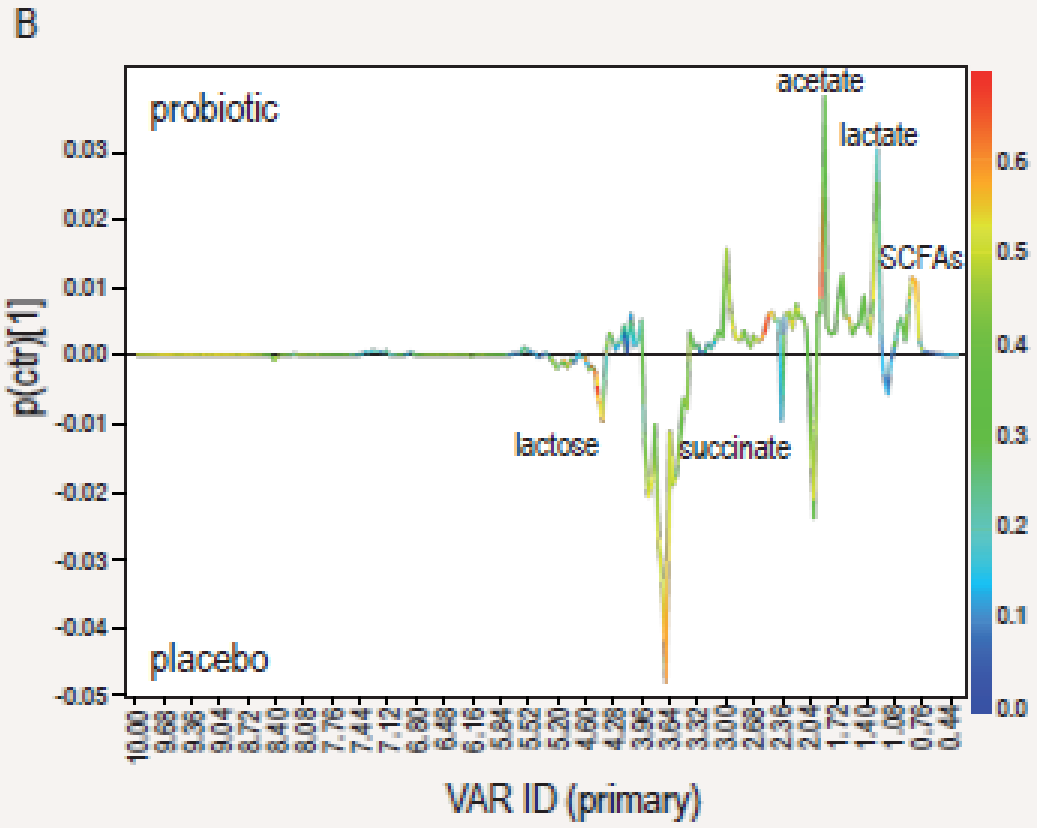
PandA Study: bacterial metabolites



OMNi-BiOTiC® PANDA <u>increases and regulates</u> the metabolite production (SCFA):

- barrier-function ↑
- T_{reg}-cells (Th1-Th2) ↑

CONCLUSION:
Early use of indication-specific probiotics to support **balanced immune development** and help **prevent allergic diseases**.

Kim HK, et al. van Hemert S, Probiotic supplementation influences faecal short chain fatty acids in infants at high risk for eczema. Benef Microbes. 2015;6:783–90.

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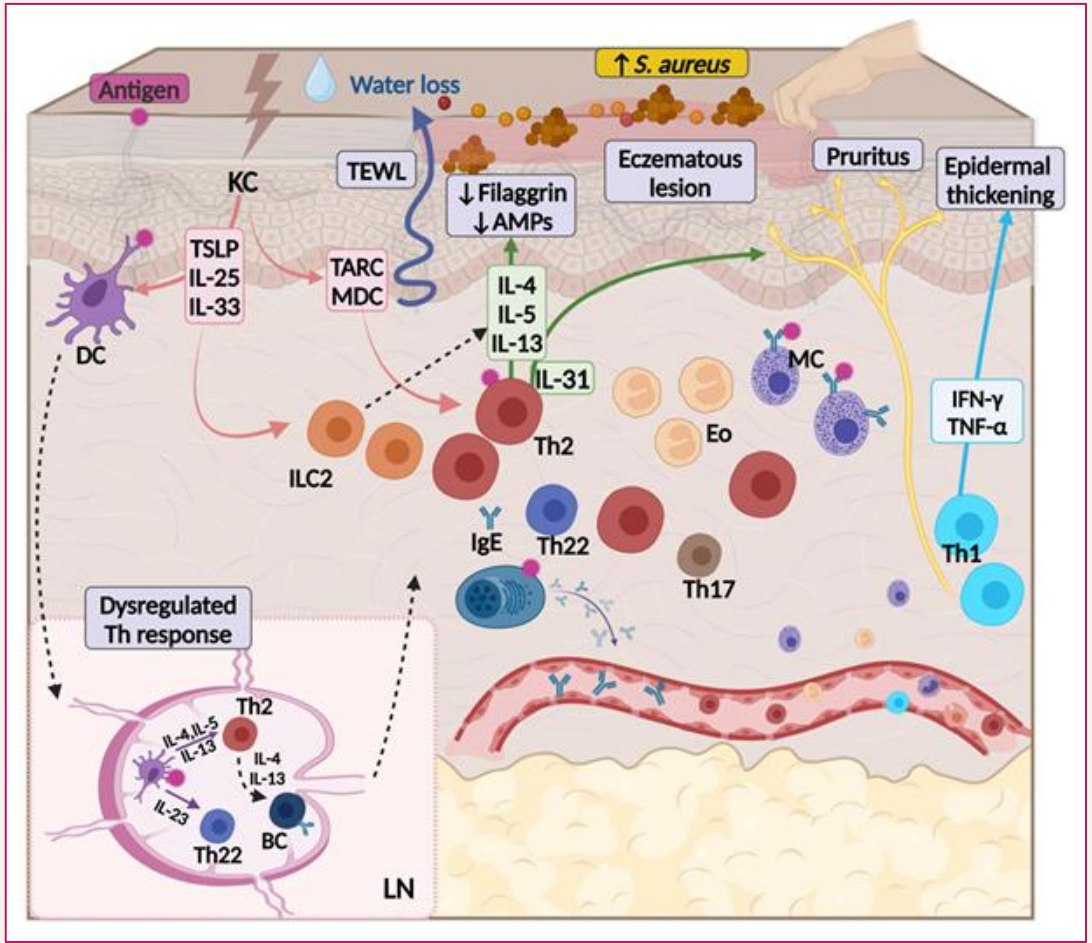
From Early Prevention to Targeted Treatment

Pathophysiology of Atopic Dermatitis



Skin microbiome shift

Lower microbial diversity and *Staphylococcus aureus* expansion

Skin Barrier Dysfunction

Reduced barrier integrity increases water loss and allergen penetration; scratching adds mechanical damage.

Type-2 inflammation

IL-4/IL-5/IL-13 signaling reinforces barrier weakness and pruritus; increase of eosinophils and IgE

Rios-Carlos, M., Cervantes-García, D., Córdova-Dávalos, L. E., Bermúdez-Humarán, L. G., & Salinas, E. (2024). Unraveling the gut-skin axis in atopic dermatitis: exploiting insights for therapeutic strategies. Gut Microbes, 16(1). https://doi.org/10.1080/19490976.2024.2430420

Kader, H.A.; Azeem, M.; Jwayed, S.A.; Al-Shehhi, A.; Tabassum, A.; Ayoub, M.A.; Hetta, H.F.; Waheed, Y.; Iratni, R.; Al-Dhaheri, A.; et al. Current Insights into Immunology and Novel Therapeutics of Atopic Dermatitis. Cells 2021, 10, 1392. https://doi.org/10.3390/cells10061392

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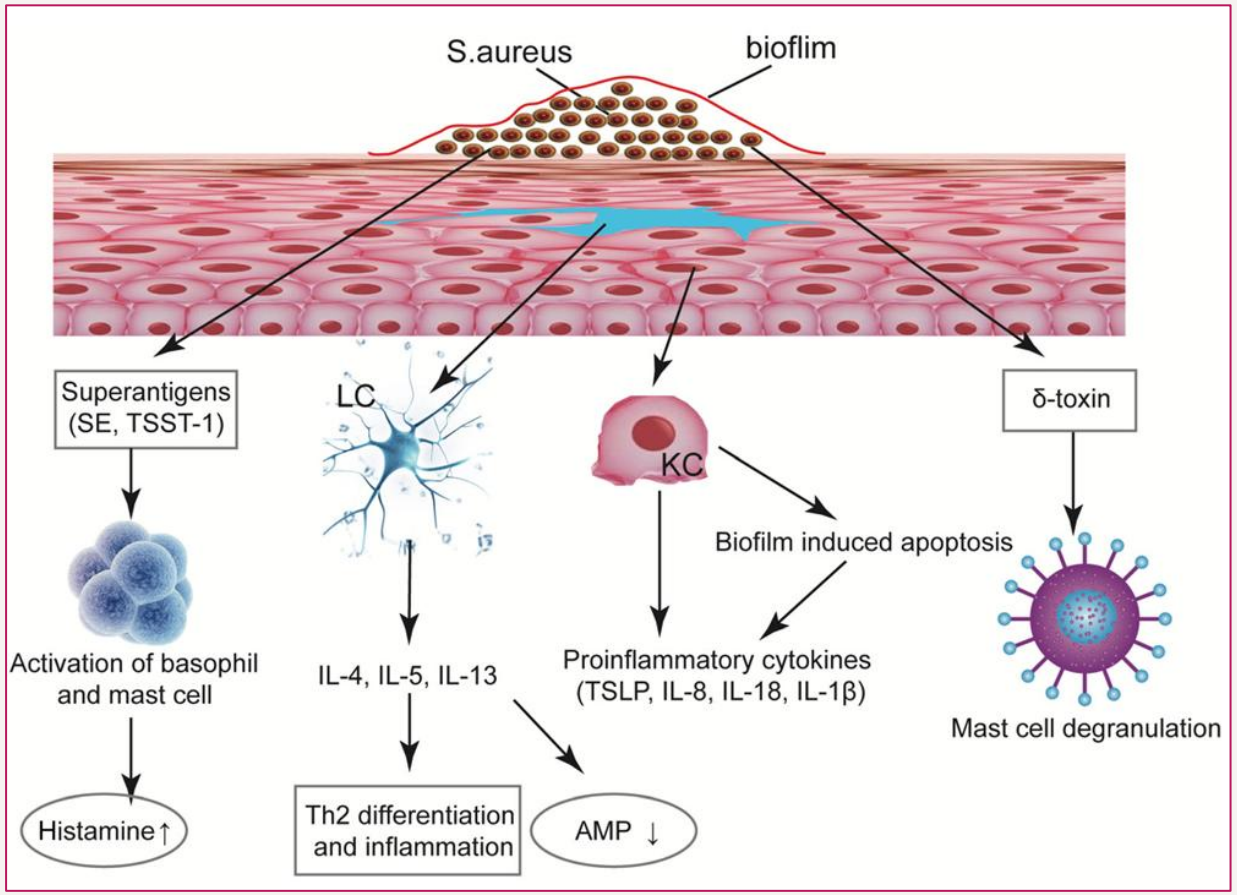
Pathogenic role of *Staphylococcus aureus*



Increased prevalence of *S. aureus*

- biofilm formation
- production of enterotoxins (SE)
- degranulation of mast cells
- release of histamine
- proinflammaory cytokins
- Th2 differentiation and inflammation

Wan, P., Chen, J. A Calm, Dispassionate Look at Skin Microbiota in Atopic Dermatitis: An Integrative Literature Review. Dermatol Ther (Heidelb) 10, 53–61 (2020). https://doi.org/10.1007/s13555-020-00352-4

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Targeted support using specifically developed topical probiotics

- ✓ displacement of *Staphylococcus aureus*
- ✓ restoration of the microbial balance
- ✓ enrichment of probiotic bacteria on the skin
- ✓ stabilisation of the skin barrier
- ✓ positive influence on dermal immune system

Giordani B et al. (2019): Liposomes Containing Biosurfactants Isolated From Lactobacillus Gasseri Exert Antibiofilm Activity Against Methicillin Resistant Staphylococcus Aureus Strains. EurJ Pharm Biopharm 139:246-252. RosignoliC et al. (2018): A topical treatment containing heat-treated Lactobacillus johnsonii NCC 533 reduces Staphylococcus aureus adhesion and induces antimicrobial peptide expressionin an in vitro reconstructed human epidermis model. Exp Dermatol 27(4):358-365. GuénicheA et al. (2010a): Lactobacillus paracasei CNCM I-2116 (ST11) inhibits substance P-induced skin inflammation and accelerates skin barrier function recovery in vitro. European Journal of Dermatology 20(6): 731-737. Di Marzio L et al. (2008): Increase of skin-ceramide levels in aged subjects following a short-term topical application of bacterial sphingomyelinase from Streptococcus thermophilus. Int J Immunopathol Pharmacol 21(1): 137-143. Lew L-C, Gan C-Y, Liong M-T. (2013) Dermal bioactives from lactobacilli and bifidobacteria. Ann Microbiol63: 1047-1055. Peral MC, Huaman Martinez MA, Valdez JC (2009) Bacteriotherapy with Lactobacillus plantarum in burns. International Wound Journal 6: 73–81. Lebeer et al., 2022 Selective targeting of skin pathbionts and inflammation with topically applied lactobacilli. Cell Reports Medicine 3, 1000521

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OMNi-BiOTiC SKiN®

Baplexin® 621 with 9 active probiotic strains

Lactobacillus gasseri AL90100
Lactobacillus johnsonii AL00102
Lactobacillus paracasei AL00103
Lactobacillus plantarum AL00104
Lactobacillus reuteri AL00605
Lactobacillus rhamnosus AL00106
Bifidobacterium lactis AL00091
Bifidobacterium longum AL00092
Streptococcus thermophilus AL00112



1,8 x 10^9 CFU/g
Other ingredients: Inulin, maltodextrin



3 x 10^8 CFU/ml
Other ingredients: Helianthus annuus (sunflower oil), hydrogenated vegetable oil, Simmondsia chinensis (jojoba oil), Calendula officinalis (marigold extract), tocopherol, ethyl ferulate, humulus lupus (hop extract), lactobacillus ferment lysate

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Topical application of probiotic partial baths as a promising treatment option for atopic dermatitis



Der Hautarzt

In der Diskussion

Hautarzt 2021 · 72:549–556
https://doi.org/10.1007/s00105-021-04789-2
Angenommen: 17. Februar 2021
Online publiziert: 17. März 2021
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[2] Dermatologische Fachklinik, Bad Salzschlirf, Deutschland
[3] Institut für Bioanalytik, Hochschule Coburg, Coburg, Deutschland

Probiotische Teilbäder bei atopischer Dermatitis

OMNi-BiOTiC SKiN® Intensive skin bath significantly reduces skin lesions



Day 0



Day 7



Day 0



Day 7

After just 7 days of using the probiotic partial bath, patients show **significant improvement in erythema**, **excoriation**, **edema** and **crust formation**.

Axt-Gadermann M, Chudomirova K, Noll M. Probiotische Teilbäder bei atopischer Dermatitis. Hautarzt. 2021 Jun;72(6):549-556. German. doi: 10.1007/s00105-021-04789-2. Epub 2021 Mar 17. PMID: 33730257; PMCID: PMC8169505

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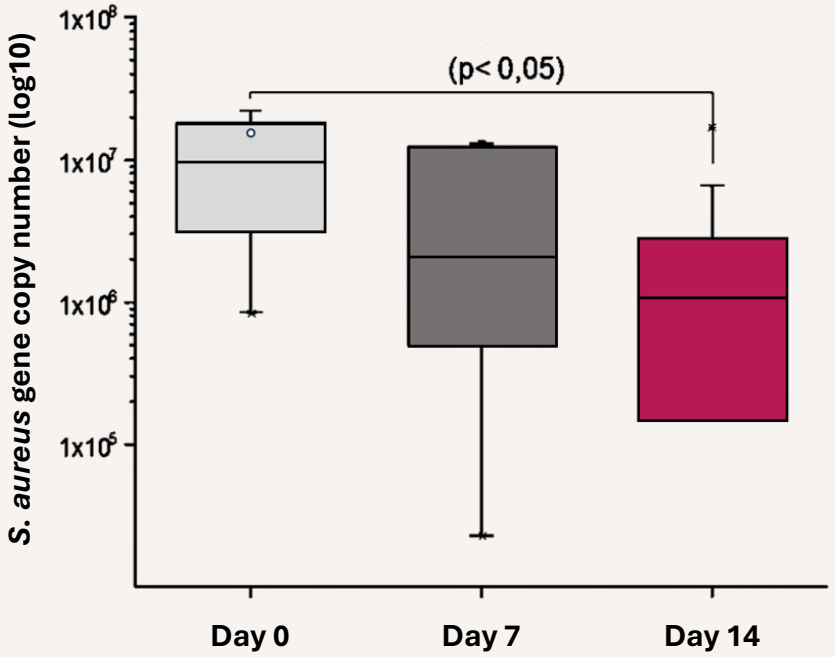

Significant reduction of *Staphylococcus aureus* by 83%

OMNi-BiOTiC SKiN® Intensive skin bath with **active probiotic bacteria** leads to a **clear reduction** in ***Staphylococcus aureus* colonisation** of the treated lesions after just 14 days of intervention.

Axt-Gadermann M, Chudomirova K, Noll M. Probiotische Teilbäder bei atopischer Dermatitis. Hautarzt. 2021 Jun;72(6):549-556. German. doi: 10.1007/s00105-021-04789-2. Epub 2021 Mar 17. PMID: 33730257; PMCID: PMC8169505

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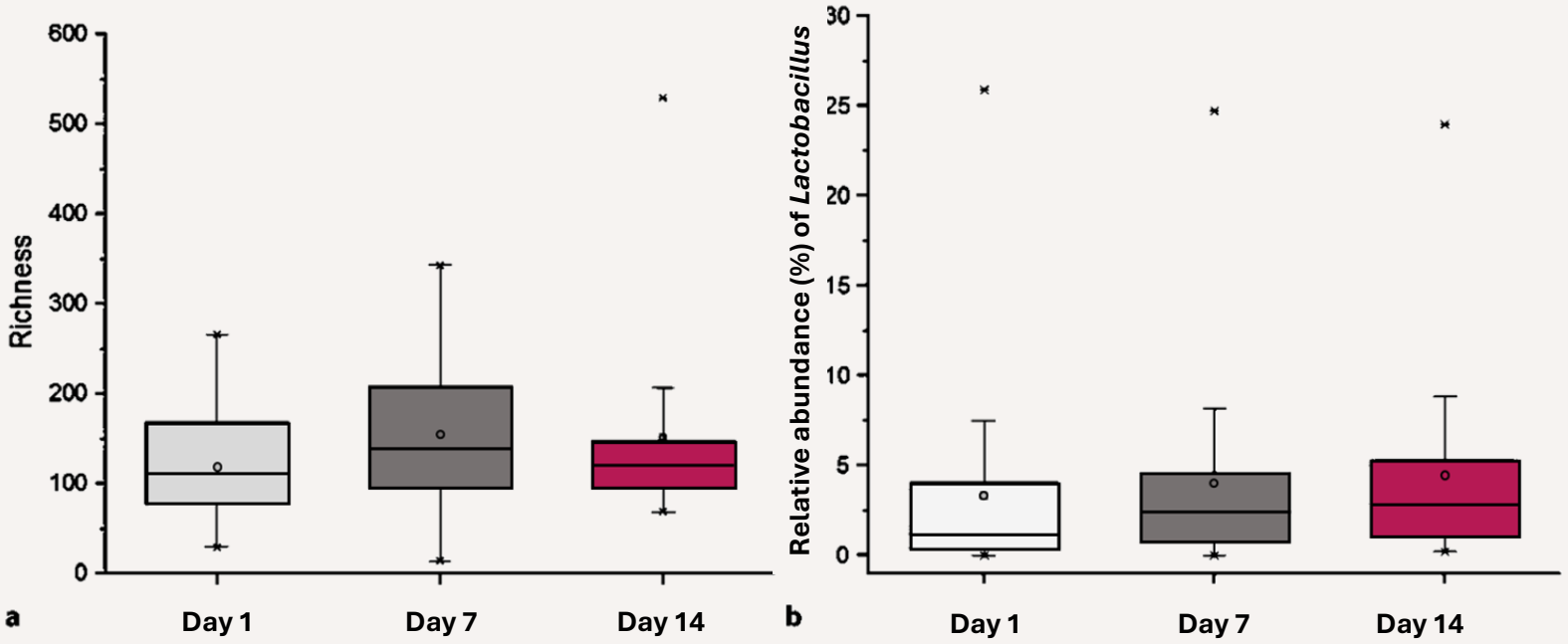
Probiotic bath increases the α-diversity of the skin microbiome



→ Increased richness of the bacterial community on the skin.

→ Increased relative abundance of bacteria of the genera *Lactobacillus* and *Bifidobacterium*.

Axt-Gadermann M, Chudomirova K, Noll M. Probiotische Teilbäder bei atopischer Dermatitis. Hautarzt. 2021 Jun;72(6):549-556. German. doi: 10.1007/s00105-021-04789-2. Epub 2021 Mar 17. PMID: 33730257; PMCID: PMC8169505

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Positive effect of OMNi-BiOTiC SKiN® Intensive care ointment on symptoms of atopic dermatitis

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OMNi-BiOTiC SKiN® Intensive care ointment visibly improves the skin's appearance after just 1 week



Before application



After 1 week



Before application



After 1 week

Kolleritsch S., Axt-Gadermann M. Die positive Wirkung einer probiotischen Salbe auf Symptome der Neurodermitis. OM & Ernährung Nr. 190. März 2025

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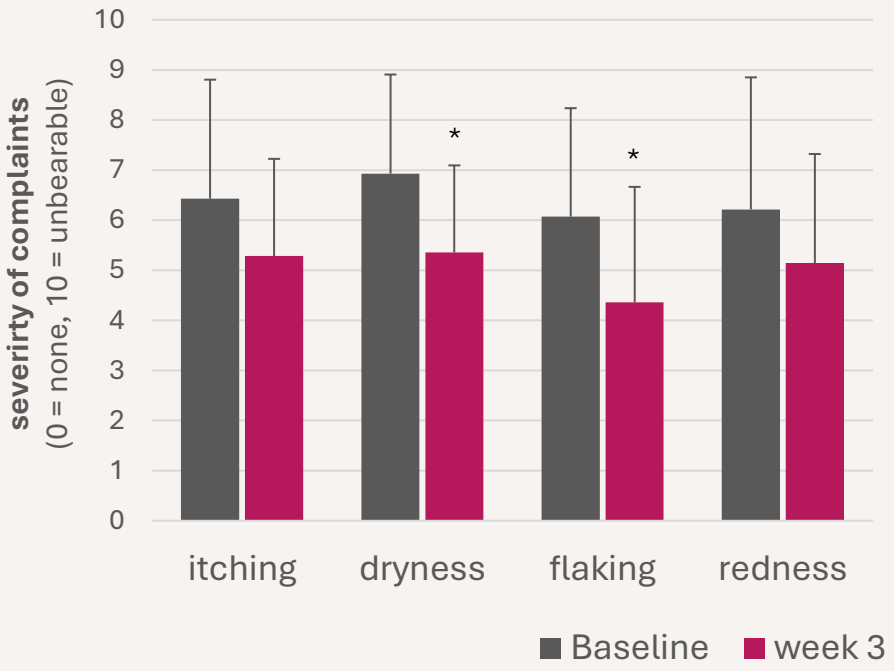
The probiotic care ointment improves skin complaints in patients with atopic dermatitis



*, p<0.05

Just 3 weeks of intervention with **OMNi-BiOTiC SKiN® Intensive care ointment** lead to a reduction of all skin symptoms.

Skin **dryness** and **flaking** were **significantly improved** compared to baseline.

Kolleritsch S., Axt-Gadermann M. Die positive Wirkung einer probiotischen Salbe auf Symptome der Neurodermitis. OM & Ernährung Nr. 190. März 2025

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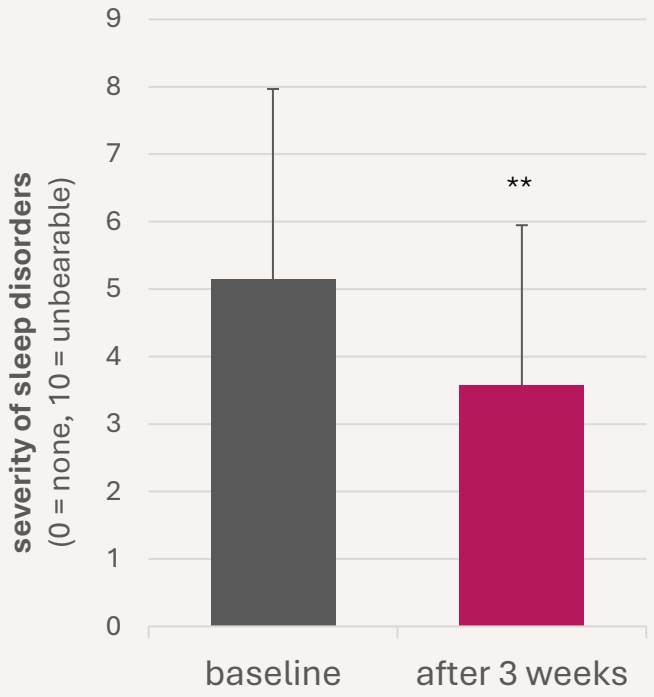
OMNi-BiOTiC SKiN® Intensive care ointment reduces sleep disorders



The **probiotic care ointment significantly reduces sleep disorders** caused by atopic dermatitis after just 3 weeks.

Kolleritsch S., Axt-Gadermann M. Die positive Wirkung einer probiotischen Salbe auf Symptome der Neurodermitis. OM & Ernährung Nr. 190. März 2025

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Take home message



- Atopic dermatitis involves immune dysregulation, skin barrier dysfunction, and dysbiosis of the skin and the gut microbiomes.
- The gut–skin axis connects the intestinal microbiome, immune regulation, and skin health.
- Oral and topical probiotics offer complementary strategies to support immune balance and skin health in AD
  - **Indication specific oral probiotics** reduce the risk of developing AD by supporting early immune maturation and promoting immune tolerance.
  - **Specifically developed topical probiotics** improve AD symptoms, support skin microbiome balance, and reduce *S. aureus* colonization.

Supporting a healthy start to life.







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