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IL.13
PREDICT TO PREVENT - HARNESSING THE SKIN MICROBIOME TO TRANSFORM ATOPIC DERMATITIS CARE

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The skin microbiome plays a pivotal role in the onset, severity, and chronicity of atopic dermatitis (AD), yet its clinical translation has long been hampered by methodological and analytical challenges. In a series of studies, we have advanced methods to accurately capture, quantify, and interpret skin microbiome data. We developed approaches to correct extraction bias based on bacterial morphology and established MicrobIEM, a user-friendly tool for rigorous decontamination of low-biomass datasets. By combining next-generation sequencing with targeted qPCR, we demonstrated that Staphylococcus aureus not only dominates relative abundance in AD but also drives bacterial overgrowth, particularly in severe disease. We further linked microbial diversity, S. aureus burden, and host cofactors with AD severity, and showed in a randomized controlled trial that baseline S. aureus abundance, tightly associated with skin pH, predicts worsening of AD severity. Beyond pathogenic overgrowth, we identified protective microbe–lipid interactions as key determinants of barrier integrity: Staphylococcus hominis was found to directly modulate epidermal lipid metabolism and counteract type 2 inflammation, highlighting the therapeutic potential of commensal bacteria. These methodological and clinical insights culminated in translational proof-of-concept studies: in a longitudinal observational cohort, we demonstrated that baseline microbiome composition predicts the risk of severe radiodermatitis with striking accuracy, introducing the principle of "predict to prevent" in skin diseases. Most recently, strain-resolved analyses revealed genomic and functional divergence of S. aureus in AD compared with healthy skin, underscoring the relevance of functional microbiome profiling for therapeutic decision-making. Together, these advances establish the skin microbiome not only as a biomarker source but also as a predictive and actionable tool. By identifying host–microbiome interactions such as skin pH and lipid–commensal networks as modifiable drivers of disease, microbiome-informed diagnostics will soon guide therapy selection, open windows for disease modification, and ultimately transform atopic dermatitis care from reactive treatment to personalized prevention.