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Comprehensive analysis of the human microbiome, immune responses, and metabolic disease reveals new therapeutic strategies

Stanford researchers have created a new strategy for collecting and integrating human microbiome, multi-omics, and immune cell activation data that reveals new insights into the roles of different bacterial strains in human health.

Humans live in concert with thousands of different bacteria throughout our bodies. These bacteria help digest our food, protect us from infection, and regulate our immune system. Accordingly, alterations in the human microbiome are associated with diseases ranging from diabetes to cardiovascular disease, and therapeutics that alter the microbiome represent a promising approach to treating a wide range of disorders. However, deciphering the roles of bacterial strains in disease has remained a major challenge, due to the large number of unique bacteria that compose the microbiome and their variability from individual to individual.

Researchers therefore developed an approach that integrates microbiome analysis and multi-omics to better understand the roles of different members of the microbiome. Levels of immune markers and co-culture of immune cell organoids with different commensal bacteria further inform their role in the immune system. Using this approach, researchers discovered bacterial strains that could treat high cholesterol and insulin resistance or act as vaccine adjuvants. This strategy has broad applicability in creating new therapeutics that act by altering the microbiome.

Stage of Development
Clinical data: microbiome data, multi-omics, and clinical markers collected from 86 individuals over up to 6 years.

Applications

- Diagnosis of disease and disease progression through a microbiome signature
- Microbiome-based therapeutics, including personalized therapeutics
- Discovery of bacterial strains that can act as vaccine adjuvants

Advantages

- Simultaneous analysis of microbiome and immune response
- Comprehensive multi-omics analysis
- Personalized approach

Publications

- Zhou, W., Sailani, M.R., Contrepois, K. et al. Longitudinal multi-omics of host–microbe dynamics in prediabetes. Nature 569, 663–671 (2019).

Patents

- Published Application: WO2024259003

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