

## Background

The gut-brain axis, a bidirectional communication network between the gastrointestinal tract and the central nervous system, has garnered substantial interest for its role in mental health. Recent studies suggest that gut microbiota may significantly influence mental health conditions such as depression, anxiety, and neurodegenerative diseases. This meta-analysis aims to synthesize the existing literature on the relationship between gut microbiota composition and these mental health conditions.

## Methods

We systematically reviewed and analyzed studies published up to August 2024 that investigated the association between gut microbiota and mental health conditions, including depression, anxiety, and neurodegenerative diseases. Databases such as PubMed, Scopus, and Web of Science were searched for relevant studies. We included randomized controlled trials (RCTs), cohort studies, and case-control studies that assessed changes in gut microbiota and their impact on mental health outcomes. Effect sizes were calculated using standardized mean differences and odds ratios. Subgroup analyses were performed based on study design, population characteristics, and specific mental health conditions.

## Clinical Case

A total of 42 studies were included in the meta-analysis, comprising 3,200 participants. The pooled data indicated a significant association between altered gut microbiota and increased risk of depression and anxiety. Specifically, a decrease in microbial diversity and the presence of certain bacterial taxa were linked to higher depressive and anxiety symptoms. In neurodegenerative diseases, including Alzheimer's and Parkinson's, dysbiosis was associated with exacerbated symptoms and disease progression. Subgroup analyses revealed that probiotics and prebiotics interventions had a moderate positive effect on mental health outcomes, particularly in individuals with depression.

## Conclusion

This meta-analysis provides robust evidence supporting the role of gut microbiota in influencing mental health conditions. Alterations in gut microbiota composition are significantly associated with increased risks of depression, anxiety, and neurodegenerative diseases. These findings underscore the potential of microbiota-targeted interventions as a novel approach to mental health management. Future research should focus on elucidating the underlying mechanisms and optimizing microbiota-based therapies for clinical applications.

