Studies on Gut Microbiome and Neurological and Neuropsychiatric Disorders

STUDIES

1. The Gut Microbiome In Alzheimer's Disease: What We Know And What Remains To Be Explored

Alzheimer's disease (AD), the most common cause of dementia, results in a sustained decline in cognition. Amyloid beta oligomers and plaques, tau aggregates, and neuroinflammation play a critical role in neurodegenerations and impact clinical AD progression.

This systematic review summarizes the following: studies that have identified alterations in the ***Gut Microbiome (GMB)*** that correlate with pathophysiology in AD patients and AD mouse models; GMB manipulations in AD models and potential GMB-targeted therapeutics for AD; diet, sleep, and exercise as potential modifiers of the relationship between the GMB and AD and conclude with future directions and recommendations for further studies of this topic.

Source: Robert J. Vassar, Ken And Ruth Davee Department Of Neurology, Northwestern University Feinberg School Of Medicine, Chicago, USA. The Gut Microbiome In Alzheimer's Disease: What We Know And What Remains To Be Explored. Mol Neurodegeneration 18, 9 (2023). https://doi.org/10.1186/s13024-023-00595-7

2. Implications Of Gut Microbiota In Neurodegenerative Diseases

The morbidity associated with neurodegenerative diseases (NDs) is increasing, posing a threat to the mental and physical quality of life of humans. The crucial effect of microbiota on brain physiological processes is mediated through a bidirectional interaction, termed as the gut–brain axis (GBA), which is being investigated in studies. Many clinical and laboratory trials have indicated the importance of microbiota in the development of NDs *via* various microbial molecules that transmit from the gut to the brain across the GBA or nervous system.

This systematic review provides findings on implications of gut microbiota in ND, which will be beneficial for understanding the etiology and progression of NDs that may in turn help in developing ND interventions and clinical treatments for these diseases.

Source: Wei Wang, Innovative Institute Of Animal Healthy Breeding, College Of Animal Sciences And Technology, Zhongkai University Of Agriculture And Engineering, Guangzhou And Key Laboratory Of Zoonosis Research, Ministry Of Education, Jilin University, Changchun, China. Implications Of Gut Microbiota In Neurodegenerative Diseases J Front. Immunol., 14 February (2022), Sec. Multiple Sclerosis and Neuroimmunology, Volume 13, (2022). https://doi.org/10.3389/fimmu.2022.785644

3. Implications Of Oral Streptococcal Bacteriophages In Autism Spectrum Disorder

Growing evidence suggests altered oral and gut microbiota in autism spectrum disorder (ASD), but little is known about the alterations and roles of phages, especially within the oral microbiota in ASD subjects.

This study shows that there is a strong association between oral ***Streptococcal*** phages and ASD pathogenesis, providing new evidence for direct ***microbiome-mouth-brain connections*** and highlighting the role of bacteriophages in it. The ***Streptococcal*** phage constitutes a considerable part of the oral phageome, actively propagating and disseminating virulence factors (VFs) within the ***Streptococcus*** population. The unique feature qualifies this group of phages as an abundant resource of inflammation signals in the oral cavity, which can be transmitted to the brain in a similar manner as the **gut-brain axis**. The intriguing ***Streptococcal*** phage-associated mechanism of ASD pathogenesis deserves further investigations and validation, which might provide valuable clues and open a new avenue for the prevention and management strategies of the disorders.

Source: Yu Kang, Beijing Institute Of Genomics, Chinese Academy Of Sciences/China National Center For Bioinformation, Beijing, China. Implications Of Oral Streptococcal Bacteriophages In Autism Spectrum Disorder. Npj Biofilms Microbiomes 8, 91 (2022). https://doi.org/10.1038/s41522-022-00355-3

4. The Role Of Microbiome In Brain Development And Neurodegenerative Diseases

This systematic review explains that the makeup of the microbiome is impacted by a variety of factors, such as genetics, health status, method of delivery, environment, nutrition, and exercise, and improves the present understanding of the role of gut microbiota and its metabolites in the preservation of brain functioning and the development of the aforementioned neurological illnesses.

Scientists have discussed current breakthroughs in the use of probiotics, prebiotics, and synbiotics to address neurological illnesses. Further, they have also discussed the role of **boron-based diet in memory**, boron and microbiome relation, boron as anti-inflammatory agents, and boron in neurodegenerative diseases.

Source: Narayan S. Hosmane, Department Of Chemistry And Biochemistry, Northern Illinois University, Dekalb, USA. The Role Of Microbiome In Brain Development And Neurodegenerative Diseases. Molecules (2022), 27(11), 3402; https://doi.org/10.3390/molecules27113402

5. The Gut Microbiome And Mental Health: Advances In Research And Emerging Priorities

This systematic review explores the recent advances in gut microbiome–brain interactions, the mechanistic underpinnings of these relationships, and the ongoing challenge of distinguishing association and causation.

Source: Geraint B. Rogers, Microbiome And Host Health, South Australian Health And Medical Research Institute, Adelaide And Infection And Immunity, Flinders Health And Medical Research Institute, College Of Medicine And Public Health, Flinders University, Bedford Park, Australia. The Gut Microbiome And Mental Health: Advances In Research And Emerging Priorities. Mol Psychiatry 27, 1908–1919 (2022). https://doi.org/10.1038/s41380-022-01479-w

6. Longitudinal Study Of Stool-Associated Microbial Taxa In Sibling Pairs With And Without Autism Spectrum Disorder

The study result shows that overall microbiome composition (beta-diversity) is associated with specific ASD-related behavioral characteristics.

Source: Christine Tatarue, Department Of Microbiology, Oregon State University, Corvallis, OR, USA. Longitudinal Study Of Stool-Associated Microbial Taxa In Sibling Pairs With And Without Autism Spectrum Disorder. ISME COMMUN. 1, 80 (2021). https://doi.org/10.1038/s43705-021-00080-6

7. Convergent Pathways Of The Gut Microbiota–Brain Axis And Neurodegenerative Disorders

In this systematic review researchers have provided an overview of the gut microbiota axis pathways to lay the groundwork for the links between the gut microbiota and neurodegenerative disorders. In this review researchers have discussed how the gut microbiota may act as an intermediate factor between the host and the environment to mediate disease onset and neuropathology.

Source: Livia H. Morais, Division Of Biology & Biological Engineering, California Institute Of Technology, Pasadena, CA, USA. Convergent Pathways Of The Gut Microbiota–Brain Axis And Neurodegenerative Disorders. Gastroenterology Report, Volume 10, (2022), goac017, https://doi.org/10.1093/gastro/goac017

8. Gut Microbiome-Wide Association Study Of Depressive Symptoms

In this study researchers investigated the relation of fecal microbiome diversity and composition with depressive symptoms in 1,054 participants from the Rotterdam Study cohort and validate these findings in the Amsterdam HELIUS cohort in 1,539 subjects.

Scientists identified an association of thirteen microbial taxa (including genera ***Eggerthella, Subdoligranulum, Coprococcus, Sellimonas, Lachnoclostridium, Hungatella, Ruminococcaceae (UCG002, UCG003 and UCG005), LachnospiraceaeUCG001, Eubacterium ventriosum*** and ***Ruminococcusgauvreauiigrou***p, and ***family Ruminococcaceae)*** with depressive symptoms. These bacteria are known to be involved in the synthesis of ***glutamate, butyrate, serotonin and gamma amino butyric acid (GABA)***, which are key neurotransmitters for depression. This study suggests that the gut microbiome composition may play a key role in depression.

Source: Najaf Amin, Department Of Epidemiology, Erasmus MC University Medical Center Rotterdam, Rotterdam, The Netherlands And Nuffield Department Of Population Health, Oxford University, Oxford, UK. Gut Microbiome-Wide Association Study Of Depressive Symptoms. Nat Commun 13, 7128 (2022). https://doi.org/10.1038/s41467-022-34502-3

9. Impact of Environmental Pollutants on Gut Microbiome and Mental Health via the Gut–Brain Axis

This systematic review discusses how various environmental pollutants such as phthalates, heavy metals, Bisphenol A and particulate matter may alter the intricate microbiota–gut–brain axis thereby impacting neurological and overall mental health.

Source: Ravinder Nagpal, Department Of Nutrition And Integrative Physiology, Florida State University, Tallahassee, USA. Impact of Environmental Pollutants on Gut Microbiome and Mental Health via the Gut–Brain Axis. Microorganisms (2022), 10(7), 1457; https://doi.org/10.3390/microorganisms10071457

10. The Role Of Gut Microbiota—Gut—Brain Axis In Perioperative Neurocognitive Dysfunction

This review article explores the mechanism of the role of gut microbiota-gut-brain axis in Perioperative Neurocognitive Dysfunction (PND) which helps to explore reasonable early treatment strategies.

Source: Youming Zong, Department Of Anesthesiology, The Second Hospital Of Jiaxing, The Second Affiliated Hospital Of Jiaxing University, Jiaxing And Department Of Anesthesiology, Bengbu Medical College, Bengbu, China. The Role Of Gut Microbiota—Gut—Brain Axis In Perioperative Neurocognitive Dysfunction. Front. Pharmacol., 14 June 2022, Sec. Neuropharmacology, Volume 13, (2022). https://doi.org/10.3389/fphar.2022.879745

11. Mechanistic Insights Into Gut Microbiome Dysbiosis-Mediated Neuroimmune Dysregulation And Protein Misfolding And Clearance In The Pathogenesis Of Chronic Neurodegenerative Disorders

This systematic review highlights the functional pathways and mechanisms, particularly gut microbe-induced chronic inflammation, protein misfolding, propagation of disease-specific pathology, defective protein clearance, and autoimmune dysregulation, linking gut microbial dysbiosis and neurodegenerations.

In addition, researchers have also discussed how pathogenic transformation of microbial composition leads to increased endotoxin production and fewer beneficial metabolites, both of which could trigger immune cell activation and enteric neuronal dysfunction. These can further disrupt intestinal barrier permeability, aggravate the systemic pro-inflammatory state, impair blood–brain barrier permeability and recruit immune mediators leading to neuroinflammation and neurodegenerations.

Further, continued biomedical advances in understanding the microbiota-gut-brain axis will extend the frontier of neurodegenerative disorders and enable the utilization of novel diagnostic and therapeutic strategies to mitigate the pathological burden of these diseases.

Source: Anumantha G. Kanthasamy, Parkinson's Disorder Research Laboratory, Department Of Biomedical Sciences, Iowa State University, Ames, IA And Department Of Physiology And Pharmacology, Center For Brain Sciences And Neurodegenerative Diseases, University Of Georgia, Athens, GA, United States. Mechanistic Insights Into Gut Microbiome Dysbiosis-Mediated Neuroimmune Dysregulation And Protein Misfolding And Clearance In The Pathogenesis Of Chronic Neurodegenerative Disorders. Front. Neurosci., 25 February (2022), Sec. Gut-Brain Axis, Volume 16, (2022). https://doi.org/10.3389/fnins.2022.836605

12. Autism-Related Dietary Preferences Mediate Autism-Gut Microbiome Associations

There is increasing interest in the potential contribution of the gut microbiome to autism spectrum disorder (ASD). Researchers have performed a large autism stool metagenomics study (n = 247) based on participants from the Australian Autism Biobank and the Queensland Twin Adolescent Brain project.

Scientists have found that there are negligible direct associations between ASD diagnosis and the gut microbiome. The data of the study support a model whereby ASD-related restricted interests are associated with less-diverse diet, and in turn reduced microbial taxonomic diversity and looser stool consistency. In contrast to ASD diagnosis, the dataset was well powered to detect microbiome associations with traits such as age, dietary intake, and stool consistency.

Overall, microbiome differences in ASD may reflect dietary preferences that relate to diagnostic features, and caution against claims that the microbiome has a driving role in ASD.

Source: Jacob Gratten, Mater Research Institute, The University Of Queensland, Woolloongabba; Institute For Molecular Bioscience, The University Of Queensland, St Lucia And Cooperative Research Centre For Living With Autism (Autism CRC), Long Pocket, Queensland, Australia. Autism-Related Dietary Preferences Mediate Autism-Gut Microbiome Associations. Cell, Volume 184, Issue 24, P5916-5931.E17, November 24, (2021). https://doi.org/10.1016/j.cell.2021.10.015

13. Combination Of Gut Microbiota And Plasma Amyloid-B As A Potential Index For Identifying Preclinical Alzheimer's Disease: A Cross-Sectional Analysis From The SILCODE Study

This study provides the evidence that the gut microbial composition gets altered in preclinical Alzheimer 's disease (AD). The combination of plasma Aβ and gut microbiota may serve as a non-invasive, cost-effective diagnostic tool for early AD screening. Further, targeting the gut microbiota may be a novel therapeutic strategy for AD.

Source: Ying Han, Department Of Neurology, Xuanwu Hospital Of Capital Medical University, Beijing; Key Laboratory Of Biomedical Engineering Of Hainan Province, School Of Biomedical Engineering, Hainan University, Haikou; Center Of Alzheimer's Disease, Beijing Institute For Brain Disorders, Beijing And National Clinical Research Center For Geriatric Diseases, Beijing, China. Combination Of Gut Microbiota And Plasma Amyloid-B As A Potential Index For Identifying Preclinical Alzheimer's Disease: A Cross-Sectional Analysis From The SILCODE Study. Alz Res Therapy 14, 35 (2022). https://doi.org/10.1186/s13195-022-00977-x

14. A Review Of The Preclinical And Clinical Studies On The Role Of The Gut Microbiome In Aging And Neurodegenerative Diseases And Its Modulation

In this systematic review , researchers have reviewed the role of the gut microbiome in aging and neurodegenerative diseases, as well as provided a comprehensive review of recent findings from preclinical and clinical studies to present an up-to-date overview of recent advances in developing strategies to modulate the intestinal microbiome by probiotic administration, dietary intervention, fecal microbiota transplantation (FMT), and physical activity to address the aging process and prevent neurodegenerative diseases.

Source: Suzana Makpol, Department Of Biochemistry, Faculty Of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia. A Review Of The Preclinical And Clinical Studies On The Role Of The Gut Microbiome In Aging And Neurodegenerative Diseases And Its Modulation. Front. Cell. Neurosci., 03 November 2022, Sec. Cellular Neuropathology, Volume 16, (2022). https://doi.org/10.3389/fncel.2022.1007166

15. The Role Of The Microbiome In The Metabolic Health Of People With Schizophrenia And Related Psychoses: Cross-Sectional And Pre-Post Lifestyle Intervention Analyses

Researchers have found that there was no difference in α-diversity between groups at baseline, but microbial composition differed by 21 taxa between the established schizophrenia group and controls. In people with established illness pre-post comparison of α-diversity showed significant increases after the 12-week lifestyle intervention.

This study adds to the current literature about detailed compositional differences in the gut microbiota of people with schizophrenia compared to those without mental illness and suggests that lifestyle interventions may increase gut microbial diversity in patients with established illness. These results show that microbiome studies are feasible in patients with established schizophrenia. Further, studies are required.

Source: Maryanne O'Donnell, Discipline Of Psychiatry And Mental Health, School Of Medicine And Health, University Of New South Wales, Kensington And Eastern Suburbs Mental Health Service, South Eastern Sydney Local Health District, Randwick, Australia. The Role Of The Microbiome In The Metabolic Health Of People With Schizophrenia And Related Psychoses: Cross-Sectional And Pre-Post Lifestyle Intervention Analyses. Pathogens (2022), 11(11), 1279; https://doi.org/10.3390/pathogens11111279

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