

Gut-Brain Axis, Metabolic Dysfunction, and Cognitive Decline: The Role of Diet in Modulating Neuroinflammation

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RESUMO

Introduction: The increasing prevalence of metabolic diseases, such as obesity and type 2 diabetes mellitus, has been associated with an increased risk of cognitive decline and neurodegenerative diseases. Recent evidence highlights the role of the gut-brain axis as a central mediator of this relationship, in which alterations in the gut microbiota promote systemic inflammation, oxidative stress, and metabolic dysfunction. In this context, diet emerges as a modifiable factor capable of influencing both the composition of the microbiota and metabolic and cognitive outcomes.

Objective: To analyze the role of diet in modulating the gut-brain axis and its influence on inflammation, metabolism, and cognitive decline in chronic metabolic conditions. **Methods:** This is a narrative literature review, with searches conducted in PubMed, EMBASE, and Cochrane using descriptors related to gut microbiota, cognition, metabolism, and dietary patterns. Clinical studies, experimental studies, and relevant reviews addressing the interaction between diet, inflammation, and cognitive function in the context of metabolic diseases were included. **Results:** The findings indicate that diets rich in fiber, bioactive compounds, and plant-based foods are associated with greater diversity of the gut microbiota and increased production of beneficial metabolites, such as short-chain fatty acids. These compounds play an important role in maintaining the integrity of the intestinal barrier, modulating the inflammatory response, and regulating energy metabolism. These effects contribute to the preservation of cognitive function, since the integrity of the intestinal barrier and the modulation of the microbiota are associated with the reduction of pro-inflammatory mediators, such as Tumor Necrosis Factor- α (TNF α), Interleukin (IL)-6, IL-1 β , and C-reactive protein (CRP), as well as the inhibition of pathways such as Nuclear Factor- κ B (NF- κ B) and NOD-LRR- and pyrin domaincontaining protein 3 (NLRP3), in addition to the decrease in reactive oxygen species (ROS) and markers of oxidative stress, such as malondialdehyde (MDA). Simultaneously, an increase in anti-inflammatory cytokines, such as IL-10, and the activity of antioxidant enzymes, such as superoxide dismutase (SOD), catalase, and glutathione peroxidase (GPx), is observed, favoring the reduction of neuroinflammation, the maintenance of gut-brain axis homeostasis, and the preservation of neuronal plasticity. On the other hand, dietary patterns rich in ultra-processed foods and saturated fats favor intestinal dysbiosis, increased intestinal permeability, and activation of inflammatory pathways, contributing to insulin resistance and impaired cognitive function.

Conclusion: Diet plays a fundamental role in modulating the gut-brain axis, directly influencing mechanisms related to inflammation, metabolism, and cognitive function. Nutritional strategies aimed at improving diet quality may represent a promising approach in the prevention and management of cognitive alterations associated with metabolic diseases.

Palavras-chave: Gut Microbiota Cognition Inflammation Oxidative Stress Diet.