

# Chapter 4

## Dietary Interventions in Neurodegenerative Diseases: Neuroinflammatory Mechanisms and Implications

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### **ABSTRACT**

*Neurodegenerative diseases are a broad group of diseases characterized by the loss of structure and function of neuronal cells via various genetic and environmental mechanisms. The basic physiopathology is neuronal integrity disruption by activating intracellular apoptotic mechanisms. The neuronutritional perspective on neurodegenerative diseases has gained importance by discovering the relationship between neuroinflammatory mechanisms and dietary protocols that offer non-invasive treatment options. Gut microbiome imbalance is important for brain-gut pathways. Antiinflammatory diet modeling, one of the non-invasive treatment methods that can reduce neurodegeneration on a disease basis and provide clinical improvement, will contribute to people economically and socially. This chapter provides an overview of the disease-based etiopathogenesis of chronic inflammatory processes underlying various neurodegenerative diseases with available literature data and analyzes the central interactions of different antiinflammatory diet models based on their anti-inflammatory mechanisms.*

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## INTRODUCTION

The typical features of neurodegenerative diseases are progressive neuron loss and impaired neuron function, which develop due to oxidative stress, chronic inflammation, and mitochondrial dysfunction because of the inducing intracellular and extracellular neurotoxic microenvironment (Fischer & Maier, 2015). The primary pathology is due to increased oxidative stress and accumulation of protein aggregates in neurons (Liu et al., 2022). Intra and intercellular accumulation of these proteins, which form insoluble aggregates, stimulates various inflammatory mechanisms in the central nervous system, especially the microglial system, which causes multiple neuronal death mechanisms to be triggered. Microglia naturally activate other immune elements due to their arrival in the neuronal microenvironment and the release of specific pro-inflammatory cytokines and chemokines, such as IL-1, IL-6, and CCL2 (Rodriguez et al., 2022). During normal processes, this system is a critical defense system developed by cerebral mechanisms against endogenous and exogenous factors that occur during the formation of neuroinflammation in the brain, which performs essential tasks in terms of brain plasticity, tissue repair, and neuroprotection (Rodriguez et al., 2022). However, in chronic inflammation, these mechanisms trigger the processes that initiate neuron death by leading to cytokinergic degeneration. The findings of current studies have shown that the dietary protocol to be selected on behalf of the patient can control energy metabolism and synaptic plasticity by influencing various molecular processes (Estrada & Contreras, 2019; Sambu et al., 2022). The effect of dietary nutrients and gut microbiome components on gastrointestinal signaling molecules and neurotransmitters has shown that nutritional patterns affect systemic metabolic and inflammatory changes (Estrada & Contreras, 2019).

In population-based studies, the synergistic effect of different dietary modalities has been shown to provide more positive effects in supporting membrane structure and function than other modifiable risk factors such as exercise, stress reduction, and lifestyle changes. There are different literatures evaluating the effects of different micronutrients for maintaining membrane fluidity in the neuronal environment and preventing chronic inflammation, and as a result, it has been determined that dietary modalities rich in nutrients such as vitamin E and omega-3, polyunsaturated fatty acids, vitamins A and C, and various phenolics have superior anti-inflammatory and anti-degenerative effects and increase the age of onset and positively affect the course of neurodegenerative diseases such as Alzheimer's Disease (AD), Parkinson's Disease (PD), Amyotrophic Lateral Sclerosis (ALS), and Multiple sclerosis (MS). Various dietary inflammation indices and peripheral serum biomarkers have shown many times that diets rich in antioxidants and anti-inflammatory components are beneficial in preventing neurodegenerative diseases. In clinical practice, it is evident

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