Sex-based computational analysis of estrogen impact on microglia during progression of AD

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Alzheimer's disease, a common neurodegenerative disease is caused by the formation of amyloid-β plaques and tau tangles within and around neurons, results in marked cognitive decline, memory loss, and changes in behavior in aging individuals. Microglia are the primary resident immune cells of the brain that act as the inherent response systems to address the impact of these formations and maintain homeostasis in the central nervous system. The onset and progression of AD have been directly linked to microglia function which is markedly different in males and females due to underlying differences in inflammatory responses and hormonal influences. Women account for two-thirds of prevalent AD cases and yet most of the research on the cause, effects, and progression of the disease has been focused on the male population, leading to a gap of knowledge in understanding how fluctuating estrogen concentrations and menopause play a role in AD. The purpose of this research is to create a computational tool that will allow us to predict differences in the microglial effects of the brain based on sex, age, and APOE genetics. We aimed to simulate an agent-based computational model to analyze the microglial efficiency in clearing the degenerated neurons in both women and men. The key variables required for simulation come from scientific data published by research work within PubMed and the National Institute of Health's data collection. The simulations are generated from an open-source agent-based modeling tool, NetLogo, with the computational model described here openly available online at https://github.com/teenie3/ SexEffect_Microglia_AD.

Fields: Bioengineering

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