Predicting Cognitive Decline using Neuroimaging Biomarkers in Healthy Older Adults from the Knight ADRC: A Supervised Machine Learning Model

Accumulation of ß-amyloid (Aß) plaques, tau-containing neurofibrillary tangles, and progressive neuronal atrophy are the hallmark neuroanatomical biomarkers of Alzheimer Disease (AD), and these progressive changes emerge up to two decades prior to decline in cognition. Following the Aß, tau, and neurodegenerative (ATN) framework, we will investigate the relationship between AD biomarkers and cognitive decline in healthy older adults from the Charles F. and Joanne Knight Alzheimer Disease Research Center (Knight ADRC) and the Alzheimer Disease Neuroimaging Initiative (ADNI) cohorts.

Participants selected for this study were cognitively unimpaired at time of study enrollment and were required to have completed one PiB-positron emission tomography (PET) and magnetic resonance (MR) imaging session, and at least two cognitive visits. From PET data, we were able to calculate the levels of abnormal Aß protein deposition and classify individuals as either amyloid positive or negative. Regional brain volume and cortical thickness measures were derived from MRI, and participants were categorized as being positive or negative for neurodegeneration. We used these distinctions to categorize individuals into four groups: A+N+, A+N-, A-N+, and A-N-. Genetic data was used to determine whether or not participants carried the APOE ε4 allele, which is a known risk factor for developing dementia. We used the Clinical Dementia Rating ® scale to classify individuals as cognitive unimpaired or cognitively impaired. Participants that remained cognitively unimpaired at time of follow-up were labeled as cognitively stable, while those whose score increased by time of follow-up were considered cognitive decliners.

The following data were included for analysis: age, sex, education, race, APOE ε4 status, BMI, hippocampal volume, cortical thickness, neurodegenerative positivity, centiloid, amyloid positivity, and cognitive performance. The purpose of this project was to determine whether or not biological markers of AD were predictive of cognitive decline. Because we knew the classification outcomes for our participants, we used a supervised learning model.