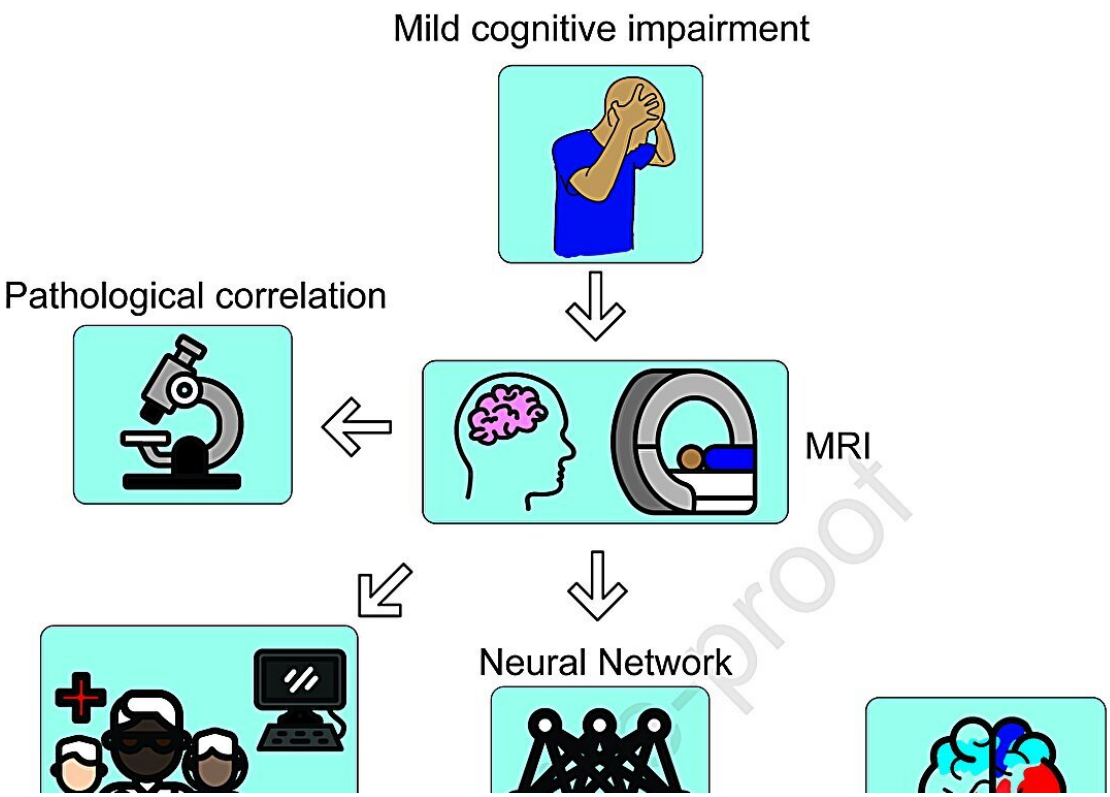
Medical Xpress

Researchers propose a strategy to stratify risk of progression from mild cognitive impairment to Alzheimer's

August 4 2023



Graphical abstract. Credit: *iScience* (2023). DOI: 10.1016/j.isci.2023.107522

The projected cost of caring for millions of individuals who have Alzheimer's disease (AD) worldwide will exceed a $1 trillion in a few years. In addition to the enormous health burden, patients and their caregivers experience financial, physical and psychological strain. A theory regarding repeated drug failure in AD is that patients undergoing experimental therapies are selected too late in the disease process. Therefore, it is important to identify patients at a high risk of progression to AD in early stages of the disease.

To help identify persons who could benefit from early interventions, researchers from Boston University have developed a deep learning framework that can stratify individuals with mild cognitive impairment (MCI) based on their risk of advancing to AD.

"Quantifying the risk of progression to Alzheimer's disease (AD) could help identify persons who could benefit from early interventions," says corresponding author Vijaya B. Kolachalama, Ph.D., FAHA, associate professor of medicine at Boston University Chobanian & Avedisian School of Medicine.

The team studied data from the Alzheimer's Disease Neuroimaging Initiative (ADNI) and National Alzheimer's Coordinating Center (NACC), separating individuals with mild cognitive impairment (MCI) into groups based on their brain fluid amyloid-β levels. They studied gray matter volume patterns within these groups to identify risk groups, validating their findings with expert assessments.

They developed models that combined neural networks with survival analysis to predict the progress from MCI to Alzheimer's disease. They then linked their model predictions with biological evidence, confirming Alzheimer's diagnoses with post-mortem data.

"By utilizing advances in interpretable machine learning, we demonstrated that brain regions relevant to AD such as the medial temporal lobe are among the most important regions for predicting progression risk, thereby assuring that our findings are consistent with established medical knowledge," added Kolachalama.

According to the researchers, these findings represent innovation at the intersection of neurology and computer science, while underscoring model conformity with biological evidence using routinely collected information such as structural MRI to quantify risk of progression from MCI to AD.

"We utilized survival-based deep neural networks in conjunction with minimally processed structural MRI, a widely available, non-invasive technique. Further, by employing state-of-the-art deep learning methods in conjunction with SHapley Additive exPlanations (SHAP), a method based on cooperative game theory and used to increase transparency and interpretability of machine learning models, we were able to identify regions particularly important for predicting increased progression risk."

These findings appear online in the journal *iScience*.

More information: Michael F. Romano et al, Deep learning for risk-based stratification of cognitively impaired individuals, *iScience* (2023). DOI: 10.1016/j.isci.2023.107522

Provided by Boston University School of Medicine