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BIOMARKERS

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NEUROIMAGING

Detecting amyloid positivity from MRI scans using comprehensible convolutional neural networks

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Abstract

Background: Analysis of neuroimaging data based on convolutional neural networks (CNNs) can improve detection of clinically relevant characteristics of patients with Alzheimer's disease (AD). Previously, our group developed a CNN-based approach for detecting AD via magnetic resonance imaging (MRI) scans and for identifying features that are relevant to the decision of the network. In the current study, we aimed to evaluate the potential utility of applying this approach to MRI scans to assist in the identification of individuals at high risk for amyloid positivity to aid in the selection of study samples and case finding for treatment.

Method: In the current analysis, we have trained a CNN to detect amyloid positivity using MRI scans from 1461 Alzheimer's Disease Neuroimaging Initiative (ADNI) participants (498 cognitively normal participants, 103 participants with significant memory concern, 640 participants with mild cognitive impairment, and 220 participants with AD dementia). Amyloid positivity was assessed via amyloid PET scans obtained with [^{18}F]florbetapir or [^{18}F]florbetaben and quantified on a Centiloid scale. A threshold of 24.1 CL categorized 46% of participants as amyloid-positive. The modeling approach was evaluated using 10-fold cross-validation, the number of epochs in training was set to 10.

Result: For each of 10 cross-validation folds, we selected a model state corresponding to an epoch showing best performance in the validation partition. Balanced accuracy across these models ranged from 0.62 to 0.72 with an average of 0.68 (SD = 0.03).

Conclusion: We used a previously established approach to train CNNs for detecting amyloid positivity using MRI scans. Such models, particularly when tuned to have low rates of false negatives, have a potential to enhance identification of patients who would benefit from more in-depth assessments, which could then inform antibody treatment. We are conducting ongoing work to improve and characterize the modeling approach, including evaluation of relevance maps which indicate importance of brain regions for detecting amyloid positivity. Future work will evaluate the role of amyloid positivity threshold selection. Planned analyses also include validation in independent data such as the German DZNE - Longitudinal Cognitive Impairment and Dementia Study (DELCODE) dataset.