Northwestern Medicine
Feinberg School of Medicine

Mesulam Center for Cognitive
Neurology and Alzheimer's Disease

26th Annual Alzheimer Day

Age prediction and amyloid deposition in SuperAgers

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Background: Machine learning techniques to predict biologic brain age versus chronologic brain age may be a potential biomarker for accelerated pathologic aging. Here, we use these same techniques to identify potential protective mechanisms of resilience and resistance to brain aging in SuperAgers. SuperAgers are over age 80 with episodic memory at least as good as that of average middle-age adults. SuperAgers have previously been shown to have higher cortical thickness than age-matched peers and resist cortical atrophy over time.

Objective: We examined whether SuperAgers resist amyloid accumulation using ^{18}F-florbetapir PET and whether their predicted brain age is lower than their chronologic age using a deep learning framework.

Methods: We used a previously established graph convolutional neural network (gCNN), trained on 8,046 healthy individual's publicly available T_1-weighted images (age=6-89 years). The gCNN predicts age entirely based on the geometric shape of the brain. Briefly, it takes the x,y,z coordinates of four Freesurfer surfaces: pial and white, left and right hemispheres, 10,242 vertices each, affinely registered to MNI-space. Using 5-fold cross validation on 8,046 participants, the gCNN predicted age with Pearson's r=0.93 and average absolute error of 4.58 years. The model was implemented on MRI scans from 11 SuperAgers with florbetapir PET scans. Amyloid PET positivity was assessed with 6 bilateral Clark et al. 2011 cortical regions and full cerebellar reference region.

Results: gCNN predicted brain age from 11 SuperAgers was significantly lower than their chronologic age (p<0.0001; mean difference 20.76 years ± 8.65 [s.d.]). Only one of the 80+-year-old SuperAgers was amyloid positive (SUVR > 1.17).

Conclusions: SuperAgers show a mismatch between chronologic and biologic brain age, consistent with our previous reports. AD pathology is present in approximately 30% of cognitive healthy adults >65, but only <10% of SuperAgers. Both results suggest SuperAging may inform mechanisms of resistance to age-related changes.

This research was presented as part of the 26th Annual Alzheimer Day hosted by the Northwestern University Mesulam Center for Cognitive Neurology and Alzheimer Disease on September 24, 2020.

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