

26th Annual Alzheimer Day

Cortical Atrophy in Adults 80+ Years with Superior Memory vs Cognitively Average Middle-Age Adults

Eldes F, Sridhar J, Zhang H, Kuang A, Coventry C, Moeller S, Maher A, Mesulam M-M, Weintraub S, Rogalski E

Introduction: Memory decline has been associated with old age and may have increasing rates from middle-age (50s-60s) to older age (80+). One unique cohort who has displayed resistance to age-related memory decline is “SuperAgers” who are adults 80 years and older with episodic memory ability at least as good as cognitively average middle-age adults¹. Northwestern University’s larger SuperAging research program seeks to identify factors that contribute to superior memory performance in older age. Previous cross-sectional results show that SuperAgers have a significantly thicker cortex than their same age peers and remarkably no significant atrophy compared to a cognitively average middle-age adults in their 50s and 60s². Longitudinal analysis revealed annual percent change (APC) in cortical volume was more than two times greater in the cognitively average 80+ year olds compared to SuperAgers³, suggesting SuperAgers are on a different trajectory of cortical decline than their average peers. This study extends this previous work by exploring whether the APC in whole-brain cortical volume of SuperAgers is different from middle-age adults with similar episodic memory performance.

Methods: The sample consisted of 15 cognitively average middle-age adults, 12 cognitively average elderly adults and 24 SuperAgers with baseline and follow up data approximately two years apart. All participants received T1-weighted three-dimensional MP-RAGE sequences (TR = 2300ms, TE = 2.86ms, flip angle = 9°, FoV = 256mm) on a 3T Magnetom Trio, Siemens scanner. The cortical reconstructions were performed using FreeSurfer version 5.1.0 and manually corrected for inaccuracies^{4,5}. Whole-brain cortical volume was extracted by controlling for intracranial volume and annual percent change in cortical volume for each group was compared to zero using one-sample t-tests. The APC differences between groups were investigated using two-sample t-tests.

Results: All three groups demonstrated statistically significant mean annual percent whole brain volume loss compared to zero (cognitively average middle-age adults 0.50%, $p = 0.03$; SuperAgers, 1.06%, $p < 0.001$; cognitively average elderly adults, 2.24%, $p = 0.002$)³. Pairwise comparison between SuperAgers and cognitively average middle-age adults did not show significant difference in the APC in whole-brain cortical volume (difference, 0.56%; $p > 0.05$). Compared to the cognitively average middle-age adults, there is significantly greater annual volume loss in the cognitively average elderly (difference, 1.74%; $p = 0.003$). The APC in whole-brain cortical volume was significantly greater in cognitively average elderly compared to SuperAgers (difference, 1.18%; $p = 0.04$)³. No differences were detected between SuperAgers and cognitively average middle-age adults in demographics including education and handedness.

Discussion: Our study aimed to investigate annual percent change in whole-brain cortical volume in SuperAgers relative to two cognitively average groups, middle-age adults and cognitive average 80+ year old peers. The annual percent change in cortical volume of SuperAgers more closely aligns with that of cognitively average middle-age adults than their cognitively average 80+ year old peers. These data suggest SuperAgers provide a unique model for studying mechanisms of resistance to age-related cortical atrophy.

References

- (1) Rogalski EJ, Gefen T, Shi J, et al. Youthful memory capacity in old brains. *J Cogn Neurosci*. 2013;25(1):29-36.
- (2) Harrison TM, Weintraub S, Mesulam MM, Rogalski E. Superior memory and higher cortical volumes in unusually successful cognitive aging. *J Int Neuropsychol Soc*. 2012;18(6):1081-1085.
- (3) Cook AH, Sridhar J, Ohm D, et al. Rates of Cortical Atrophy in Adults 80 Years and Older With Superior vs Average Episodic Memory. *JAMA*. 2017;317(13):1373–1375.
- (4) Reuter M, Schmansky NJ, Rosas HD, Fischl B. Within-subject template estimation for unbiased longitudinal image analysis. *Neuroimage*. 2012;61(4):1402-1418.
- (5) Fischl B. FreeSurfer. *Neuroimage*. 2012;62(2):774–781.

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.

brain.northwestern.edu