

Detection Of Brain Networks Modulating The Relationship Between White Matter Volume And Global Cognitive Performance

Osamu Katayama^{1,2}, Ryo Yamaguchi¹, Daiki Yamagiwa¹, Shoma Akaida¹, Takahiro Shimoda¹, Chika Nakajima¹, Ayuka Kawakami¹, Takayuki Kodama², Hiroyuki Shimada^{1,3,4}

1 Department of Preventive Gerontology, Center for Gerontology and Social Science, National Center for Geriatrics and Gerontology, 7-430 Morioka-cho, Obu, Aichi 474–8511, Japan
2 Department of Physical Therapy, Graduate School of Health Sciences, Kyoto Tachibana University, 34 Yamada-cho, Oyake, Yamashina-ku, Kyoto 607–8175, Japan
3 Cognitive Function Research, Aging Research (Partnership field), Nagoya University Graduate School of Medicine, Nagoya, Aichi 466-8550, Japan
4 Medical Science Division, Department of Medical Sciences, Graduate School of Medicine, Science and Technology, Shinshu University, Matsumoto, Nagano 390-8621, Japan

INTRODUCTION	METHODS	RESULTS	CONCLUSIONS	REFERENCES
Some individuals demonstrate superior cognitive performance than would be expected given the extent of brain changes, injury, or disease. This phenomenon, known as cognitive reserve, modulates the impact of age-related structural changes on cognitive function. This study aimed to identify brain networks associated with cognitive reserve—those enabling higher cognitive performance than would be predicted by white matter volume—using brain networks derived from electroencephalography (EEG) data.	Participants’ global cognitive function was assessed using the National Center for Geriatrics and Gerontology-Functional Assessment Tool. White matter volume, measured in cubic millimeters using MRI, was calculated and normalized by dividing by the estimated total intracranial volume. Participants underwent a 5-min resting-state EEG recording with their eyes closed. Cortical electrical activity was measured using a mobile, high-standard, dry-electrode 19-channel EEG system sampled at 500 Hz. EEG signals were bandpass filtered from 0.53 to 120 Hz using Brain Vision Analyzer software. We performed exact low-resolution brain electromagnetic tomography-independent component analysis (eLORETA-ICA) to assess resting-state EEG networks in community-dwelling older adults. To identify networks associated with cognitive reserve, we employed a moderation analysis framework consistent with the definitions established by the “Reserve and Resilience”.	The analysis included 832 individuals (median age: 74 years). An oscillatory pattern characterized by decreased beta activity in the right temporoparietal junction (TPJ) and increased alpha activity in the right inferior frontal gyrus (IFG) appeared to reflect adaptive, and possibly compensatory, neural processes that help preserve cognitive performance in the context of declining white matter volume attenuating the adverse effect of white matter loss ($\beta = -0.00215$, 95% CI: -0.00417 to -0.00013, $p = 0.037$).	This study provides novel evidence that an oscillatory pattern characterized by decreased beta activity in the right TPJ and increased alpha activity in the right IFG reflects adaptive neural processes. These findings suggest that specific oscillatory patterns could serve as potential biomarkers for cognitive reserve.	Katayama O, Stern Y, Habeck C, Coors A, Lee S, Harada K, Makino K, Tomida K, Morikawa M, Yamaguchi R et al: Detection of neurophysiological markers of cognitive reserve: an EEG study. <i>Front Aging Neurosci</i> 2024, 16:1401818. Katayama O, Yamaguchi R, Yamagiwa D, Akaida S, Shimoda T, Nakajima C, Kawakami A, Kodama T, Shimada H: Brain networks modulating the relationship between white matter volume and cognition. <i>Alzheimer's & Dementia: Translational Research & Clinical Interventions</i> 2026, 12(1). CONTACT  National Center for Geriatrics and Gerontology National Research and Development Agency Osamu Katayama katayama.o@ncgg.go.jp ALZHEIMER'S ASSOCIATION 