

Background

The cerebellum has long been recognized for its integral role in motor learning and control.

Recent findings suggest its involvement extends beyond motor functions, potentially impacting non-motor domain and contributing to cognitive decline in Alzheimer's disease (AD)¹.

Cerebellum is considered relatively resilient to AD-related pathology, such as amyloid plaques².

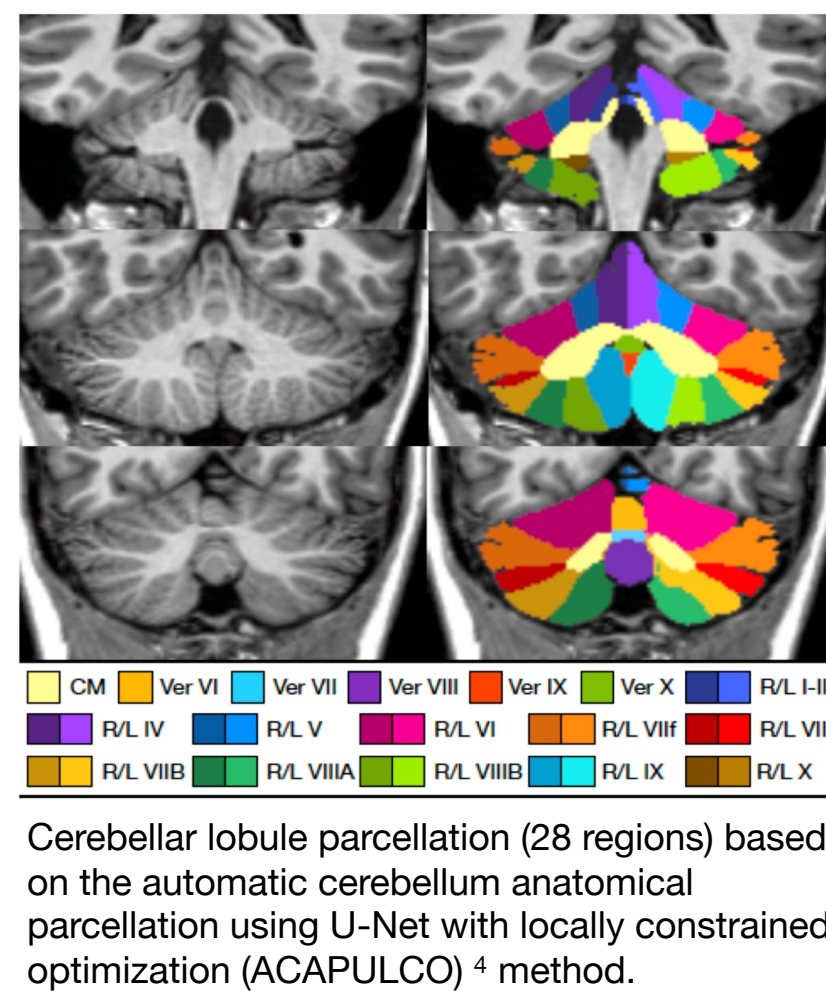
Our understanding of other changes in the cerebellum, such as regional volume atrophy, during aging and in AD remains to be investigated.

Study Goal

To investigate differential cerebellar regional atrophy trajectories across cognitive diagnosis groups

Methods

- 3T, T1-weighted scans from ADNI (downloaded in May 2025)
- All the scans were preprocessed with the HCP minimal preprocessing pipeline³, followed by cerebellar parcellation method based on convolutional neural networks.
- Linear mixed effects model predicting cerebellar regional volume (mm³) with region, group × region, and time × group × region as fixed effects; random intercepts and slopes for time nested within subject and region; covariates: age, sex, scan quality, and ICV.



	CU stable	CU to MCI	MCI Stable	MCI to AD	AD Stable	Total
n	663	45	599	144	309	1760
Baseline age (SD), yrs	70.9 (7.5)	76.8 (6.4)	72.7 (7.8)	73.2 (7.5)	74.9 (8.4)	72.6 (7.9)
Female n (%)	408 (61.5)	19 (42.2)	271 (45.2)	57 (39.6)	146 (47.2)	901 (51.2)
No. of Visits (max)	2.7 (10)	4.4 (10)	3.2 (15)	5.1 (11)	2.5 (5)	3 (5)
Time from baseline (SD), yrs	2.2 (7.5)	4.7 (6.4)	1.9 (7.8)	3.4 (7.5)	0.8 (8.4)	2 (7.9)
Inter-visit interval (SD), yrs	1.59 (0.59)	1.63 (0.93)	0.88 (0.41)	0.85 (0.46)	0.63 (0.23)	1.09 (0.47)

Acknowledgements



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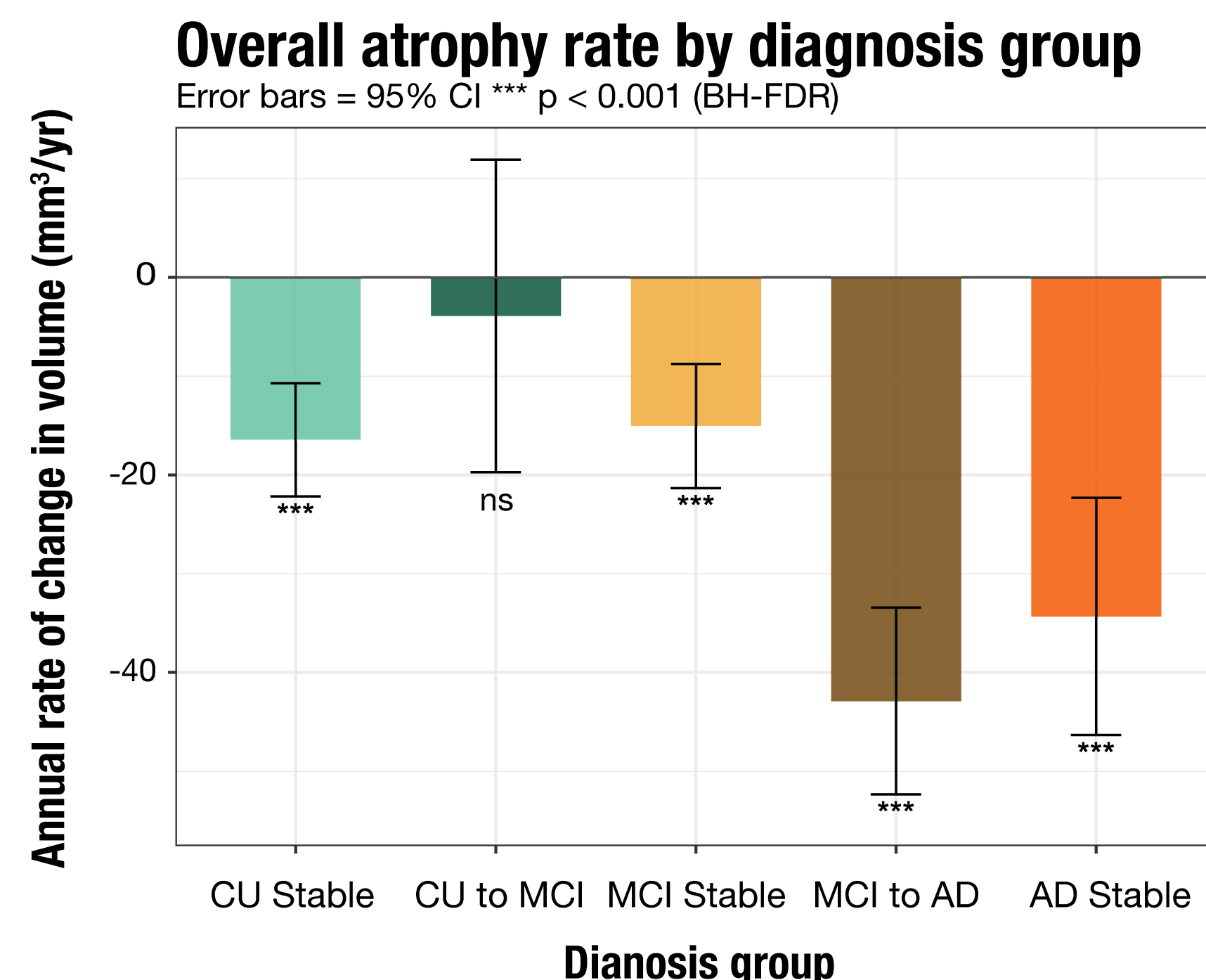
References

- [1] Schmahmann, J.D. (2019) *Neuroscience Letters*
- [2] Thal et al., (2015) *Acta Neuropathol*
- [3] Glasser, M.F. et al. (2013) *Neuroimage*
- [4] Han, S. et al. (2020) *Neuroimage*

QR Code

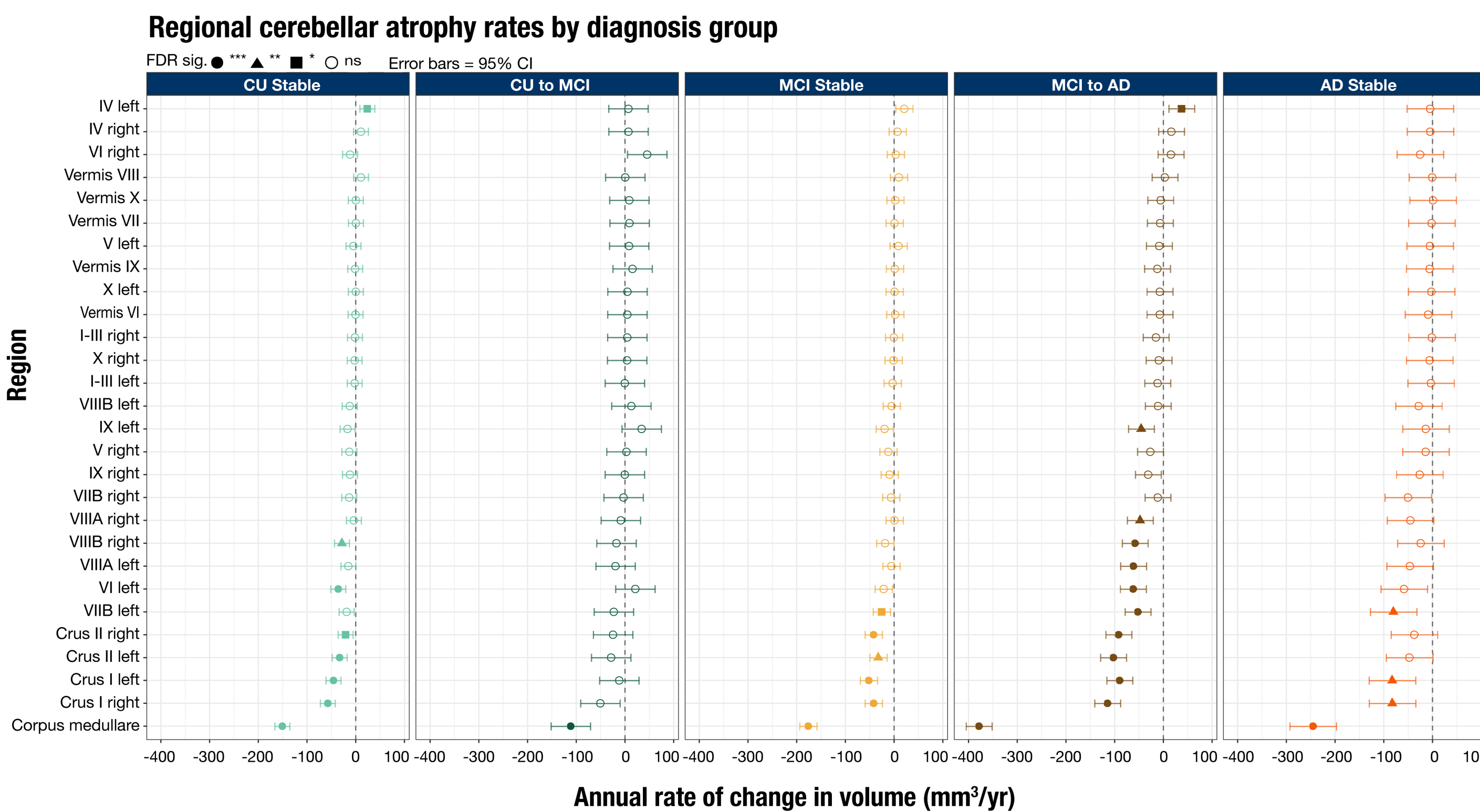


Cerebellar atrophy over time

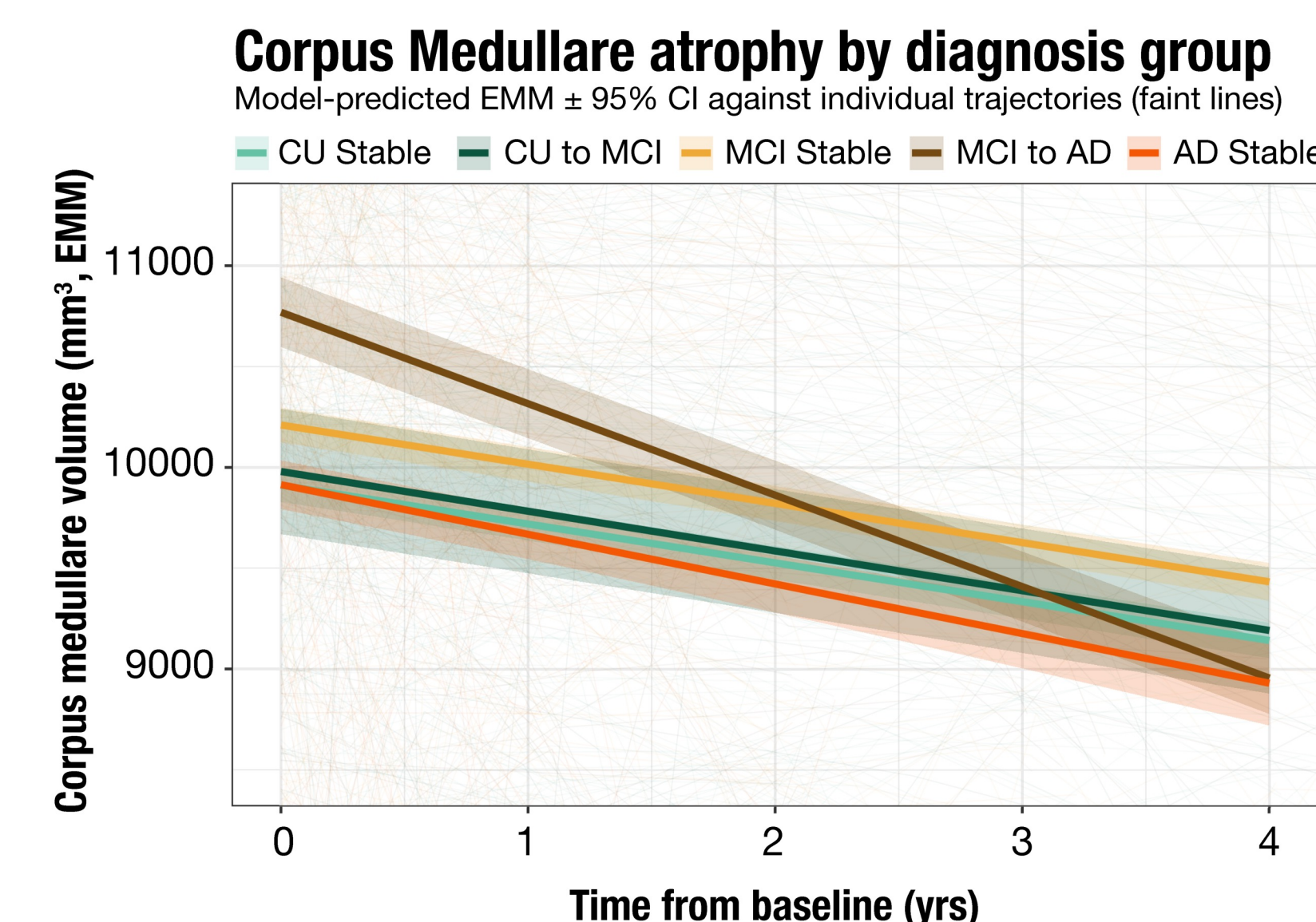


- Overall cerebellar volume declined significantly over time (-16.4 mm³/yr)
- No baseline volume difference across groups except for AD Stable
- Older age at baseline associated with smaller cerebellar volume (-14.0 mm³/yr of age)
- CU to MCI group showed no significant change
- MCI to AD (-42.9 mm³/yr) and AD Stable (-34.3 mm³/yr) groups decline significantly faster than CU Stable group

Accelerated cerebellar white matter atrophy



- Atrophy rates varied significantly across cerebellar regions and diagnosis groups
- Crus I and II atrophy in cognitively impaired groups
- Corpus medullare (white matter of the cerebellum) is the most severely and consistently affected region across all groups
- Vermis regions showed minimal atrophy across all groups



Cerebellar white matter shows the greatest vulnerability to atrophy in cognitively impaired individuals.