

Ultra-low field MRI for neurodegenerative disorders - experience from a lower-middle-income country



Background

- Neurodegeneration is an understudied area of research in Pakistan, especially limited by the cost of neuroimaging.
- Ultra-low-field (ULF) MRI (0.064T) shows promise in combination with image super-resolution methods as a low-cost tool for research and diagnostics for neurodegenerative disorders in LMICs.



ULF MRI vs conventional MRI:

- ✓ Lower power requirements
- ✓ Portable
- ✓ Reduced cost
- ✓ Ease of use
- ✓ Real-time monitoring
- ✓ Compatibility with medical devices

Objective

We assessed the feasibility of ULF MRI in patients with Parkinson's disease (PD), Parkinson's disease (PDD), Alzheimer's disease (AD), and healthy older adults (HC) as controls.

Methodology

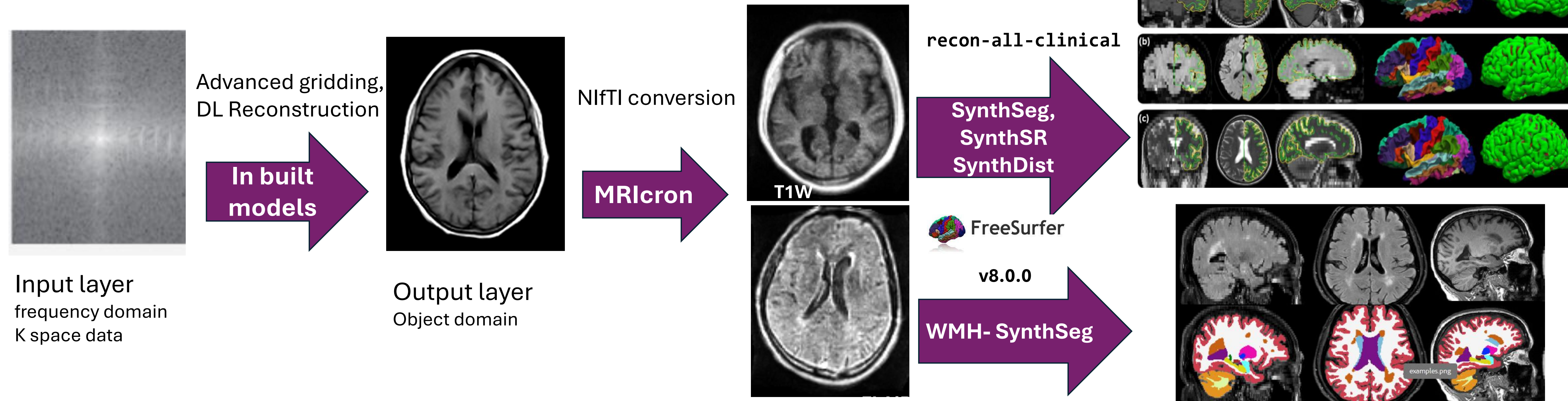
Recruitment:

- Consenting patients from Neurology clinics, Aga Khan University Hospital, Karachi. (Jan 2025 - April 2025)
- Clinical assessment:
 - Mini-mental State Examination (MMSE)
 - Unified Parkinson's Disease Rating Scale (UPDRS-III) (for PD)
- MRI sequences
 - T1W (gray/white axial)
 - FLAIR (axial)
 - DWI and ADC
- Visual rating scales on MRI:
 - Medial Temporal lobe Atrophy (MTA)
 - Fazekas

Conclusion

- First study to demonstrate the feasibility of ULF MRI in patients with neurodegenerative disorders and healthy older adults in a lower-middle-income country (LMIC).
- Challenges with recruitment and research infrastructure.
- Meaningful results for a pilot study; further high-powered studies needed for group-wise comparisons.

Image preprocessing pipeline:



Results

	HC	AD	PD	PDD
Subjects (n)	6	2	6	2
Age (years)	66.8 ± 7.3	79 ± 4.2	59.3 ± 10.9	69 ± 8.5
Gender (M/F)	5/1	1/1	3/3	1/1
MMSE	28	23	28	20
UPDRS-III	NA	NA	52	72
MTA score	2	2	1	2
Fazekas visual rating	2	2	1	2

Table 1. Characteristics of the study participants

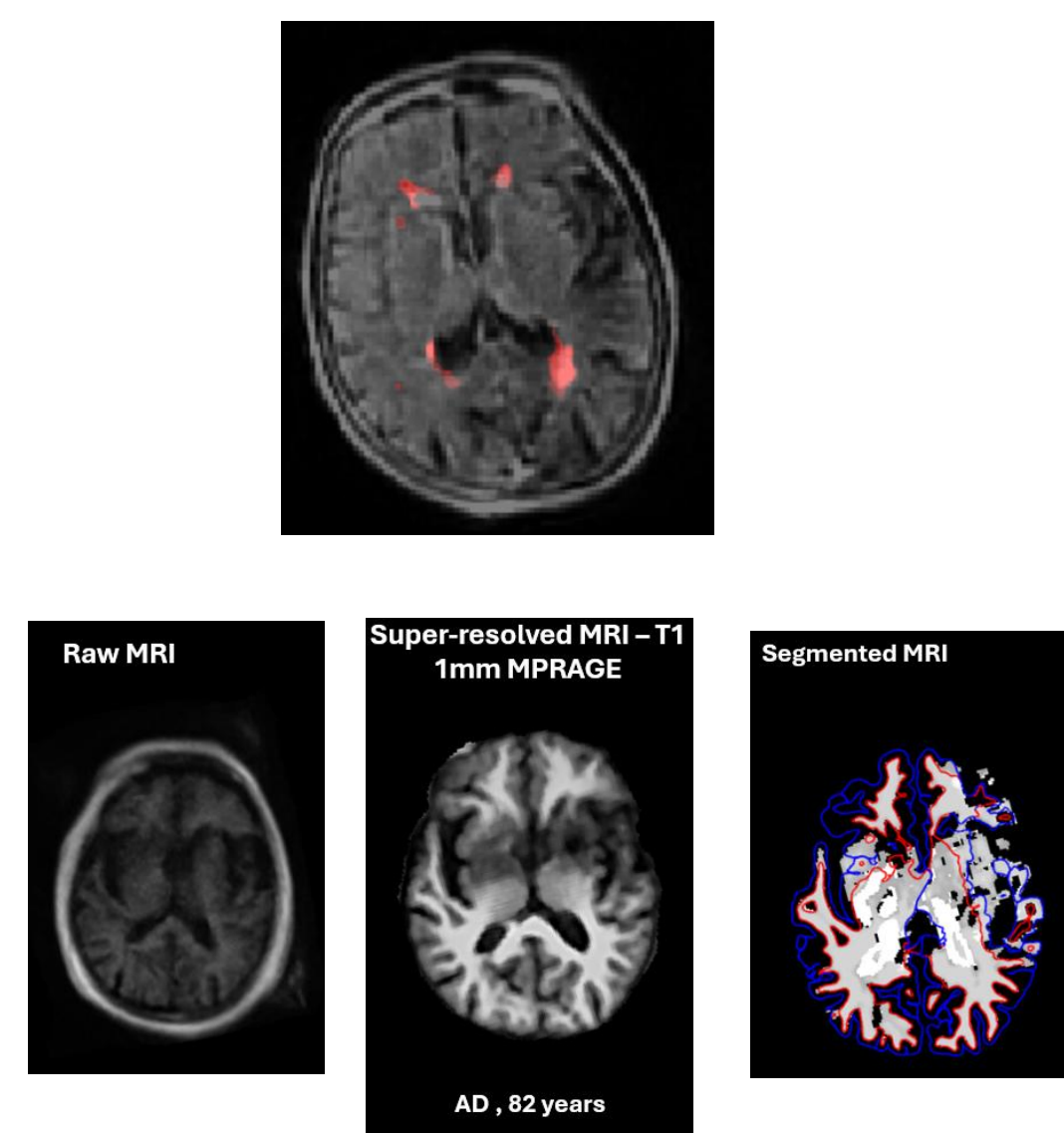


Figure 2. A Performance of WMH-SynthSeg B. Failure of freesurfer segmentation in AD with severe atrophy

Diagnosis - Age (years)	Raw MRI		Super-resolved MRI	Segmented MRI
	T1 G/W	FLAIR		
HC - 65				
AD - 76				
PD - 68				
PDD - 75				

Figure 1. Raw MRI images from ULF MRI scanner, super-resolved MRI from SynthSR, brain tissue segmentation with recon-all-clinical pipeline

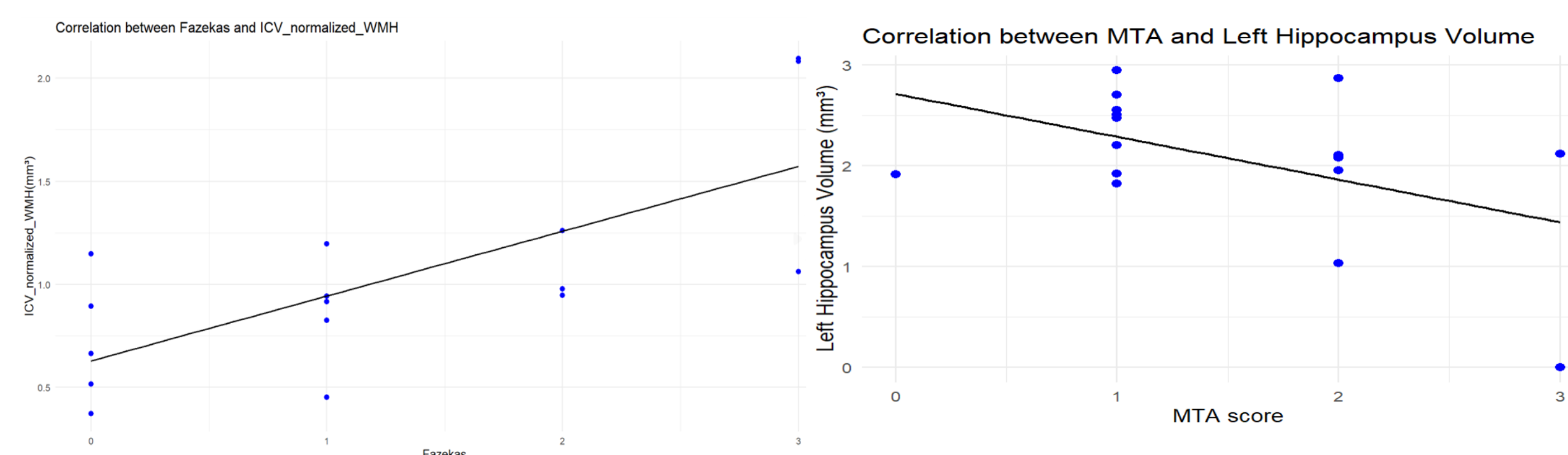


Figure 3. Agreement between visual rating scales and volumes

Brain ROIs by Diagnosis

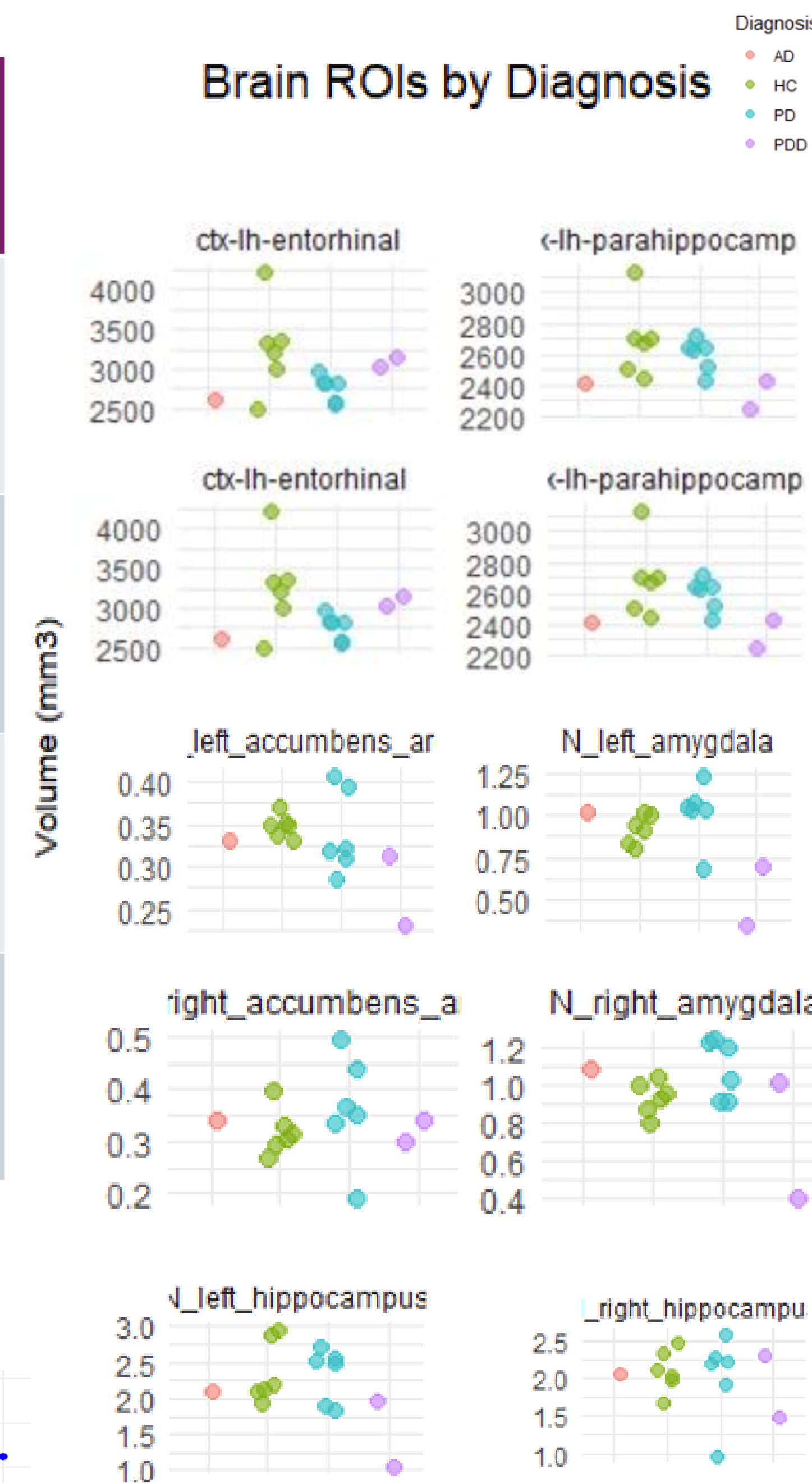


Figure 4. Regions of Interest (ROIs) within the Medial Temporal Lobe (MTL)

Acknowledgements and Further reading

This work is supported by the Association of Commonwealth Universities (ACU) Fellowship grant awarded to Kiran Aftab.
• Sorby-Adams, Annabel J., et al. "Portable, low-field magnetic resonance imaging for evaluation of Alzheimer's disease." Nature Communications 15.1 (2024)
• Gopinath, Karthik, et al. "Cortical analysis of heterogeneous clinical brain MRI scans for large-scale neuroimaging studies." International Conference on Medical Image Computing and Computer-Assisted Intervention. Springer Nature Switzerland, 2023.

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