

Linking Hippocampal Atrophy to Emotional Dysregulation and Sleep Disturbances in Neurodegenerative Disease

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01. BACKGROUND

- In neurodegenerative diseases causing dementia, hippocampal atrophy can lead to cognitive decline and emotional dysregulation.
- Sleep is crucial for memory consolidation and emotional regulation, with the hippocampus being fundamental in forming episodic emotional memories.
- Emotional dysregulation (e.g., apathy, aberrant behaviour) and sleep disturbances are symptoms occasionally observed in dementia.
- Assessment tools:
 - Neuropsychiatric Inventory (NPI): Evaluates behavioural symptoms (e.g., apathy, aberrant behaviour).
 - Pittsburgh Sleep Quality Index (PSQI): Assesses subjective sleep quality.

02. OBJECTIVE

- This study examined correlations between hippocampal volumes with NPI and PSQI scores in patients with neurodegenerative disease.
 - Emotional/behavioural dysregulation, assessed via the Neuropsychiatric Inventory scores (NPI).
 - Sleep related symptoms/disturbances, assessed via the Pittsburgh Sleep Quality Index (PSQI).
- Conducted exploratory analyses of a clinic-based cohort of older adults comprising a heterogeneous, mixed-disease patient population (SDS).

03. METHODS

- Participant Data Sources:
 - Sunnybrook Dementia Study (SDS)
 - Ontario Neurodegenerative Disease Research Initiative (ONDRI)
- Neuroimaging:
 - Hippocampal volumes measured using HippMapp3r.
 - Whole-brain atrophy estimated via brain parenchymal fraction (BPF).
 - Cerebral small vessel disease derived from white matter hyperintensity (WMH) volumes.
- Behavioural Measures:
 - NPI and PSQI scores collected during clinic visits.
- Statistical Analyses:
 - Correlation and linear regression models
 - Controlled for age, sex, education, BPF, and WMH.

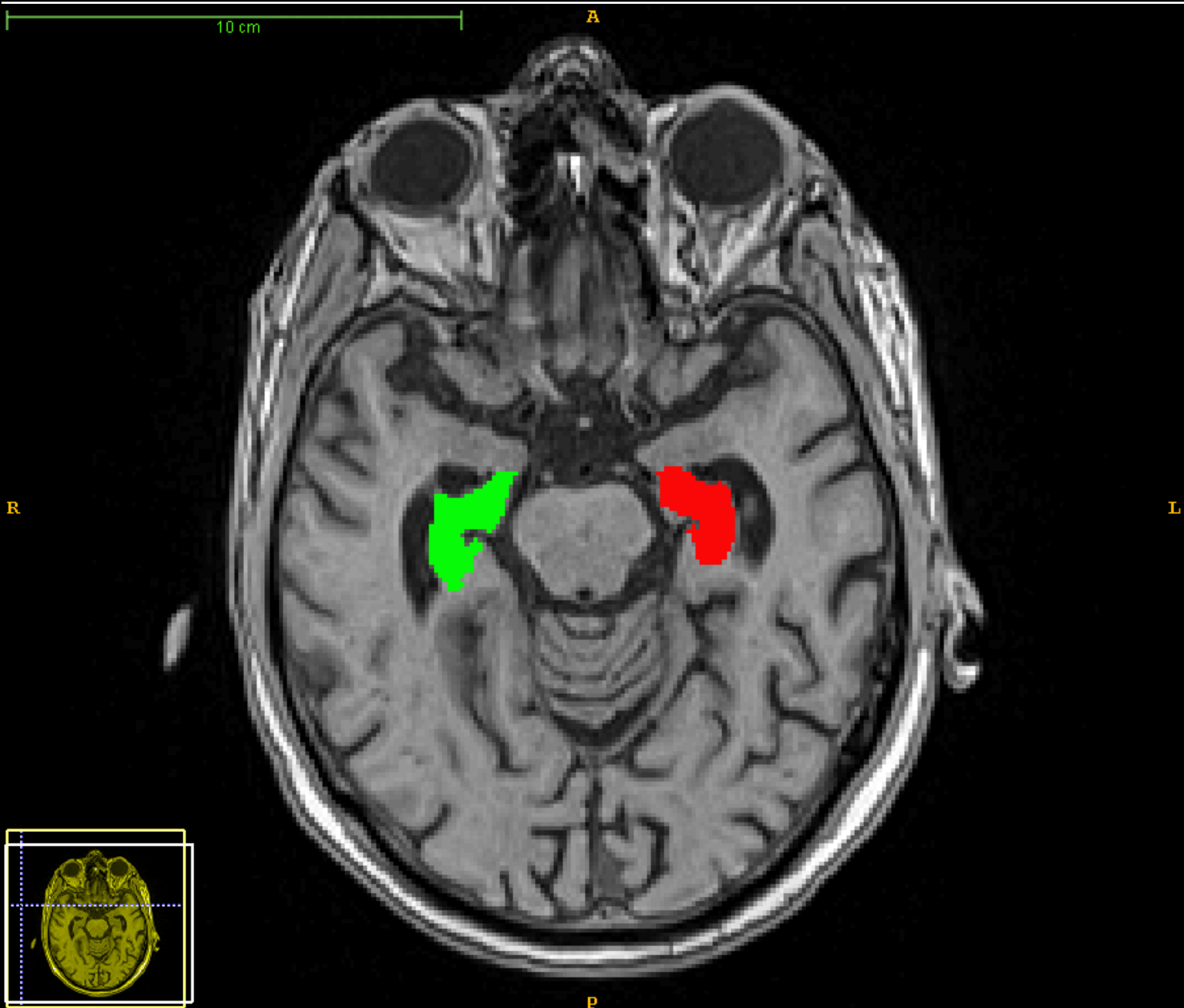
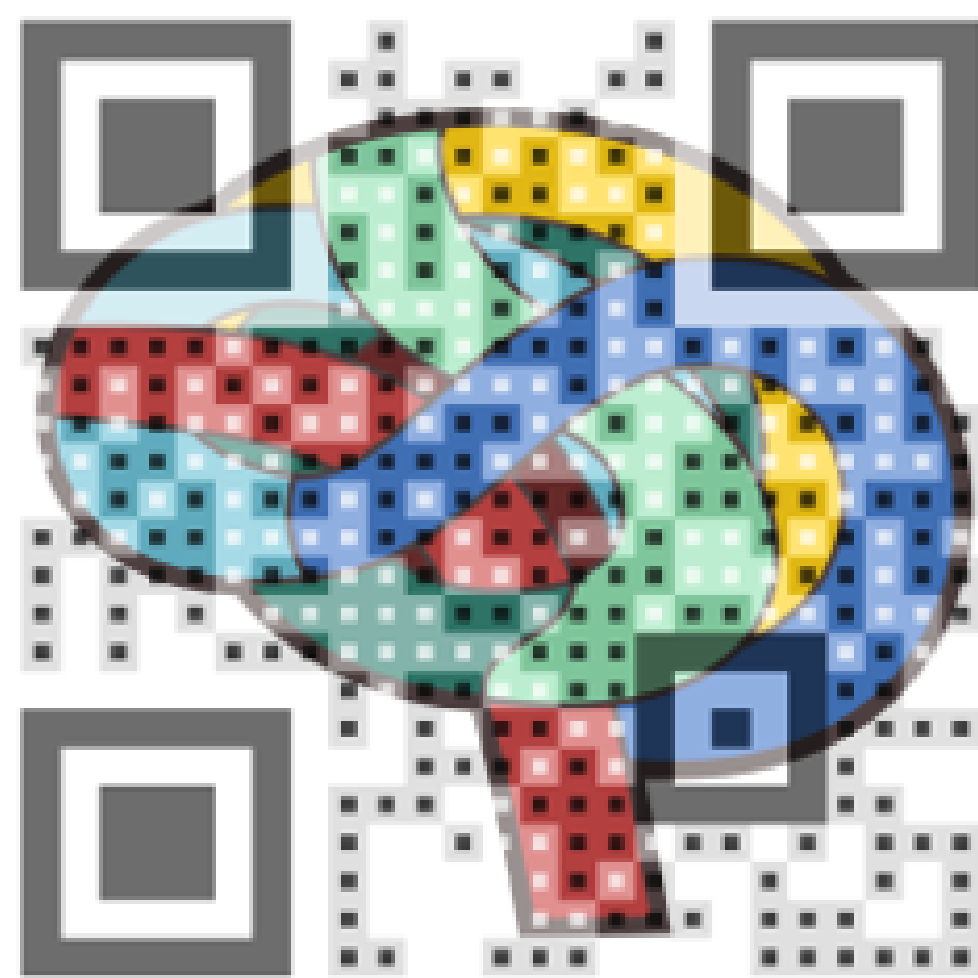


Figure 1. HippMapp3r hippocampal segmentation on an SDS participant's T1-weighted image.



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04. RESULTS

- SDS Cohort
 - ↓ Hippocampal volume correlated with ↑ NPI-Aberrant Behaviour ($p = -0.13$, $p = 0.029$)
 - ↓ Hippocampal volume associated with ↑ NPI-Apathy ($\beta = -0.085$, $p = 0.007$)
- ONDRI Cohort
 - ADMCI: ↑ Hippocampal volume correlated with poorer sleep quality ($p = 0.26$, $p < 0.0001$)
 - CVD: Similar correlation with poorer sleep quality ($p = 0.17$, $p = 0.002$)
 - ADMCI: ↓ Hippocampal volume correlated with ↑ sleep duration ($p = -0.33$, $p < 0.0001$)
- No significant NPI-apathy correlation found in ONDRI.
- Aberrant behaviour not measured in ONDRI; PSQI not available in SDS.

Compensatory mechanism?

Table 1. Summary of associations between hippocampal volume and emotional and sleep-related symptoms across the SDS and ONDRI datasets.

Dataset	Clinical Group	N	Outcome Variable	Association with Hippocampal Volume	Statistic	p-value
SDS	All	297	NPI-Aberrant	Negative	$p = -0.13$	0.029
SDS	All	1027	NPI-Apathy	Negative	$\beta = -0.085$	0.007
ONDRI	ADMCI	215	Sleep Quality (PSQI)	Positive	$p = 0.26$	<0.0001
ONDRI	CVD	331	Sleep Quality (PSQI)	Positive	$p = 0.17$	0.002
ONDRI	ADMCI	211	Sleep Duration	Negative	$p = -0.33$	<0.0001

05. CONCLUSIONS

- Hippocampal atrophy in neurodegenerative diseases may be related to:
 - Increased apathy and aberrant behaviours (SDS).
 - Altered sleep patterns; perceived sleep quality and longer sleep duration (ONDRI).
- These findings suggest that diminished hippocampal volumes may impair emotional regulation and introduce compensatory sleep quality mechanisms.

06. FUTURE DIRECTIONS

- Future studies on neurodegenerative diseases with neuroimaging should include:
 - Full measures of apathy and aberrant behaviour.
 - More objective sleep quality measures (e.g., polysomnography, wrist actigraphy) to further explore important relationships with brain atrophy.
- Further explore hippocampus-related mechanisms of emotional and sleep regulation in dementia.

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