

The limitations of hippocampal volumetric measurements on clinical decision-making: a case study

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Background

- NeuroQuant is a fully-automated software using MRI data to quantify the volumes of brain structures, providing population-based normative data for neuroanatomical structures of interest
- Findings may be particularly valuable for identifying neurodegenerative processes
- Novel technologies continue to emerge to aid in the disease detection process
- However, integrating multiple pieces of information is a clinical challenge, since there are aspects of novel technology (e.g., comparison norms and expected amount of measurement error) which are unknown
- We present a unique case study demonstrating the limitations of hippocampal volumetric data on case conceptualization

Summary of Case Findings

- Performance on neuropsychological testing was stable across time and did not reveal significant impairment
- On longitudinal follow-up, clinical workup (including neuropsychological test results) were stable over a 10-year period except for NeuroQuant
- Hippocampal volumes were estimated between 5-19th percentiles across the first three MRIs (see Table 1)
- At the most recent MRI, the patient's hippocampal volumes were estimated at the 61st percentile

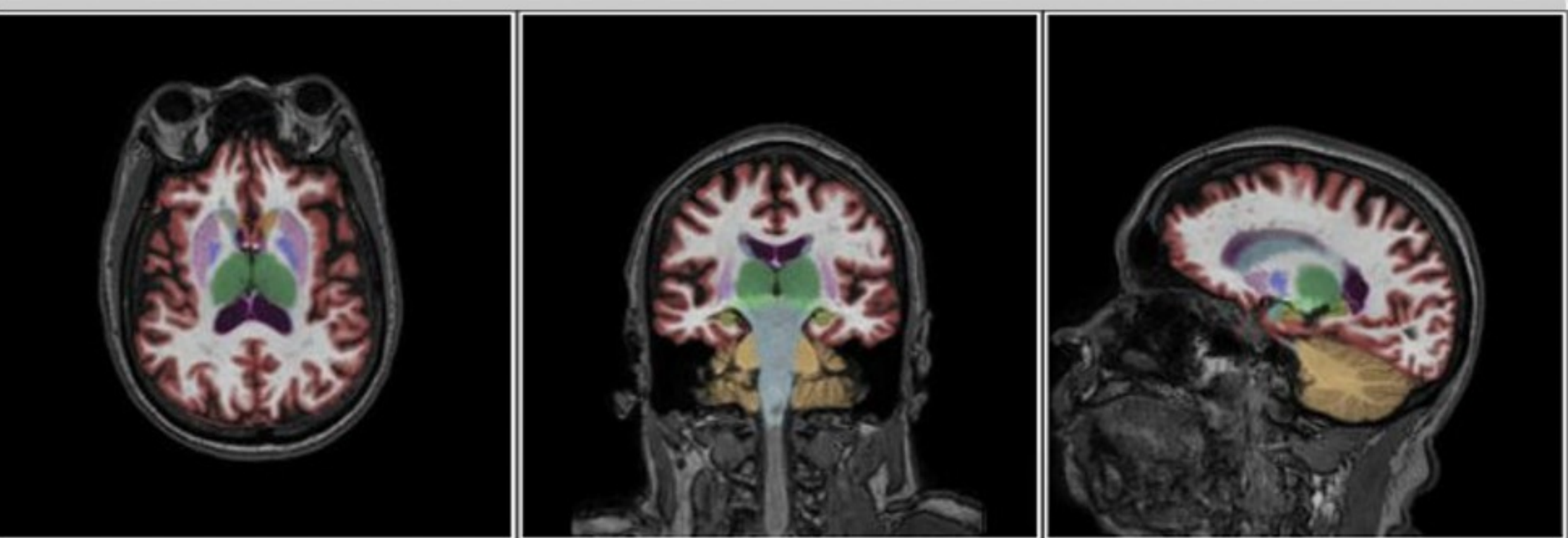
Table 1. Longitudinal Findings

Variables	Index Score or Percentile			
	2016	2018	2019	2021
MMSE	25/30	28/30	--	28/30
DRS-2	--	--	131/144	--
NeuroQuant				
Hippocampi Volume	6.51	6.07	5.85	6.00
Normative Percentile	19%	7%	<5%	61%

Note. MMSE = Mini-Mental Status Exam; DRS-2 = Dementia Rating Scale-2. NeuroQuant Hippocampi Volume measured in cm³.

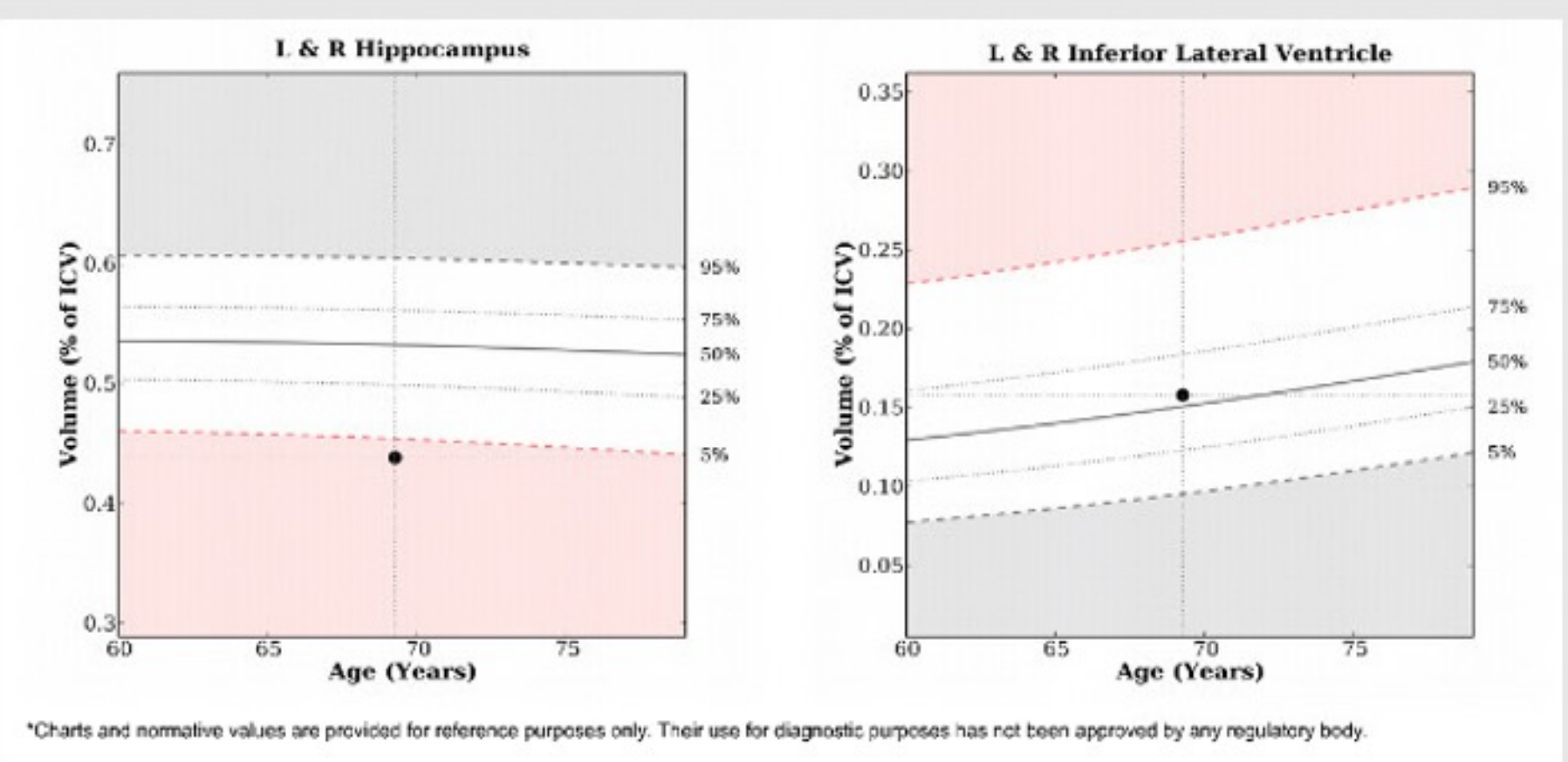
Figure 1. Imaging Results (2019 vs. 2021)

MORPHOMETRY RESULTS: 2019

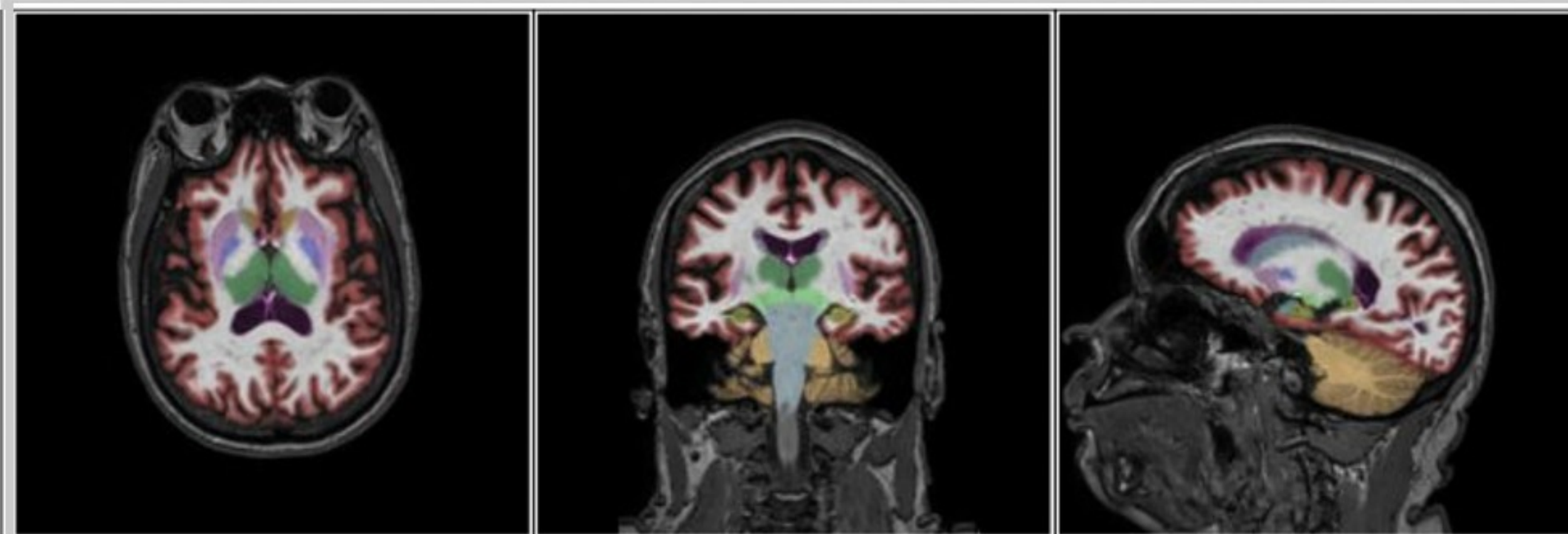


Brain Structure	Volume (cm ³)	% of ICV (5%-95% Normative Percentile*)	Normative Percentile*
Hippocampi	5.85	0.44 (0.45-0.61)	< 5
Lateral Ventricles	25.48	1.91 (0.82-3.42)	56
Inferior Lateral Ventricles	2.11	0.16 (0.10-0.26)	56

AGE-MATCHED REFERENCE CHARTS

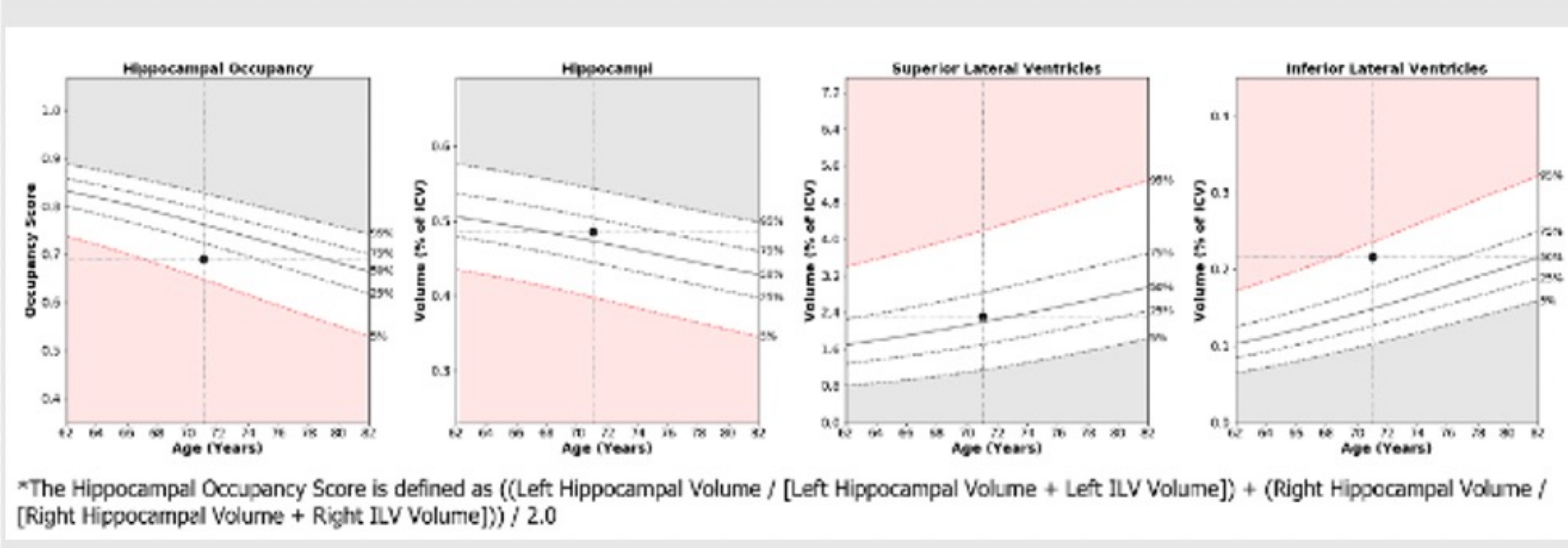


MORPHOMETRY RESULTS: 2021



Brain Structure	Volume (cm ³)	% of ICV (5%-95% Normative Percentile)	Normative Percentile
Hippocampal Occupancy Score (HOC)	0.69	N/A	13
Hippocampi	6.00	0.49 (0.40 - 0.54)	61
Superior Lateral Ventricles	28.62	2.31 (1.14 - 4.19)	55
Inferior Lateral Ventricles	2.67	0.22 (0.10 - 0.24)	92

AGE-MATCHED REFERENCE CHARTS



*The Hippocampal Occupancy Score is defined as ((Left Hippocampal Volume / [Left Hippocampal Volume + Left ILV Volume]) + (Right Hippocampal Volume / [Right Hippocampal Volume + Right ILV Volume])) / 2.0

Neuropsychological Results

Table 2. Neuropsychological Testing (2019 vs. 2021)

Test	Normative Score	
	2019	2021
Boston Naming Test	56T	56T
TMT Part A	37T	39T
TMT Part B	43T	41T
WMS-IV		
Logical Memory I	11SS	8SS
Logical Memory II	11SS	11SS
FAS	50T	44T
Animal Naming	57T	59T
CVLT-II		
Total	37T	44T
RCFT		
Copy	21T	29T
Immediate Recall	53T	56T
Delayed Recall	44T	53T

Note. TMT = Trail Making Test; WMS-IV = Wechsler Memory Scale Fourth Edition; CVLT-II = California Verbal Learning Test Second Edition; RCFT = Rey Complex Figure Test.

- Reported neuropsychological results from year 2019 and 2021 are selected to demonstrate performance consistency, despite discrepancy in hippocampal volumes (see Figure 1)
- No indication of reliable decline in performance over time

Patient Description

- 71-year-old Black female with serial neuropsychological, neurological (10-year period) and MRI with NeuroQuant evaluations (5-year period)
- Presented results span the last 5 years
- Patient reported declines in memory over time
- Early neuropsychological testing results, in combination with NeuroQuant, raised suspicion for a potential neurodegenerative process

Conclusion

- Reported hippocampal volumes from years 2019 and 2021 are selected to demonstrate largest discrepancy between NeuroQuant evaluations
- From 2019 to 2021, the patient's reported hippocampal volumes respectively shifted from the <5th to 61st normative percentile

- If used in isolation, NeuroQuant findings may have conceptualized the presented patient with a neurodegenerative process, ultimately impacting treatment
- Novel automated software for volumetric analyses may produce conflicting results, especially across updated versions
- Potential explanations for observed change:
 - Update to the normative database
 - Software update
 - Patient moving normative age bands
- Understanding the basis of scores produced by NeuroQuant and characteristics of the normative population is necessary for effective clinical-decision making