Hippocampal Volume and Working Memory in Ageing: Evidence for Compensation

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INTRODUCTION

Working memory (WM) is a cognitive system responsible for the temporary storage and manipulation of information required for performing complex tasks. Decline in WM is considered a marker of cognitive deterioration.

The hippocampus is a brain structure critical for learning, as well as the formation and consolidation of memory. However, research examining the relationship between the hippocampus and WM has yielded mixed results.

Evidence shows that WM declines with age, and aging is also associated with hippocampal volume loss. Nevertheless, it remains unclear whether, and to what extent, hippocampal volume is directly related to WM functioning in older adults.

AIM & HYPOTHESIS

Aim: Explore the relationship between verbal digit WM and hippocampal subfields.

H1: Hippocampal subfield volumes correlate with WM performance in older adults.

H2: This correlation is stronger in adults with mild cognitive impairment (MoCA 19-25).

METHODS

Participants: 46 older adults (65-85 years; M=71.8, SD=5.05; 82.6% female).

Cognitive measures: Numbers Reversed (Woodcock-Johnson) for verbal digit WM; Montreal Cognitive Assessmen (MoCA) for cognitive status.

MRI: Hippocampal subfield volumes from structural MRI.

Analyses: Spearman correlations and hierarchical regressions.

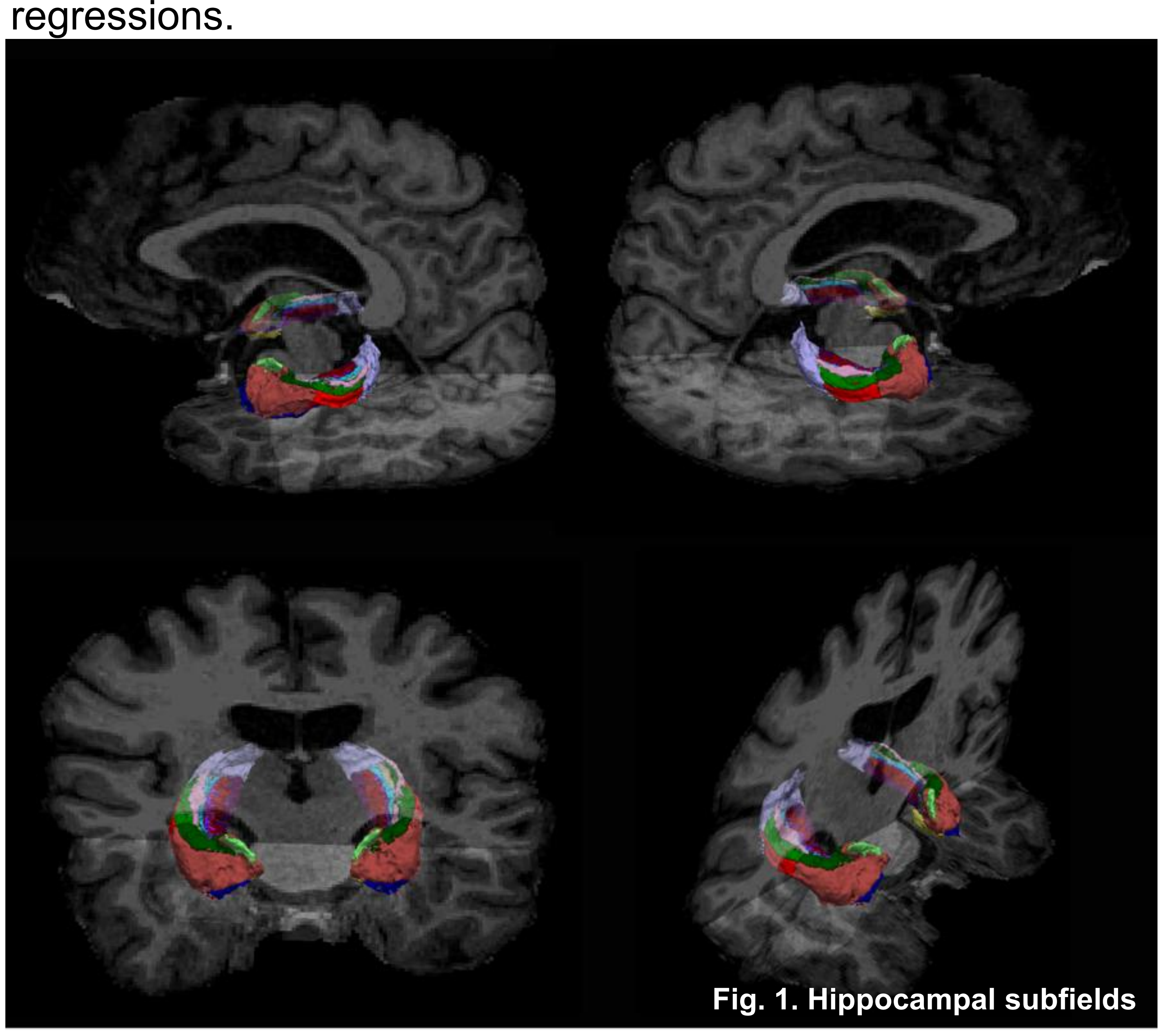

Fig. 1. Hippocampal subfields

- CA1 head
- CA1 body
- CA3 head
- CA3 body
- CA4 head
- CA4 body
- parasubiculum
- HATA
- fimbria
- hippocampal fissure
- HP tail
- presubiculum head
- presubiculum body
- subiculum head
- subiculum body
- GC - ML - DG head
- GC - ML - DG body
- molecular layer HP head
- molecular layer HP body

RESULTS

Hippocampal subfields	Whole sample	MoCA 19-25	MoCA 26-29
Both Hippocampi	13%		
LH Whole hippocampal head	24%		
LH Whole hippocampus	14%		
RH Whole hippocampal head	20%	30%	
lh CA1-head	26%		
lh molecular layer HP-head	20%		
lh GC-ML-DG-head	15%	32%	
lh CA4-head	16%	31%	27%
lh CA3-head	16%	35%	
rh presubiculum-head	17%		
rh CA1-head	18%	30%	
rh presubiculum-body			31%
rh molecular layer HP-head	16%		
rh GC-ML-DG-head	15%	47%	33%
rh CA4-head	17%	48%	
rh CA3-head	12%	58%	
rh HATA	17%	30%	

Color scale: 20%, 30%, 40%, 50%

Whole sample (N=46, controlled for eTIV & MoCA); MoCA 19–25 (N=24) & 26–29 (N=22, controlled for eTIV).
Abbreviations: LH – left, RH – right; GC-ML-DG – Granule Cell & Molecular Layer of Dentate Gyrus; HP – hippocampal; HATA – hippocampus-amygdala transition area; eTIV – estimated total intracranial volume.

Fig. 2. WM variance explained (%) by hippocampal subfields: statistically significant ($p < .05$) hierarchical regression results (see QR code below for details)

In the whole sample, hippocampal heads - especially the left - explained the largest WM variance (LH: 24%, RH: 20%), with subfields contributing 13-26%. In the low MoCA (MCI) group, specific subfields accounted for 25-58% of the variance, whereas in the high MoCA group, only a few subfields were linked to WM (27-33%).

CONCLUSION

Our study showed that older adults with MCI displayed stronger and more widespread associations between WM and hippocampal subregions than cognitively intact adults. These findings suggest that the hippocampus may serve as a compensatory mechanism for WM in individuals with MCI.

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Contacts and supplementary information

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