Physical Activity and the Development of Declarative Memory and Hippocampal Volume in Early Childhood

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INTRODUCTION

Memory improves markedly across early childhood and is dependent on the hippocampus (1,2).

Physical activity (PA) benefits memory in adults, but few studies have explored associations with forms of declarative memory in children (3,4).

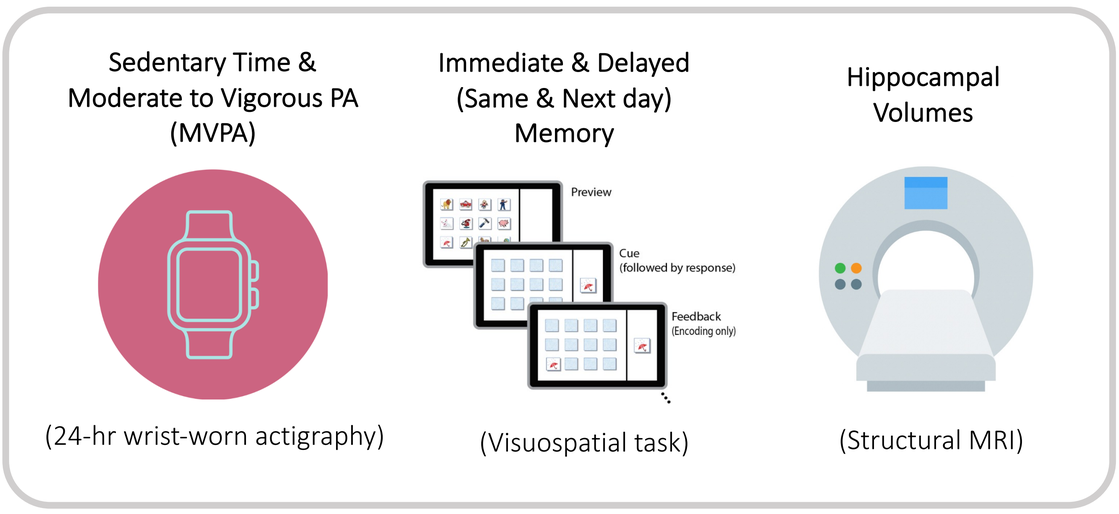
Moreover, adults appear to have increased or retained hippocampal volume in response to exercise training (5).

Early childhood is a period of substantial neural and behavioral development and thus, habitual PA may influence memory and hippocampal development (6, 7).

PURPOSE: To determine if sedentary time and PA is associated with memory performance and hippocampal volume development in preschool children.

METHODS

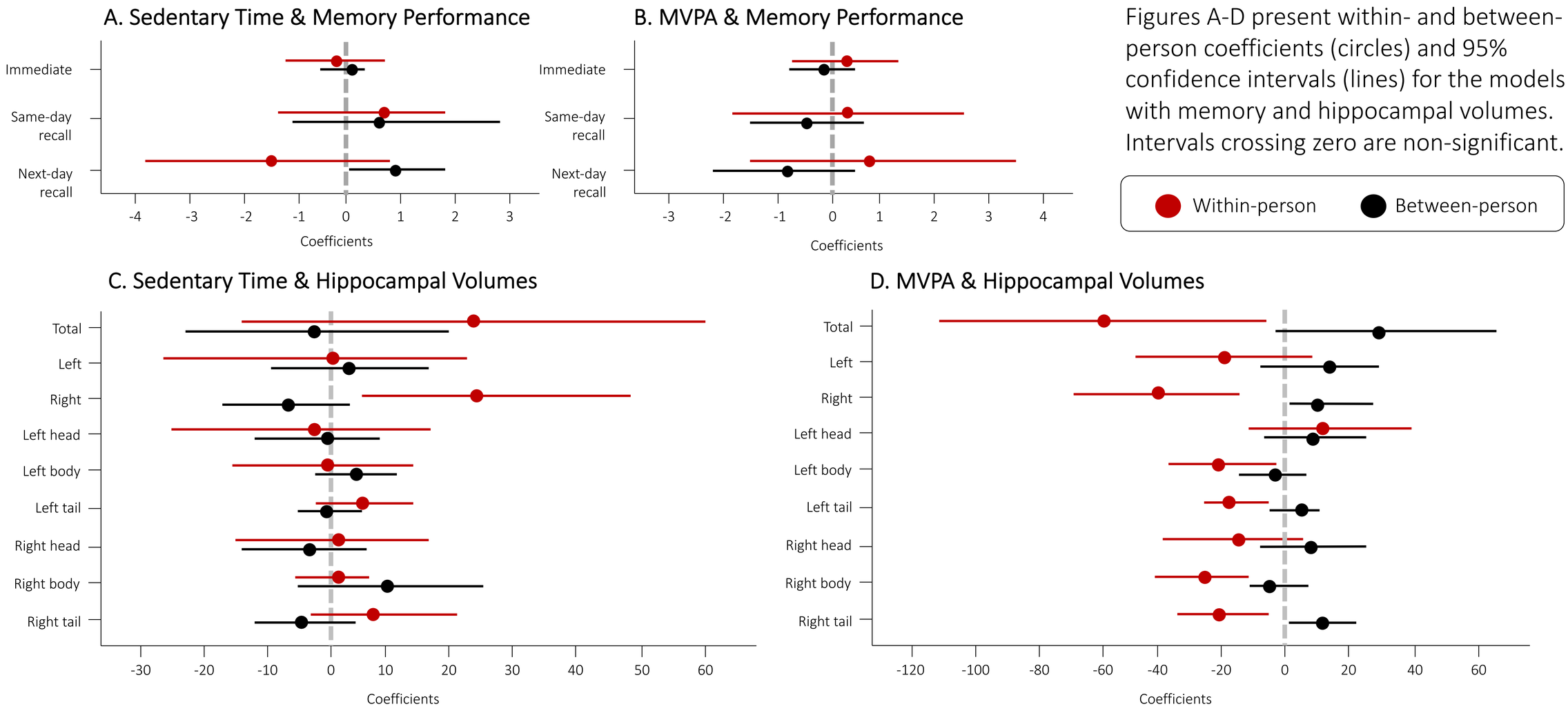
Preschool children (3-5 years, regular nappers, 63.% White, 8.2% Hispanic) participated in two 16-day measurement periods 6 months apart (Times 1 and 2).



Time 1: 37 children (memory = 37 memory & hippocampal = 22)

Time 2: 37 children (memory = 36 & hippocampal = 19)

RESULTS



CONCLUSIONS

Next day memory recall was higher among children with greater sedentary time. Relations for hippocampal volume were mixed, but multiple negative associations for within-person MVPA were observed, meaning greater variances within individuals were associated with smaller hippocampal volume. Exploring contexts of PA and the role of cardiorespiratory fitness in future studies may be warranted.

REFERENCES

1. Riggins T, Bauer PJ. A Developmental Neuroscience Approach to the Study of Memory. In: Courage ML, Cowan N, editors. The Development of Memory in Infancy and Childhood. Psychology Press; 2022.
2. Riggins T, Blankenship SL, Mulligan E, Rice K, Redcay E. Developmental Differences in Relations Between Episodic Memory and Hippocampal Subregion Volume During Early Childhood. Child Dev. 2015 Nov 1;86(6):1710–8.
3. Erickson KI, Hillman C, Stillman CM, Ballard RM, Bloodgood B, Conroy DE, et al. Physical Activity, Cognition, and Brain Outcomes: A Review of the 2018 Physical Activity Guidelines. Med Sci Sports Exerc. 2019;51(6):1242–51.
4. St. Laurent, C. W., Burkart, S., Andre, C., & Spencer, R. M. C. (2021). Physical Activity, Fitness, School Readiness, and Cognition in Early Childhood: A Systematic Review. *Journal of Physical Activity and Health*, *18*(8), 1004–1013.
5. Firth J, Stubbs B, Vancampfort D, Schuch F, Lagopoulos J, Rosenbaum S, et al. Effect of aerobic exercise on hippocampal volume in humans: A systematic review and meta-analysis. Neuroimage [Internet]. 2018;166(April 2017):230–8.
6. Ofen N, Kao YC, Sokol-Hessner P, Kim H, Whitfield-Gabrieli S, Gabrieli JDE. Development of the declarative memory system in the human brain. Nat Neurosci. 2007 Sep;10(9):1198–205.
7. Canada KL, Botdorf M, Riggins T. Longitudinal development of hippocampal subregions from early- to mid-childhood. Hippocampus. 2020;1–14.

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