

Physical Activity, Cardiovascular Risk Factors and Brain Health: Impact on Long Range Monosynaptic **Connections, Modular Organization of Cortical Regions, and Verbal Fluency**

Barbara K. Marebwa¹, Robert J. Adams¹, Gayenell S. Magwood², Martina Mueller², Julius Fridriksson³, Leonardo Bonilha¹ ¹Department of Neurology, Medical University of South Carolina, Charleston, SC, USA ²College of Nursing, Medical University of South Carolina, Charleston, SC, USA ³Department of Communication Sciences and Disorders, University of South Carolina, Columbia, SC, USA

Introduction

Long standing cardiovascular risk factor burden in the absence of clear clinical or radiological "events", is associated with pathological brain changes and cognitive decline, coupled with changes in the functional and structural organization of the brain. New MRI techniques exploring the integrity of neuronal fiber connectivity within white matter networks supporting cognitive processing could be used to measure the impact of cardiovascular (CV) disease on brain integrity and brain health, which may in turn be used beyond bedside neuropsychological tests, to detect subclinical changes. Using individual high resolution structural whole brain connectomes and graph theory methods, we assessed the topological network organization of cortical and subcortical networks of participants with cardiovascular risk factors. In this study, we show topological differences in the community structures of healthy participants and participants with cardiovascular risk factors. We therefore propose a singular measure of overall brain health using imaging connectomics based on graph

Participants

- 60 participants : 33 healthy controls, 27 with CVD
- Verbal IQ quantified by the North American Adult Reading Test (NART)
- Community Health Activities Program for Seniors (CHAMPS) questionnaire for physical activity
- MRI scanning (T1-, T2- and diffusion-weighted)
- Gray matter parcellation using high resolution AICHA anatomical atlas
- Connections traced using probabilistic tractography

Community Detection and Statistical Analysis

- Connectomes partitioned into modules by optimizing Newman's modularity algorithm (Newman and Girvan 2004) for both hemispheres.
- Modularity score and optimal community structure extracted for each subject
- Pearson correlation analysis performed to evaluate relationship between network density, verbal IQ and CHAMPS.
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- T-test analysis to compare the network density, and modularity scores of normal controls and participants with cardiovascular risk factors



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