Resistance training improves white matter structural connectivity in older adults at-risk for cognitive decline

Ryu Lien, BSc, University of Western Ontario, London, ON, Canada, Joyla Furlano, PhD, McMaster University, Hamilton, ON, Canada, Lindsay Nagamatsu, PhD, University of Western Ontario, London, ON, Canada

rlien2@uwo.ca

@embhlab

INTRODUCTION

Diabetes is a global health concern that impacts 415 million people worldwide (CDC, n.d.).

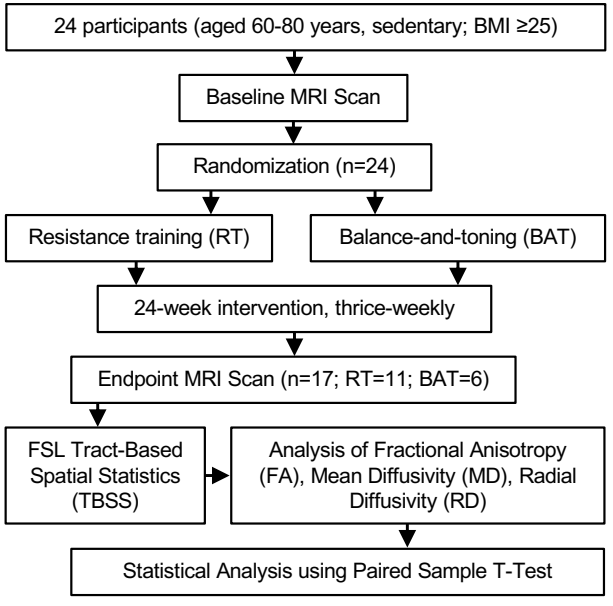
Individuals who are at-risk for diabetes (characterized by high blood glucose and/or being overweight) have white matter atrophy, decreased cognitive function, and an increased risk of Alzheimer's disease (AD) (Marseglia et al., 2016; Bitra et al., 2015).

Recently, resistance training (RT) has been shown to lower white matter atrophy and white matter lesion volume (Herold et al., 2019).

Diffusion tensor imagining (DTI) is an indicator of cerebral white matter integrity, and has the potential to detect and track earlier evidence of white matter abnormalities in patients developing AD (Dalboni da Rocha et al., 2020).

+ The study aimed to measure the effects of RT on structural connectivity in older adults at-risk for cognitive decline using DTI.

METHODS



RESULTS

+ Brain regions showing significant decreases in MD and RD after RT intervention:

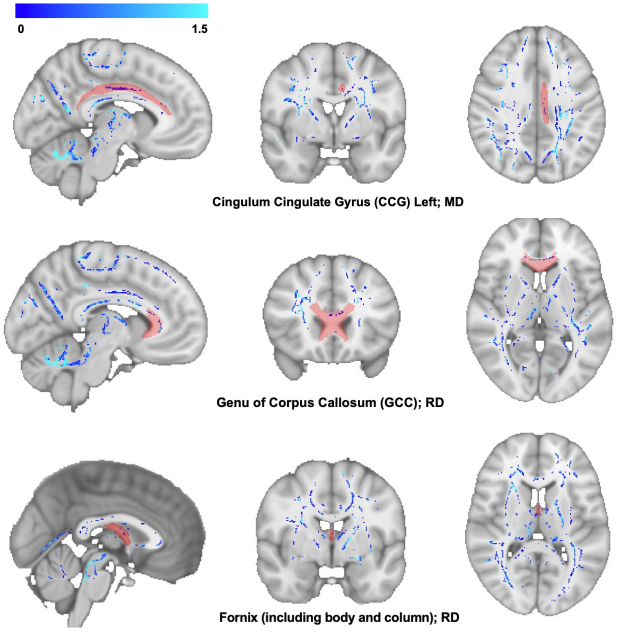


Figure 1. Illustration of diffusion images of the cingulum (cingulate gyrus) left, $t(10) = 2.746$, $p < 0.021$, genu of corpus callosum, $t(10) = 2.396$, $p < 0.038$, and the fornix, $t(10) = 2.184$, $p < 0.05$.

+ Brain regions showing significant increases in MD and RD after BAT intervention:

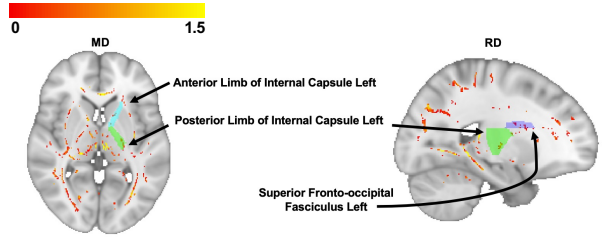


Figure 2. Illustration of diffusion images for anterior limb of internal capsule left (MD), $t(5) = -2.561$, $p < 0.05$, posterior limb of internal capsule left (MD), $t(5) = -2.618$, $p < 0.047$, posterior limb of internal capsule left (RD), $t(5) = -2.655$, $p < 0.045$, and the superior fronto-occipital fasciculus left (RD), $t(5) = -2.529$, $p < 0.05$.

DISCUSSION

+ CCG, GCC, Fornix, and Higher-level Cognition

The cingulum plays a major role in working memory, attention, and executive functions (Kantarci et al., 2011; Bubb et al., 2018).

The GCC have been found to predict executive function test performance and found to be responsible for short-term memory binding impairments (Zahr et al., 2009).

Fornix plays a crucial role in the encoding, consolidation, and recall of declarative and episodic memory, and damage to the fornix leads to significant executive dysfunction (Thomas et al., 2011).

+ Changes in MD and RD, and Alzheimer's Disease

Decreases in MD and RD indicate heightened myelination and dense axonal packing; and increased myelination, respectively. Overall, showing greater cerebral white matter integrity and brain health.

The deafferentation through white matter in the cingulum may play a role in the progressive development of cognitive dysfunction in AD (Bozzali et al., 2012).

The corpus callosum are preferentially vulnerable to Aβ deposition, atrophy, and disruption of activity (Buckner et al., 2005, Scahill et al., 2002, Greicius et al., 2004).

The fornix may predict the conversion from mild cognitive impairment to AD (Benear et al., 2020).

+ BAT and Cognition

BAT may impact the transmission between cerebral hemispheres and subcortical structures (Figure 2), but it is worth noting that the present study observed increases in FA in regions related to verbal memory and that should be explored in future research.

CONCLUSION

+ Participating in RT is a promising lifestyle intervention that has the potential to shape one's cortical structure to ensure brain regions related to higher-level cognitive function are healthy, which are often damaged in AD.

Acknowledgments: Thank you to Dr. Nagamatsu, Dr. Furlano, and Dr. Witt for providing me the support and knowledge in bringing this to fruition. **Funding** for this study provided by Western University; Funding for R. Lien provided by the Western Institute for Neuroscience (WIN).