Resting-state fMRI Changes Following A Six Month Aerobic Training Intervention Among Healthy Older Adults

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Background: The neuroprotective effects of aerobic exercise are well known from the animal literature. Evidence from cross-sectional studies in humans confirms there is a positive link between cardiovascular fitness and cognitive health. However, the results from human intervention studies have yielded less consistent results. In order to investigate the putative neurophysiological mechanisms mediating the effects of exercise on preserving brain health and cognition in older adults, we collected multimodal brain imaging data and made a comprehensive cognitive assessment before and after a physical exercise intervention.

Methods: Sixty healthy older adults (64-78y) completed a randomized physical activity intervention, contrasting aerobic exercise with an active control group where the subjects made balance, stretching, and resistance exercises. Training was performed in groups, three days a week, 30-60 minutes per session, for six months. Multimodal brain imaging data was acquired at baseline and at follow-up. This included 10 min of resting state fMRI, structural MR, ASL-fMRI, and [11C]raclopride and [O15] PET. Additionally, a comprehensive battery of cognitive tasks assessing working memory, processing speed, episodic memory, task shifting, updating, and reasoning was administered. For resting state fMRI analysis, seed regions are to be defined based on longitudinal changes in ASL-fMRI and grey matter density. For graph-theoretical analyses, we will also employ a set of functionally significant seed regions covering the whole brain (Power et al, 2011), in an attempt to relate global network changes in connectivity with changes in aerobic fitness.

Results: Both groups improved their aerobic fitness (peak VO2), but importantly, there was a significant group by time interaction favoring the aerobic exercise group. Initial longitudinal whole brain analysis of cerebral blood flow and grey matter densities (VBM) did not reveal significant group differences. However, ROI based analyses indicated a positive relationship between changes in gray matter volume of hippocampus and changes in peak VO2, rendering hippocampus a central role in further resting state connectivity analysis.

Conclusions: The aim of current study is to probe the neurophysiological processes mediating the effects of physical exercise on the brain, with a particular focus on resting-state connectivity. Complementary results from other imaging modalities, e.g. indicating hippocampal changes, will enable a richer resting-state characterization of the effects of aerobic exercise on the functional connectome.