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SUPRAMAXIMAL HIGH-INTENSITY INTERVAL TRAINING FOR OLDER ADULTS

MOTIVATION, APPLICABILITY, PHYSIOLOGICAL AND COGNITIVE EFFECTS

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Akademisk avhandling

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Abstract
Background: Regular physical exercise can counteract age-related physiological and cognitive decline, lower disease risk, and improve well-being. Still, many older adults remain insufficiently active. Supramaximal high-intensity interval training (HIT) is a time-efficient and appealing alternative to longer moderate-intensity training (MIT). Research indicates promising effects from supramaximal HIT also for older adults, but interpretation of these results is limited to a few small studies, highlighting a need for large, high-quality randomized controlled trials (RCT). The aims of this thesis were to investigate motivational aspects of physical exercise, and controlled supramaximal HIT in particular; and to examine the applicability and effects of controlled supramaximal HIT in comparison to aerobic MIT, among non-exercising older adults.
Methods: This thesis include four research papers, totaling 117 participants (ages 64-79, 56% women). *Paper I* used cross-sectional data to explore a neurobiological link between dopamine and exercise-related motivation. *Papers II-IV* used data from the Umeå HIT Study, an RCT, to assess the applicability and effects of 3 months of twice-weekly controlled supramaximal HIT (10×6-sec intervals, 20 min in total) compared to MIT (3×8-min intervals, 40 min in total), on stationary bicycles in a group setting. All Umeå HIT study participants received medical clearance prior to training. *Paper II* described the applicability of controlled supramaximal HIT and its effect on exercise motivation. *Paper III* examined its effects on physiological and cognitive functions, such as cardiorespiratory fitness (CRF) and global cognitive function. *Paper IV* used structural and functional magnetic resonance imaging data to investigate effects on the hippocampus.
Results: *Paper I* found a positive association between self-reported exercise motivation and dopamine D2-receptor availability in the brain's frontal regions. *Paper II* demonstrated that non-exercising, but otherwise healthy older adults could engage in supramaximal training intensities without negatively impacting their physical or mental well-being or exercise motivation. No serious adverse events occurred. Notably, the participants performing supramaximal HIT reported more positive and fewer negative exercise-related events than the participants performing MIT. *Paper III* found that three months of controlled supramaximal HIT produced similar and additional effects compared to MIT despite half the total training time. Both groups improved CRF and cardiovascular function, and supramaximal HIT also improved muscle strength. While neither group showed changes in global cognitive function, there was a potential improvement in working memory favoring supramaximal HIT, and mixed episodic memory effects. *Paper IV* found associations between changes in CRF and hippocampus function for CA4/DG during pattern completion, which in turn was associated with episodic memory pattern completion performance.
Conclusion: This thesis supports controlled supramaximal HIT as an effective and appealing training method for older adults. While the relationship between motivation, dopamine, and aging needs further investigation, it was noted that controlled supramaximal HIT did not negatively impact motivation, contrary to previous concerns. Controlled supramaximal HIT is a valuable addition to existing exercise programs for older adults, as tailored and individualized training may promote physical exercise for health and well-being. The cognitive effects of supramaximal HIT were mixed; future studies should aim for longer interventions and more pronounced physiological changes. Additionally, research should explore the application of controlled supramaximal HIT in broader populations including those with chronic conditions and disease, and investigate how it can be implemented in everyday settings.

Keywords
Aging, Episodic Memory, Feasibility, HIT, fMRI, Self-Determination-Theory

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