

Acute Effects of High Intensity Exercise on Dual-Tasking Efficiency in Older Adults: A Theory Report



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Theory

Acute bouts of high-intensity aerobic exercise (HIAE) cause neuroplastic changes in the brain to improve dual-tasking efficiencies (DTE) in older adults.

Phenomenon

DTE refers to efficient performance of 2 or more tasks simultaneously. Most activities of daily living (ADLs) are dual-tasking activities requiring concurrent performance of physical and mental tasks, for example, conversing-while-ambulating. Efficient dual-tasking requires high levels of physical (strength, balance, motor coordination) and cognitive processing abilities (working memory, attention, planning, mental flexibility, inhibitory control – all part of executive functions). However it is well documented that there are both physical and cognitive impairments associated with normal aging, which can decrease DTE. The proposed theory could explain any potential effects of single bouts of HIAE on improving DTE in older adults.

Purpose

Improvement in understanding of the effects of acute bouts of HIAE on DTE in older adults.

Evidence

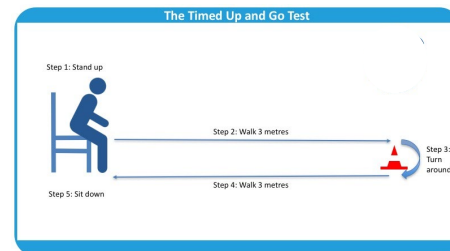
DTE declines with aging, and is associated with multiple brain changes.^{1,2} Structural changes of the brain include general loss of mass and atrophy of frontal cortex grey matter, where executive function and working memory processes are known to occur⁵.

Additionally, processing speeds and the ability to handle multiple processes simultaneously are thought to be affected due to decreased central neurons and synaptic connections⁵. Evidence suggests that increased executive function abilities are associated with better DTE³, therefore loss of executive function skills due to age-related changes of the brain could limit DTE in older adults.

Single bouts of exercise have demonstrated acute improvements in cognition function domains related to DTE, notably memory and planning^{4,5,6,7}. Acute bouts of high-intensity exercise have been shown to improve the brain's information-processing speeds, which might not be possible with lower intensities⁷. Physiological mechanisms thought to contribute to exercise-induced cognitive improvements include increased levels of cerebral blood flow, oxygen delivery, neuromodulators and brain-derived neurotrophic factor (BDNF)⁷, which may promote neurogenesis^{1,4} and neuroplasticity.^{6,7} There is also a reported relationship between increased serum BDNF and aerobic training^{4,6,7}.

DTE in older adults can be assessed using dual-task tests, for e.g., the cognitive timed up and go (CogTUG). CogTUG requires concurrent performance of a physical (TUG) and a cognitive task (backward counting of numbers by 3s or 7s).

If single bouts of HIAE can directly improve DTE, it could have practical implications in helping older adults remain efficient with ADLs and recreational activities.



Testable Hypothesis

A single bout of age-adjusted high-intensity treadmill running will improve performance in the CogTUG in older adults. The Cog-TUG requires backwards counting of numbers by 3s or 7s while completing the TUG as fast as possible. DTE could be measured by recording accurately spoken numbers and the TUG completion time, as pre- and post-tests.

Importance

Timely and accurate accomplishment of ADLs is important for older adults' health and wellbeing. Since ADLs are dual-tasking activities, it would be clinically useful to know if HIAE has any immediate benefits on DTE in older adults. If so, it would be beneficial to recommend short sessions of HIAE for its immediate DTE benefits, even if the older adults do not engage in regular exercise training for extended periods.

References

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