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Cerebral Pulsatility Mediates the Link Between Physical Activity and Executive Functions in Older Adults with Cardiovascular Risk Factors: A Longitudinal NIRS Study

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Abstract : A chronically higher cerebral pulsatility is thought to damage cerebral microcirculation, leading to cognitive decline in older adults. Although it is widely known that regular physical activity is linked to improvement in some cognitive domains, including executive functions, the mediating role of cerebral pulsatility on this link remains to be elucidated. This study assessed the impact of 6 months of regular physical activity upon changes in an optical index of cerebral pulsatility and the role of physical activity for the improvement of executive functions. 27 older adults (aged 57-79, 66.7% women) with cardiovascular risk factors (CVRF) were enrolled in the study. The participants completed the behavioral Stroop test, which was extracted from the Delis-Kaplan executive functions system battery at baseline (T0) and after 6 months (T6) of physical activity. Near-infrared spectroscopy (NIRS) was applied for an innovative approach to indexing cerebral pulsatility in the brain microcirculation at T0 and T6. The participants were at standing rest while a NIRS device recorded hemodynamics data from frontal and motor cortex subregions at T0 and T6. The cerebral pulsatility index of interest was cerebral pulse amplitude, which was extracted from the pulsatile component of NIRS data. Our data indicated that 6 months of physical activity was associated with a reduction in the response time for the executive functions, including inhibition (T0: 56.33± 18.2 to T6: 53.33± 15.7,p= 0.038)and Switching(T0: 63.05± 5.68 to T6: 57.96 ±7.19,p< 0.001) conditions of the Stroop test. Also, physical activity was associated with a reduction in cerebral pulse amplitude (T0: 0.62± 0.05 to T6: 0.55± 0.08, p < 0.001). Notably, cerebral pulse amplitude was a significant mediator of the link between physical activity and response to the Stroop test for both inhibition (β=0.33 (0.61,0.23),p< 0.05)and switching (β=0.42 (0.69,0.11),p <0.01) conditions. This study suggests that regular physical activity may support cognitive functions through the improvement of cerebral pulsatility in older adults with CVRF.

Keywords : near-infrared spectroscopy, cerebral pulsatility, physical activity, cardiovascular risk factors, executive functions
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