

高強度運動時に認知機能の低下が起こるのはなぜか —脳血流と脳酸素動態からの検証—

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The Effect of Intense Exercise on Cognitive Function: Focus on Influencing by Cerebral Blood Flow and Oxygenation

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ABSTRACT

Cognitive function seems to decline during intense exercise. Concurrently, intense exercise decreases cerebral blood flow and cerebral oxygenation. Given that brain neuronal activity needs adequate oxygen delivery, decrease in cerebral blood flow and cerebral oxygenation may be associated with decline in cognitive function during intense exercise. The purpose of this study was to determine whether decrease in cerebral blood flow and cerebral oxygenation is associated with decline in cognitive function during intense exercise. Fifteen subjects (Age: 23.3 ± 1.8 yr, Height: 1.70

± 0.06 m, Weight: 64.4 ± 5.8 kg, BMI: 22.5 ± 1.9 m²/kg, peak oxygen uptake (peak $\dot{V}O_2$) : 47.3 ± 6.4 ml/min/kg) performed cognitive tasks at rest and during exercise on the cycle ergometer. Exercise intensities corresponded to 50% (moderate) and 80% (intense) of peak $\dot{V}O_2$, and exercise duration were 7 min, respectively. The cognitive tasks consisted of Spatial Delayed Response task and GO/NOGO task, which required working memory and executive function. Cognitive function was evaluated by accuracy rate and reaction time of the tasks. Middle cerebral artery mean velocity (MCA V_{mean}) and cerebral oxygenation were monitored continuously. Cerebral oxygenation was recorded by near infrared spectroscopy and was expressed as changes from baseline. Intense exercise significantly impaired accuracy of the cognitive task as compared with rest and moderate exercise (rest: $P < 0.05$, moderate $P < 0.01$). In contrast, reaction time in the cognitive task was not changed during intense exercise ($P = 0.31$). MCA V_{mean} significantly increased during moderate exercise compared with rest ($P < 0.01$). However, it significantly decreased during intense exercise compared with moderate exercise ($P < 0.01$). Cerebral oxygenation tended to decrease during intense exercise relative to rest ($P = 0.058$). These findings suggested that decreased in cerebral blood flow and cerebral oxygenation during intense exercise may be, least in part, associated with impairment in cognitive function.

要 旨

高強度運動時の認知機能の低下に関わる要因として、脳血流と脳酸素飽和度が関与している可能性がある。本研究では、15名の健常成人男性（年齢： 23.3 ± 1.8 歳，身長： 1.70 ± 0.06 m，体重： 64.4 ± 5.8 kg，最高酸素摂取量： 47.3 ± 6.4 ml/kg/min）を対象に、中強度及び高強度の運動中に認知課題を実施し、同時に中大脳動脈血流速度と前頭前野の脳酸素飽和度の測定を行い、高強度運動時の認知機能の低下と脳血流及び脳酸素飽和度の変化との関係性を明らかにすることを目的とした。

高強度運動時には、安静時及び中強度運動時と比較して認知課題の正解率は有意な低下が認められた（安静時： $P < 0.05$ ，中強度運動時： $P < 0.01$ ）。一方で反応時間に有意な差は認められな

かった（ $P = 0.31$ ）。脳血流速度は安静時と比較して中強度運動時に増加し（ $P < 0.01$ ）、高強度運動時では中強度運動時と比較して有意な低下がみられた（ $P < 0.01$ ）。脳酸素飽和度は安静時と比較して高強度運動時に低下する傾向が認められた（ $P = 0.058$ ）。従って、高強度運動時の脳血流や脳酸素飽和度の低下は、認知機能の低下に関与している可能性が示唆された。