

なぜ運動による覚醒レベルの上昇は 認知パフォーマンスを高めるのか？

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Why does Exercise-Induced Increase in Arousal Level Improve Cognitive Performance?

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ABSTRACT

A large number of studies have shown that acute exercise improves cognitive performance. Increase in arousal level has been suggested to be associated with cognitive improvement induced by acute exercise. However, it is still unclear which parts of the brain are responsible for increase in arousal level. The first purpose of this study was to clarify the brain areas involved in the increase in arousal level after acute exercise. The second purpose was to test if the increase in arousal level is associated with altered functional connectivity with the brain areas. Eighteen young male participants were recruited in the experiment. Experiments were performed on two separate days in a randomized crossover design. In the Exercise condition, the participants cycled an ergometer at 40% peak oxygen uptake for 30 minutes. In the Control condition, the participants rested for 30 minutes without exercise. They performed cognitive tasks before and after acute exercise or resting period, and fMRI images were acquired during the cognitive task. Cognitive task was a Go/No-Go task that requires executive function. Cognitive performance was assessed by reaction time and response accuracy. After exercise, arousal level increased and cognitive performance improved. The increase in arousal level was associated with increased activations of the left middle frontal gyrus, the right frontal pole, and the right dorsal

anterior cingulate cortex. The increased activations were accompanied by increase in functional connectivity among these areas. These results suggest that the increase in arousal level is associated with the activations of the prefrontal cortex, the frontal pole, and the cingulate cortex. The present results also suggest that neural network of these brain areas appears to contribute to cognitive improvement induced by acute exercise.

要 旨

本研究の目的は、運動による覚醒レベルの上昇が認知パフォーマンスを向上させるメカニズム解明のために、運動による覚醒レベルの向上に関わる脳領域を同定すること、脳領域間の機能的結合の変化が覚醒レベルの変化に関与するかを明らかにすることであった。18名の実験参加者は、最高酸素摂取量の40%の運動強度での運動前後、および安静の前後に認知課題を行い、fMRIを用いて脳活動を撮像した。運動後に覚醒レベルは上昇し、認知パフォーマンスは向上した。運動による覚醒レベルの変化は、準備刺激に対する左下前頭回、右前頭極、および右背側帯状回皮質の活動増加と関係がみられた。さらに、覚醒レベルの変化は、これらの領域間での機能的結合の増加を伴っていた。本研究から、運動による覚醒レベルの上昇には、前頭前野、前頭極、帯状回皮質の領域間の神経ネットワークが関与し、この領域間のネットワークが高まることが認知パフォーマンスの向上に貢献することが示唆された。