運動の快眠促進効果の解明：
運動と睡眠の質をつなぐ新たな解析指標

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Exploring The Effect of Exercise to Promote Quality of Sleep: Insights from Exercise and Quality of Sleep on The New Analytical Method

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ABSTRACT

Exercise is believed to improve sleep, i.e., it reduces sleep latency and increases slow wave sleep. However, there are studies reporting contrary to this consensus that exercise had an adverse effect on sleep architecture. Therefore, discrepancies in the effects of exercise on sleep architecture remain to be explained. We enrolled 9 healthy young males （mean ± SEM: 23.8 ± 2.1 years）in a cross-over intervention study, assessed by core body temperature and indirect calorimetry, and on sleep quality during subsequent sleep, assessed by quality of sleep polysomnography. Subjects exercised at 60 % of $\dot{V}O_{2max}$ for 60 min beginning at 6 hours before bedtime using a treadmill or remained seated. Exercise increased the energy expenditure throughout the following sleep phase 5 h later. The objective measurements, based on polysomnographic recordings revealed that exercise trial shortens slow wave sleep time and REM sleep latency （~28 min）. Average δ power in N3 is shifted toward higher δ power in the

trial with exercise compared to controls trial. In addition, The coefficient of variation of the envelope values were significantly lower than control trial. Although, traditional objective such as duration of sleep stages consequences in exercise trial were not enhanced. Detailed analysis of the sleep electro-encephalogram showed significantly increased delta（0.5-4 Hz）power in SWS（N3）together with increased SWS stability based on the coefficient of variation of the envelope of delta waves in early sleep phases. Vigorous exercise performed at 6 hours before bedtime might impair subjective sleep quality

要　旨

運動後は睡眠が改善すると考えられ，入眠潜時短縮や徐波睡眠を増加が見られる．しかし，運動が睡眠構築に良い影響を与えるという見解に反する報告もある．このように運動が睡眠構築に与える影響の不一致はまだ解明されていない．運動が睡眠に及ぼす影響について，9名の健康な若い男性（平均 ± SEM：23.8 ± 2.1歳）で就寝6時間前からトレッドミルを使用した60分間の運動（$\dot{V}O_{2max}$の60％）と座位安静を行う試行のクロスオーバー試験を行った．睡眠は睡眠ポリグラフ検査によって評価し，併せて深部体温と間接熱量測定を行った．運動後の睡眠時エネルギー消費量は増加した．運動により深睡眠時間とレム睡眠潜時（約28分）が短縮され，睡眠前半30分のδパワーは，運動試行がコントロール試行と比べて高い値を示した．さらに，envelope 分析により，睡眠前半において深睡眠の安定性が高くなることが示唆された．各睡眠ステージの時間を計測する従来からの睡眠構築についての解析方法からは運動が睡眠に好影響を及ぼす効果は検出できなかったが，δ波のenvelope 分析では，SWSのデルタ（0.5-4 Hz）パワーの大幅な増加とSWSの安定性の増加が示された．