

RESEARCH ARTICLE

The Effects of Physical Exercise on Spatial Learning and Serotonin Levels in the Brain of Adult Rats

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Abstract

Physical exercise can enhance tryptophan transport into the brain so that it will also increase serotonin levels in the brain. Therefore, it may influence many brain functions, such as learning and memory. This study aimed to determine the effect of physical exercise on spatial learning and serotonin levels in the brain of adult male Wistar rats. Biochemistry Laboratory of Department of Biochemistry & Molecular Biology, Faculty of Medicine, Universitas Indonesia was the study place which conducted in January–April 2013. Sixteen adult male rats randomly divided into two groups, the control group, and the treatment group. Physical exercise for the treatment group for four weeks using the animal treadmill at 15 m/min in speed for 15 minutes in the 1st week and 25 minutes for the next three weeks. Learning and memory test using water-E maze apparatus once a week. At the end of the exercised period, animals were sacrificed, and the brains were isolated. The measurement of serotonin and tryptophan levels was done using high-performance liquid chromatography (HPLC). The results showed that physical exercise improved animals performance in learning and memory test, exercised group made fewer errors at third and fourth week ($p < 0.05$). Serotonin levels in the brain of exercised group was significantly higher than that in control group ($p < 0.05$). These results indicated that the enhancement of serotonin levels in the brain induced by physical exercise is involved in improving spatial learning and memory.

Keywords: Brain, learning and memory, physical exercise, serotonin

Pengaruh Latihan Fisik terhadap Kemampuan Belajar Spasial dan Kadar Serotonin pada Otak Tikus Dewasa

Abstrak

Latihan fisik diketahui dapat meningkatkan transpor triptofan melewati sawar otak sehingga dapat meningkatkan kadar serotonin di otak. Oleh karena itu, latihan fisik berperan memengaruhi berbagai fungsi otak termasuk proses belajar dan memori. Penelitian ini bertujuan mengetahui pengaruh latihan fisik aerobik dengan intensitas yang ringan terhadap kemampuan belajar spasial serta kadar serotonin pada otak tikus Wistar dewasa. Penelitian ini dilakukan di Laboratorium Biokimia, Departemen Biokimia & Biologi Molekuler, Fakultas Kedokteran, Universitas Indonesia, Jakarta periode Januari–April 2013. Enam belas ekor tikus jantan dewasa dibagi secara acak menjadi dua kelompok, yaitu kelompok kontrol dan kelompok perlakuan. Latihan fisik diberikan kepada kelompok perlakuan selama 4 minggu menggunakan *animal treadmill* dengan kecepatan 15 m/menit selama 15 menit pada minggu pertama dan 25 menit pada 3 minggu berikutnya. Uji belajar dan memori dengan perangkat *water-E maze* dilakukan satu kali/minggu. Setelah masa latihan fisik selesai, hewan coba dikorbankan dan jaringan otak diisolasi. Pengukuran kadar serotonin dan triptofan pada otak dilakukan menggunakan kromatografi cair kinerja tinggi (KCKT). Hasil penelitian menunjukkan bahwa jumlah kesalahan yang dilakukan oleh kelompok perlakuan lebih sedikit secara signifikan pada uji belajar dan memori ke-3 dan ke-4 ($p < 0,05$). Kadar serotonin lebih tinggi secara signifikan pada otak kelompok perlakuan ($p < 0,05$). Hasil penelitian ini mengindikasikan bahwa peningkatan kadar serotonin pada otak yang diinduksi oleh latihan fisik aerobik intensitas ringan terlibat dalam meningkatkan kemampuan belajar dan memori spasial.

Kata kunci: Belajar dan memori, latihan fisik, otak, serotonin

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