Theoretical Biology and Medical Modelling

BioMed Central

Research

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Moderate exercise and chronic stress produce counteractive effects on different areas of the brain by acting through various neurotransmitter receptor subtypes: A hypothesis

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Published: 23 September 2006

Theoretical Biology and Medical Modelling 2006, **3**:33 doi:10.1186/1742-4682-3-33

Received: 13 July 2006
Accepted: 23 September 2006

This article is available from: http://www.tbiomed.com/content/3/1/33

Abstract

Background: Regular, "moderate", physical exercise is an established non-pharmacological form of treatment for depressive disorders. Brain lateralization has a significant role in the progress of depression. External stimuli such as various stressors or exercise influence the higher functions of the brain (cognition and affect). These effects often do not follow a linear course. Therefore, nonlinear dynamics seem best suited for modeling many of the phenomena, and putative global pathways in the brain, attributable to such external influences.

Hypothesis: The general hypothesis presented here considers only the nonlinear aspects of the effects produced by "moderate" exercise and "chronic" stressors, but does not preclude the possibility of linear responses. In reality, both linear and nonlinear mechanisms may be involved in the final outcomes. The well-known neurotransmitters serotonin (5-HT), dopamine (D) and norepinephrine (NE) all have various receptor subtypes. The article hypothesizes that 'Stress' increases the activity/concentration of some particular subtypes of receptors (designated nt_s) for each of the known (and unknown) neurotransmitters in the right anterior (RA) and left posterior (LP) regions (cortical and subcortical) of the brain, and has the converse effects on a different set of receptor subtypes (designated nt_h). In contrast, 'Exercise' increases nt_h activity/concentration and/or reduces nt_s activity/concentration in the LA and RP areas of the brain. These effects may be initiated by the activation of Brain Derived Neurotrophic Factor (BDNF) (among others) in exercise and its suppression in stress.

Conclusion: On the basis of this hypothesis, a better understanding of brain neurodynamics might be achieved by considering the oscillations caused by single neurotransmitters acting on their different receptor subtypes, and the temporal pattern of recruitment of these subtypes. Further, appropriately designed and planned experiments will not only corroborate such theoretical models, but also shed more light on the underlying brain dynamics.

Background

Regular, "moderate", physical exercise is a non-pharmacological form of adjunctive treatment for depressive disorders. External stimuli such as various stressors or exercise