

Neuroscience of Exercise: Association Among Neurobiological Mechanisms and Mental Health

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Abstract: Neuroscience is an emergent research field that comprises many multidisciplinary investigations, searches for explanations about the relationship between the body and the brain. Here, we will give a little summary of this field showing the main current findings. We discuss the lack of consistent data about the relationship among exercise for neurodegenerative diseases and psychiatric disorders, sports performance and rehabilitation, and therefore, the difficult to describe cause-effect associations or to describe in detail the neurobiological mechanisms underlying these associations.

Keywords: Neuroscience of exercise, neurobiological mechanisms, mental health, neurotransmitters, neurotrophins.

INTRODUCTION

The effects of exercise on physical and mental health have been discussed for centuries. Seneca, a Roman philosopher and dramatist, recommended physical exercise in his writings to reach both healthy mind and body [1]. Within this context, neuroscience, an emergent research field that comprises many multidisciplinary investigations, searches for explanations about the relationship between the body and the brain [2].

This relationship began to be investigated nearly 8 decades ago, with studies correlating predominantly the effects of substances, such as ammonia, on brain functions and fatigue [1, 3]. The human brain is able to reorganize itself through different types of stimuli, which may lead to changes in functional and structural properties, a process known as neuroplasticity. In line with this, human [4, 5] and animal studies [3] show that exercise promotes brain alterations, acting as a facilitator agent of neuroplasticity, and these studies suggest an association among volume and intensity of exercise with enhancement of neurogenesis, synaptogenesis, angiogenesis, and biomarkers levels. In addition, according to these studies, cognitive and motor skills have been correlated to these processes in health and neuropsychiatric disorders.

These types of investigation have received attention from scientist, since exercise demonstrated to promote potential mental health benefits for certain neurodegenerative and psychiatric disorders, and sports and rehabilitation sciences applications [4, 6].

Studies investigating the efficacy of exercise on treatment and/or prevention of neurodegenerative and psychiatric disorders are crucial, mainly due to the increase in the elderly population and the prevalence of neurodegenerative and psychiatric disorders [2, 7]. Thus, the rise in the incidence of neurodegenerative and psychiatric disorders, such as Alzheimer's disease [8], Parkinson's disease [9], depression and anxiety disorders [7] has generated considerable concern from the medical community. Therefore, there is a necessity to further investigation focusing new treatments for mental health. Even though the pharmacological treatments are the gold standard treatments for neurodegenerative and psychiatric disorders, adverse effects are likely to occur [10]. Consequently, exercise reduces the costs with medications and hospitalizations and improves the quality of life of the patients. In a recent meta-analysis, Budde *et al.* [7] showed a small effect of exercise for anxiety and a moderate effect of exercise for depression. In this sense, exercise can be considered a supplementary treatment for neurodegenerative and psychiatric disorders. The main neurobiological explanation thought for these improvements is an increased level of neurotransmitters and neurotrophins, which are theoretically responsible for neurogenesis, angiogenesis and neuroplasticity processes [2, 7].

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However, further evidence concerning the neurobiological mechanisms underlying exercise for clinical samples is needed. Although several studies suggest that exercise is responsible for positive effects on mental health and cognition, these findings are dependent on the regular practice of exercise [11]. Due to high rates of sedentary lifestyle around the world, individuals fail to take advantage of the benefits generated by the practice of exercises [12]. In this perspective, Williams *et al.* [13] demonstrated that the affective response to acute exercise training is closely related to the adherence by cognitive (i.e., autonomy and self-perceived efficacy) and interoceptive (i.e., lactate accumulation and blood pH) pathways. Thus, taking into account the influence of acute affective response of exercise on adherence, further studies are needed. Although the regular practice of exercise seems to promote benefits for mental health, its excess can provoke adverse effects, such as overtraining [14]. Other factors may also affect athletic performance such as stress, anxiety and others, thus contributing to an increased prevalence of psychiatric disorders among elite athletes [15].

During the last twenty years, many epidemiological and experimental studies were conducted, demonstrating that exercise could be a potential preventive and non-pharmacological therapy for cognitive decline in elderly people. Moreover, results from cross-sectional, prospective and retrospective epidemiological investigations have supported positive associations concerning the cognitive activity of elderly people with exercise [16, 17]. Nevertheless, other studies failed to detect such an association [18-21]. In this sense, numerous explanations that can elucidate such scattered exceptions comprising the use of self-report against more objectively measured physical exercise; the complications to assess the influence of social, intellectual and physical factors on different activities of daily living; the failure to discriminate among different types of exercise.

Concluding, consistent data about the relationship between the practice of exercise and mental health, or more specifically among exercise for neurodegenerative diseases and psychiatric disorders, sports performance and rehabilitation are still scarce; hence, currently, it is difficult to describe cause-effect associations or to describe in detail the neurobiological mechanisms underlying these associations.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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