

The Effect of Martial Arts on the Production of Mood Regulating Neurotransmitters: Point of View

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Abstract

Due to the increasing number of people with anxiety and depression, pharmacological and alternative mechanisms become increasingly important forms of treatment. From the physiological point of view, it is characterized as the low production of serotonin, norepinephrine and dopamine in the brain. The mechanisms for increasing these neurotransmitters have been gaining attention in the medical literature. The antidepressant drugs available on the market seek to address the dysregulation of these neurotransmitters. It is known that physical exercise has the non-pharmacological effect of increasing these neurotransmitters, especially aerobic exercise. However, it has rarely been discussed in the literature regarding the effect of martial arts on the production of serotonin, dopamine, and norepinephrine. Two studies were found to analyze serotonin with tai chi chuan and taekwondo (both oriental martial arts). Regarding dopamine, only one study involving taekwondo was found (in which no increase in dopamine levels was observed). Concomitantly, no studies were found analyzing norepinephrine. In this sense, future studies with this theme are necessary in order to bring information that may help medical professionals, psychologists, martial arts teachers and mainly, the carriers of anxiety and depression.

Keywords: neuroscience; sport psychology; combat sports; psychiatry

Introduction

Psychological illnesses such as anxiety and depression have increased in recent years [1]. From a physiological point of view, these are abnormalities in the neurotransmitters: serotonin, dopamine and norepinephrine [2]. It is also associated with impaired neurodegeneration, neuronal plasticity and neurogenesis [3]. Antidepressant drugs seek to increase the production of these neurotransmitters as well as inhibiting the expression of the enzyme monoamine oxidase [3].

In a recent review it was found that regular physical exercise (predominantly aerobic, anaerobic and/or mixed) can be a way to increase these mood-regulating neurotransmitters and consequently decrease anxiety and depression [1]. As well, martial arts being one of the manifestations of physical exercise [4]. With high-intensity intermittent characteristics [5] and has an important contribution of the ATP-Cp, glycolytic and oxidative systems [6].

Having several Olympic disciplines: judo, taekwondo, boxing, fencing, wrestlers and karate [7] and non-

Olympic: Brazilian jiu-jitsu, muay thai, and mixed martial arts [5]. There are various styles such as striking/kicking (e.g. taekwondo, boxing, kickboxing, karate and kung-fu); grappling/throwing styles (e.g. wrestling, judo, Brazilian jiu-jitsu and aikido) or combined strike and grappling hybrid styles (e.g. mixed martial arts [MMA]) [8] and some modalities may have the use of weapons (for example: fencing and kendo) [8].

The different martial arts are known and practiced worldwide [9]. Being sought after for health, self-defense and/or sports purposes [10] and can be practiced by children, teenagers, adults and seniors [11]. In the health context, studies show cardiovascular [12], and psychological [13] benefits, positive effect on bones [12], brain [14], and quality of life [15,16], among others. A recent review also showed the importance of martial arts practice for the physical and mental conditioning of police officers [17].

In view of the worldwide concern with anxiety and depression, this article will bring the evidence and discussions about the effects of martial arts on the

production of mood regulating neurotransmitters (serotonin, dopamine and norepinephrine) based on the studies available in the literature. Understanding these mechanisms will benefit medical professionals, psychologists, martial arts teachers, and especially people with anxiety and depression.

The production of serotonin, dopamine and norepinephrine

This subchapter will discuss the physiological mechanisms of the production of mood-regulating neurotransmitters. In this sense, genes encode proteins involved in the metabolism of neurotransmitters [18]. Additionally, every protein is encoded in specific genes and located in the cell nucleus then to be translated in the cytoplasm and exert its function in the cell. For this, the production of neurotransmitters depends on signaling, and to be transported via synapse a specific receptor in the postsynaptic neuron is required. [19]. Serotonin, dopamine and norepinephrine have several genes [18,20,21] to affect them. In this sense, by studying the physiology of psychopathologies one can create new methods of prevention and drug and alternative treatments.

Another important aspect are the genetic predisposition factors for the development of anxiety and depression [22]. However, it has a multifactorial cause, such as having several people in the family with a strong preexisting factor that interferes with the development of anxiety and depression (genetic factors) [23]. Also, environmental factors such as (loneliness, divorce, death of a close person, abandonment), are as strong as how people manage these factors [23].

From the neurotransmitter production point of view, serotonin is produced both in the brain and in the gut [24], with the majority (95%) residing in the intestine [25]. Specifically, glucose and fatty acids stimulate the release of serotonin from the duodenum [24]. The essential amino acid tryptophan is the main precursor for the production of serotonin [26]. This amino acid is not produced in the body, so it is necessary to obtain it through dietary sources such as: bananas, pumpkin seeds, soybeans, chickpeas, dried dates, peanuts, milk, meat, fish, turkey, and protein-rich foods [27].

Dopamine is produced in the brain from the conversion of L-DOPA in nerve terminals [28]. Being involved in various functions such as locomotor activities, emotions, affect, and neuroendocrine

secretion [29]. In this context, dopamine is directly linked to neurological diseases such as Alzheimer's and Parkinson's. [29], however, these neuro-pathologies are not the focus of this article. The neurotransmitter noradrenaline is produced by noradrenergic neurons and released from axon terminals spreading rapidly throughout the brain [30].

The effect of martial arts on the production of mood-regulating neurotransmitters

It is known that exercises such as running [31], intermittent high-intensity exercises [32], pilates [33] and strength training [34] appear to have a positive effect on mood-regulating neurotransmitters. Especially exercises with a predominance of oxidative energy [35]. Although there is speculation that the long run regular exercise can replace drugs, this hypothesis needs to be tested [1].

The collection of blood to analyze the production of serotonin, dopamine and noradrenaline in martial arts is still incipient. In the scientific literature, there were two articles carried out with taekwondo (serotonin and dopamine) [36] and tai chi (serotonin) [37]. No studies have been found with noradrenaline. The study with taekwondo, was conducted with 24 obese postmenopausal women [36]. They were divided into two groups: 1) experimental (n=12) and 2) control (n=12). The experimental group performed taekwondo training five times a week for 16 weeks, while the control group did not undergo intervention. About 8 ml of blood was collected before and immediately after the intervention in both groups in order to analyze serotonin and dopamine. As a result, the increase of serotonin level was found only in the experimental group ($p<0.05$).

In the other study conducted with tai chi chuan [37] the sample universe was composed of hospitalized alcoholics, divided into two groups (experimental n = 19 and control n = 19). Only the experimental group practiced 50 minutes of 24 tai chi chuan postures for 8 weeks. 5 ml of blood was collected before and immediately after the intervention in both groups in order to analyze serotonin in the blood. Questionnaires were also administered to analyze the level of anger, depression, and nicotine dependence. The authors found increased serotonin ($p<0.003$) and decreased markers of nicotine dependence ($p<0.001$) and anger ($p<0.001$) only in the experimental group. Depression was lower in both groups ($p<0.001$). Thus, this study demonstrates the importance of tai chi

chuan as a complementary therapy to combat anger, depression and nicotine dependence.

Final considerations

It is well known that martial arts (taekwondo and tai chi chuan) seem to increase the production of serotonin, which may have a positive impact on the mental health of their practitioners. However, this is an analysis that is still being developed in the scientific literature, with only two studies published on this topic. In this sense, future studies are necessary, analyzing different modalities and comparing them in order to bring physiological information regarding the benefits of martial arts on mental health. Once the studies of this nature are usually done in a less sophisticated way (application of questionnaires).

Only one study analyzed dopamine with taekwondo martial art (finding no positive result) and none with noradrenaline. Future studies are needed with fencing, wrestlers, Brazilian jiu-jitsu, sambo, muay thai, sumo, kung fu, boxing, savate, kickboxing, judo, and others. The information from this type of research can help psychiatrists, psychologists, martial arts teachers, and people with anxiety and depression. Both for the treatment and prevention of these psychopathologies that affect millions of people worldwide, and the expectation is that these numbers will increase.

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Cite this article: J.D.R.D.S Duarte, Elizeu A Barros, Babic M. (2023). The Effect of Martial Arts on the Production of Mood Regulating Neurotransmitters: Point of View. *Addiction Research and Behavioural Therapies*, BioRes Scientia Publishers. 2(2):1-4. DOI: 10.59657/2837-8032.brs.23.008

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Article History: Received: July 09, 2023 | Accepted: August 21, 2023 | Published: August 24, 2023