Chapter 9

Neurophysiological Benefits of Physical Exercise:
Insights for Physical Education

Diana Tavares
https://orcid.org/0000-0002-9883-3515
Escola Superior de Saúde, Politécnico do Porto, Portugal

Ana Lopes
Escola Superior de Saúde, Politécnico do Porto, Portugal

Catarina Castro
https://orcid.org/0000-0002-8970-6493
Escola Superior de Saúde, Politécnico do Porto, Portugal

Liliana Leite
Escola Superior de Saúde, Politécnico do Porto, Portugal

Mónica Quintas
https://orcid.org/0000-0002-2907-4308
Escola Superior de Saúde, Politécnico do Porto, Portugal

ABSTRACT

In the more classical teaching of Neurophysiology, there is an obvious focus on pathologies of the nervous system (in its different aspects: central, peripheral and autonomic).This chapter therefore seems to us to be a unique and pertinent moment for reflection, as it aims to systematise how the various specific areas of Neurophysiology can be related to physical exercise, thinking above all about what expertise can be

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transferred from one area of speciality to another, creating knowledge that can be applied in the future and, above all, increasing health literacy in these professionals. This chapter will cover the EEG, EMG, evoked potentials, sleep, and urodynamic.

INTRODUCTION

The World Health Organization (2022) defines physical activity as bodily movement produced by skeletal muscles requiring energy expenditure, thus referring to any activity, including leisure time, itinerary transport to work, or even intense physical activity improving health (DiPietro et al., 2020). Physical activity is a protective factor against different pathologies and health problems, and people who do not participate in physical activity are up to 30% more likely to die. Physical activity has numerous benefits on both physical and mental levels (DiPietro et al., 2020; Garcia, 2024; Troy et al., 2018). It helps prevent cardiovascular diseases such as hypertension, cancer (Watts et al., 2022), and diabetes (Gilbert et al., 2019) and helps to maintain and lose weight (Swift et al., 2014). Mentally, it reduces the symptoms of depression and anxiety for example (Kim et al., 2019).

The new WHO guidelines recommend at least 150–300 min of moderate or vigorous aerobic physical activity per week for all adults, including people living with chronic conditions or disability (World Health Organization, 2018). Although physical exercise, as already explained, has a multidimensional effect on the individual, in this chapter, we will focus on its neurophysiological and neuronal dimensions. When exploring the relationship between neurophysiology and physical exercise through an artificial intelligence repository of over 125 million academic documents, we find that the relationship is bidirectional. Physical exercise positively impacts the nervous system, affecting neuronal plasticity, cognitive functions, and mental health, while the brain can regulate physical performance. A systematic review by de Sousa Fernandes et al. (2020) found evidence that both aerobic exercise and resistance training positively affect neuroplasticity in animals and humans, enhancing cell signaling, neuronal growth, and cognitive functions.

Additionally, physical exercise benefits both physical and mental stress, enhances memory and learning, and may attenuate cognitive deficits and reduce the risk of dementia. It increases brain-derived neurotrophic factor (BDNF) associated with memory and learning and may influence synaptic proteins. Specifically, aerobic exercise appears to increase the expression of postsynaptic density protein 95 (PSD-95), phosphorylated N-methyl-D-aspartate receptor (pNMDA), and synapsin (SYN) in both healthy and hypertensive models. Regarding metabolic changes, literature indicates an increase in cyclic adenosine monophosphate-responsive element-binding protein (CREB) signaling, phosphorylation of alpha serine/threonine kinase (AKT),

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