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Cognitive and Physical Intervention in Metal Dysfunction and Neurodegeneration

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Introduction

Metals, particularly iron, copper, and manganese, are essential for brain function and development. Metal dysregulation homeostasis is linked to brain structure damage in the motor, cognitive, and emotional systems, leading to neurodegenerative processes. There is mounting evidence that specialised cognitive and motor exercises can improve brain function and slow neurodegeneration through mechanisms such as improving neuroplasticity by altering synaptic structure and function in many brain regions. As pharmacological treatments for movement, cognitive and emotional symptoms become more limited, psychological and physical methods of rehabilitation are becoming increasingly important. The current study describes physical and cognitive rehabilitation methods for patients with metal-induced neurotoxicity, such as Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis, Huntington's disease, and Wilson's disease [1].

Description

We describe physical and psychological methods that significantly improve the quality of life and independence of patients with storage diseases in our review. Storage diseases are a group of hereditary metabolic disorders characterised by an abnormal accumulation of storage material in cells. This topic is being discussed because rehabilitation is essential in the treatment of neurodegenerative diseases. Unfortunately, there are no specific guidelines for physiotherapy in neurodegenerative disorders, particularly in terms of exercise duration, type and intensity, and frequency. This is due in part to the variety of symptoms associated with these diseases, as well as the different stages of disease progression. This emphasises the importance of additional research [2].

Metals are essential trace elements in plants and animals. Unfortunately, excess metals can accumulate in various human organs, including the brain. Elevated metal levels have been linked to a variety of harmful intracellular processes, including oxidative stress, DNA fragmentation, mitochondrial dysfunction, endoplasmic reticulum stress, autophagy dysregulation, and apoptosis induction. These processes can disrupt neurotransmission, resulting in neurodegeneration with cognitive issues, movement disorders, and learning and memory dysfunction. Metal-induced neurotoxicity has been linked to a variety of neurological diseases, including Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis, autism spectrum disorders, Guillain-Barre syndrome, Huntington's disease, manganism, Gulf War syndrome, multiple sclerosis, and Wilson's disease, as well as neurodegeneration with brain iron accumulation.

The World Health Organisation defines rehabilitation as "a set of interventions designed to optimise functioning and reduce disability in individuals with health conditions in interaction with their environment." Neurological rehabilitation helps patients overcome movement and cognitive impairments, allowing them to return to more normal daily activities. Physical training and exercise can help to improve mental health, physical performance, and overall health. Virtual reality environments, robotic aides, and non-invasive brain stimulation can all be used to supplement training. All of these procedures should improve neuronal survival and plasticity. A growing body of evidence suggests that moderate-to-vigorous physical activity has numerous benefits for brain health and cognitive function [3].

Physical activity reduces the risk of dementia; it may be beneficial in mood disorders such as depression; it can reduce stress and anxiety; and it improves memory, attention, and learning, among other things. Copper and iron are essential trace elements for the human body because they act as cofactors of several enzymes and proteins and play a critical role in several biological functions such as respiration and oxidative damage protection; and in the central nervous system, functioning myelination, neurotransmitter synthesis, neuropeptide activation, and so on. Their dysmetabolism is associated with various toxic effects, primarily oxidative stress, and has been reported in many neurodegenerative disorders, including kinase-associated neurodegeneration, Wilson's disease, Menkes disease, AD, PD, and ALS [4,5].

Conclusion

It has been demonstrated that the use of preventive measures such as physical activity is critical in maintaining proper motor function and preventing impairments caused by mobility restrictions in patients suffering from various neurological conditions. Given the enormous potential effect that exercise could have on disease modification and general health improvement, there is an urgent need for more research to be conducted to further investigate these benefits. The most recent data available suggest that cognitive stimulation and cognitive training could promote independence and maintain quality of life in patients with Alzheimer's disease.

As a result, gathering prospective patient-centered outcome data may aid in documenting the positive impact of rehabilitation on activity limitations and participation restrictions, providing evidence for the importance of rehabilitation in neurodegenerative disorders. Future research should focus on large-scale trials of clinical effectiveness versus control-comparison intervention or cognitive training effectiveness versus other active or social interventions. It will be necessary to investigate whether any observed effects are generalizable to everyday functions and tasks of daily living. The literature on the subject is insufficient in terms of providing sufficient insights into the emotional treatment protocol in many neuropsychiatric disorders. Furthermore, future research should investigate whether the type, length, type of exercise, and frequency of intervention affect the efficacy results obtained. The requirement appears to be of particular importance.

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