



Cyprus
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Sciences

Doctoral Dissertation

**Gamma-Band Transcranial Magnetic
Stimulation in Rehabilitation of Amnesic Mild
Cognitive Impairment and Alzheimer's Disease**

Artemis G. Traikapi

Limassol, May 2023

CYPRUS UNIVERSITY OF TECHNOLOGY
FACULTY OF HEALTH SCIENCES
DEPARTMENT OF REHABILITATION SCIENCES

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Approval Form

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Abstract

Alzheimer's disease (AD) is a slowly progressive neurodegenerative disorder and the most common cause of dementia worldwide. Many pathogenic mechanisms and hypotheses have been proposed to explain AD pathology, and scientific knowledge has increased enormously over the last decades. However, to date, clinical trials targeting these mechanisms have not succeeded in identifying effective methods to treat or reverse the disease. AD pathogenesis has recently been explored from different perspectives, offering new insights into the potential treatments of AD. Among these, the investigation of gamma oscillations and their potential therapeutic role has signified a new and promising era in AD research.

The aim of this thesis was to combine the most recent scientific findings to develop a novel, gamma-band transcranial magnetic stimulation (TMS) protocol and investigate its efficacy in mitigating cognitive dysfunction in patients with amnesic mild cognitive impairment (MCI) and mild-to-moderate AD. On that basis the thesis is comprised by three main study pillars, being the neurophysiological, normative, and experimental.

Initially, a novel 40 Hz TMS protocol was developed and applied over the motor cortex of healthy participants. Its safety and aftereffects on cortical excitability were evaluated. The results indicated that stimulation was safe, tolerable, and generated a suppressive effect that outlasted the stimulation period. Then, the first standardized Cypriot word pool, a list of 2,850 words, was created and used for the development of alternative and equally difficult neuropsychological tools. Finally, a single-case, randomized, concurrent multiple baseline design across eight cases was employed. Patients received daily 40 Hz TMS treatment sessions for 2 weeks bilaterally to the precuneus. The analyses indicated a significant improvement in all patients' global cognition, while an identical profile of significant improvement was evident in patients' neuropsychiatric symptoms. In general, a wide effect on patients' cognitive function was observed accompanied by a significant improvement in their quality of life. This study offers preliminary evidence regarding the efficacy of gamma-band TMS as an effective and safe non-invasive technique in MCI and AD neurorehabilitation.

Keywords: Alzheimer's Disease, default mode network, episodic memory, transcranial magnetic stimulation, precuneus, 40 Hz gamma brain stimulation