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Repetitive transcranial magnetic stimulation (rTMS) for fatigue in Parkinson's disease: a pilot study

Submission date
29/09/2026

Recruitment status
No longer recruiting

Registration date
14/10/2026

Overall study status
Completed

Last Edited
14/10/2026

Condition category
Nervous System Diseases

[_] Prospectively registered
[_] Protocol
[X] Statistical analysis plan
[_] Results
[_] Individual participant data
[X] Record updated in last year

Plain English summary of protocol

Background and study aims
Parkinson’s disease can cause unusual tiredness during physical activity. This is sometimes called physical fatigability. It may be linked not only to the muscles, but also to how the brain controls movement.
This pilot study looked at recovery after tiring exercise in people with Parkinson’s disease and healthy people of a similar age. It also tested whether a non-invasive form of brain stimulation called intermittent theta-burst stimulation (iTBS) could help people recover after exercise. iTBS uses magnetic pulses to stimulate the part of the brain involved in controlling movement

Who can participate?
The study included people aged 40 to 75 years. People with Parkinson’s disease could take part if they had a confirmed diagnosis, had a stable positive response to Parkinson’s medication, and experienced fatigue related to their condition. Healthy volunteers of a similar age and sex could also take part if they did not have a medical condition or mental illness

What does the study involve?
A total of 20 people took part, including 10 people with Parkinson’s disease and 10 healthy volunteers. Each participant attended two study sessions, separated by 1 week
During each session, participants completed an arm exercise until they became tired. They then received either real iTBS or sham stimulation. Sham stimulation was designed to act as a comparison and did not provide the same brain stimulation as real iTBS. Participants received both types during the study, but in a random order
The researchers measured participants’ muscle strength and performance, electrical activity in their muscles, and responses in the brain and nerves. Measurements were taken before the exercise and stimulation, and 5, 12 and 20 minutes afterwards. These measurements allowed the researchers to study how quickly participants recovered and whether recovery differed between real and sham stimulation

What are the possible benefits and risks of participating?
Participants may not have received any direct health benefit from taking part. The information

collected may help researchers better understand why people with Parkinson's disease experience physical fatigue and whether brain stimulation could be useful for improving recovery after exercise in future studies
The study involved tiring arm exercise, magnetic brain stimulation, electrical recordings from the muscles and stimulation of nerves. The information provided does not specify the possible risks, side effects or discomforts associated with these procedures

Where is the study run from?
The study was run at Hospital Universitario Virgen del Rocío and Instituto de Biomedicina de Sevilla (IBiS) in Seville, Spain

When is the study starting and how long is it expected to run for?
August 2023 to December 2024.

Who is funding the study?
The study was funded by several organisations in Spain, including Instituto de Salud Carlos III (ISCIII-FEDER), Fundación Pública Andaluza Progreso y Salud, departments of the Regional Government of Andalusia, and Fundación Alicia Koplowitz

Who is the main contact?
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Principal investigator, Scientific, Public

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Additional identifiers

Study information

Scientific Title
Intermittent theta-burst stimulation for post-exercise recovery in Parkinson’s disease: a randomized, sham-controlled pilot crossover trial

Study objectives
1. To examine the contribution of impaired recovery of motor cortical excitability to heightened whole-body fatigability in Parkinson's disease
2. To evaluate the feasibility and preliminary therapeutic efficacy of intermittent theta-burst stimulation (iTBS) applied to the primary motor cortex following exhaustive exercise

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 29/01/2018, CEI de los Hospitales Universitarios Virgen Macarena y Virgen del Rocío (Avda. Dr. Fedriani, 3 - Unidad de Investigación 2a planta, Seville, 41071, Spain; +34 600162458; administracion.eecc.hvm.sspa@juntadeandalucia.es), ref: 1191-N-17

Primary study design
Interventional

Allocation
Randomized controlled trial

Masking
Blinded (masking used)

Control
Placebo

Assignment
Crossover

Purpose
Basic science, Device feasibility

Study type(s)

Health condition(s) or problem(s) studied
Parkinson's disease; physical (motor) fatigability.

Interventions
Single session of intermittent theta-burst stimulation (iTBS) applied to the primary motor cortex (M1) immediately following an exhaustive upper-limb fatiguing exercise, following the Huang et al. (2005) protocol at 80% of active motor threshold, compared with sham stimulation (coil rotated 90° from the head) in a randomised, single-blind, crossover design with a one-week washout between conditions. Outcomes assessed at baseline and 5, 12, and 20 minutes post-stimulation.

Randomisation:
Stratified permuted-block randomisation (stratum: group, PD/HC; block size 2), which counterbalances treatment order within each group so that five participants per group received iTBS-first and five received sham-first. The sequence was computer-generated, with allocation concealed until the first session via sequentially numbered, sealed opaque envelopes prepared by a person not involved in outcome assessment.

Intervention Type
Device

Phase
Not Applicable

Drug/device/biological/vaccine name(s)
Magstim 200 stimulator with figure-8 coil (Magstim Company Ltd, Wales, UK); intermittent theta-burst stimulation (iTBS) protocol (Huang et al., 2005)

Primary outcome(s)
1. Isometric maximal voluntary contraction (IMVC) of the biceps brachii measured using a functional electromechanical dynamometer at baseline, and 5, 12, and 20 minutes post-exercise /intervention (T1, T2, T3)

Key secondary outcome(s)
1. Power and contraction velocity measured using dynamometer at baseline, and 5, 12, and 20 minutes post-exercise/intervention (T1, T2, T3)

2. Corticospinal excitability measured using MEP/Mmax ratio (single-pulse TMS, normalised to maximal M-wave) at baseline, and 5, 12, and 20 minutes post-exercise/intervention (T1, T2, T3)

3. Voluntary activation (VA) measured using twitch interpolation technique (superimposed vs. resting twitch, peripheral nerve stimulation) at baseline, and 5, 12, and 20 minutes post-exercise /intervention (T1, T2, T3)

4. Cortical silent period (CSP) measured using TMS-EMG, duration of EMG suppression during 20% MVC background contraction at baseline, and 5, 12, and 20 minutes post-exercise /intervention (T1, T2, T3)

5. Resting and active motor threshold (RMT, AMT) measured using % of maximum stimulator output at baseline, and 5, 12, and 20 minutes post-exercise/intervention (T1, T2, T3)

6. Maximal M-wave amplitude (Mmax) measured using peripheral nerve stimulation at Erb's point (control for peripheral neuromuscular function) at baseline, and 5, 12, and 20 minutes post-exercise/intervention (T1, T2, T3)

7. EMG time- and frequency-domain measures measured using RMS amplitude, median frequency (MDF), wavelet-derived spectral power (15–45, 55–95, 95–200 Hz bands) at baseline, and 5, 12, and 20 minutes post-exercise/intervention (T1, T2, T3)

Completion date
04/12/2024

Eligibility

Key inclusion criteria
Parkinson's disease group
1. Diagnosis per MDS Clinical Diagnostic Criteria
2. Stable, positive response to L-DOPA or dopamine agonists ("ON" state)
3. Parkinson's Fatigue Scale score ≥3

Healthy control group:
1. Age- and sex-matched (±5 years) to PD participants
2. Absence of medical conditions or mental illness

Healthy volunteers allowed
Yes

Age group
Mixed

Lower age limit
40 Years

Upper age limit
75 Years

Sex
All

Total final enrolment
20

Key exclusion criteria
Parkinson's disease group:
1. Unwillingness or inability to participate

Healthy control group:
1. Presence of medical conditions or mental illness (HC)

Date of first enrolment
25/08/2023

Date of final enrolment
06/04/2024

Locations

Countries of recruitment
Spain

Study participating centre
Hospital Universitario Virgen del Rocío / Instituto de Biomedicina de Sevilla (IBiS)
Avda. Manuel Siurot, s/n
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Spain
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Sponsor information

Organisation
Fundación Pública Andaluza para la Gestión de la Investigación en Salud de Sevilla

ROR
https://ror.org/01bp61317

Organisation
Ministerio de Ciencia, Tecnología e Innovación

Funder(s)

Funder type

Funder Name
Instituto de Salud Carlos III (ISCIII-FEDER)

Funder Name
Fundación Pública Andaluza Progreso y Salud

Alternative Name(s)
Andalusian Public Progress and Health Foundation, Progreso y salud Andalusian Public Foundation, Fundación Progreso y Salud, FPS

Funding Body Type
Government organisation

Funding Body Subtype
Local government

Location
Spain

Funder Name
Consejería de Economía, Innovación, Ciencia y Empleo, Junta de Andalucía

Alternative Name(s)
Ministry of Economy, Innovation, Science and Employment, Government of Andalucia

Funding Body Type
Government organisation

Funding Body Subtype
Local government

Location
Spain

Funder Name
Consejería de Salud y Bienestar Social, Junta de Andalucía

Alternative Name(s)
Andalusian Ministry of Health and Social Welfare

Funding Body Type
Government organisation

Funding Body Subtype
Local government

Location
Spain

Funder Name

Consejería de Transformación Económica, Industria, Conocimiento y Universidades

Alternative Name(s)
Ministry of Economic Transformation, Industry, Knowledge and Universities of Andalusia, Ministry of Economic Transformation, Industry, Knowledge and Universities, Consejería de Transformación Económica, Consejería Transformación Eco., Consejería de Transformación Económica, Industria, Conocimiento y Universidades (Junta de Andalucía), Consejería de Transformación económica,Industria, Conocimiento y Universidades, Consejería de Transformación Económica, Industria, Conocimiento y Universidades de la Junta de Andalucía, Consejería de Transformación Ec., Indust., Conocimiento y Univ

Funding Body Type
Government organisation

Funding Body Subtype
Local government

Location
Spain

Funder Name
Fundación Alicia Koplowitz

Alternative Name(s)
Alicia Koplowitz Foundation

Funding Body Type
Private sector organisation

Funding Body Subtype
Trusts, charities, foundations (both public and private)

Location
Spain

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not expected to be made available

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Statistical Analysis Plan			29/09/2026	No	No