

# Effects of non-invasive brain stimulation on brain activity and brain chemicals in healthy adults

<b>Submission date</b> 14/05/2026	<b>Recruitment status</b> No longer recruiting	<input type="checkbox"/> Prospectively registered
		<input type="checkbox"/> Protocol
<b>Registration date</b> 14/05/2026	<b>Overall study status</b> Completed	<input type="checkbox"/> Statistical analysis plan
		<input type="checkbox"/> Results
<b>Last Edited</b> 14/05/2026	<b>Condition category</b> Other	<input type="checkbox"/> Individual participant data
		<input checked="" type="checkbox"/> Record updated in last year

## Plain English summary of protocol

Not provided at time of registration

## Contact information

### Type(s)

Principal investigator, Public, Scientific

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## Additional identifiers

## Study information

### Scientific Title

Effects of intermittent theta burst stimulation compared with sham stimulation on magnetic resonance imaging and neurochemical measures in the visual cortex of healthy adults

### Study objectives

This study aimed to systematically evaluate the effects of a single session of standard intermittent theta burst stimulation (iTBS) on the healthy human visual cortex, with a focus on its neurochemical, physiological, and temporal characteristics. Specifically, the objectives were to:

**1. Assess neurochemical effects of iTBS:**

Determine whether iTBS modulates cortical metabolite levels, including Glx and GABA+, measured using magnetic resonance spectroscopy (MRS).

**2. Examine changes in excitation/inhibition (E/I) balance:**

Evaluate whether iTBS alters the Glx/GABA+ ratio as an index of cortical excitatory–inhibitory balance.

**3. Evaluate effects on cortical excitability:**

Investigate changes in cortical excitability using phosphene threshold (PT) measurements.

**4. Characterize temporal dynamics of stimulation effects:**

Assess neurochemical and physiological changes across multiple post-stimulation time points (0.5 h, 3.5 h, and 24 h).

**5. Compare expected plasticity effects with prior rTMS findings:**

Determine whether a single session of iTBS induces measurable plasticity-like effects in the visual cortex, in contrast to previously reported effects of 10 Hz high-frequency rTMS.

**Ethics approval required**

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**Ethics approval(s)**

approved 19/01/2016, Institutional Review Board of National Yang Ming Chiao Tung University (No. 155, Sec. 2, Linong St, Taipei City, 112, Taiwan; +886 (0)228267000; irb.ym@nycu.edu.tw), ref: YM104122E

**Primary study design**

Interventional

**Allocation**

Randomized controlled trial

**Masking**

Blinded (masking used)

**Control**

Placebo

**Assignment**

Parallel

**Purpose**

Basic science

**Study type(s)**

**Health condition(s) or problem(s) studied**

Healthy volunteers

## **Interventions**

Participants were randomly assigned to either an intermittent theta burst stimulation (iTBS) group or a sham-control group. The order of active and sham stimulation sessions was counterbalanced across participants using computer-generated randomization. The active stimulation consisted of a single session of standard iTBS delivered over the occipital cortex (visual cortex). The iTBS protocol followed the conventional theta burst pattern, consisting of bursts of high-frequency stimulation (3 pulses at 50 Hz) repeated at 5 Hz (i.e., every 200 ms). Each iTBS train lasted 2 seconds and was repeated every 10 seconds for a total of 20 trains, resulting in 600 pulses in total. Stimulation was delivered at 100% of the participant's phosphene threshold (PT). Coil positioning was guided and maintained over the visual cortex throughout the session. For the sham-control condition, stimulation was delivered using the sham coil. All participants received only one stimulation session, and all subsequent neurochemical and physiological measurements were conducted at predefined post-stimulation timepoints.

## **Intervention Type**

Device

## **Phase**

Not Applicable

## **Drug/device/biological/vaccine name(s)**

Magstim Rapid<sup>2</sup>, 3T Siemens MRI Scanners

## **Primary outcome(s)**

1. <sup>1</sup>H magnetic resonance spectroscopy (MRS) measured using MRS-derived neurometabolite concentrations at baseline, 0.5 h, 3.5 h, and 24 h after iTBS/sham stimulation
2. TMS-based phosphene threshold (PT) assessment measured using phosphene threshold at baseline and multiple post-stimulation timepoints (0 h, 4.5 h, and 24 h)

## **Key secondary outcome(s)**

## **Completion date**

31/10/2020

## **Eligibility**

### **Key inclusion criteria**

1. Healthy adults with no history of neurological, medical, visual, or cognitive impairments
2. No contraindications to MRI or TMS, such as a history of seizures or epilepsy, metallic implants, implanted electronic devices (e.g., pacemakers), or pregnancy

### **Healthy volunteers allowed**

Yes

### **Age group**

Adult

### **Lower age limit**

20 years

**Upper age limit**

35 years

**Sex**

All

**Total final enrolment**

24

**Key exclusion criteria**

1. A history of neurological, medical, visual, or cognitive impairments
2. Any contraindications to magnetic resonance imaging or transcranial magnetic stimulation, including a history of seizures or epilepsy, metallic implants, implanted electronic devices such as pacemakers, or pregnancy
3. Unable to reliably perceive phosphenes
4. Magnetic resonance imaging or magnetic resonance spectroscopy data did not meet established quality assurance standards

**Date of first enrolment**

29/04/2016

**Date of final enrolment**

31/10/2019

## **Locations**

**Countries of recruitment**

Taiwan

## **Sponsor information**

**Organisation**

National Yang Ming Chiao Tung University

**ROR**

<https://ror.org/00se2k293>

## **Funder(s)**

**Funder type**

**Funder Name**

Ministry of Science and Technology, Taiwan

**Alternative Name(s)**

Ministry of Science and Technology, R.O.C. (Taiwan), Ministry of Science and Technology of Taiwan, MOST

**Funding Body Type**

Government organisation

**Funding Body Subtype**

National government

**Location**

Taiwan

## Results and Publications

**Individual participant data (IPD) sharing plan****IPD sharing plan summary**

Not expected to be made available