

Supplementary Table S3: Full-text reports excluded from the systematic review (n = 11), with the specific reason for exclusion for each study

Excluded Article	PICO Evaluation	Reason for Exclusion
Gu (2021) [1]	The population includes relapsing-remitting multiple sclerosis (RRMS) patients and healthy controls, satisfying the population and comparison parameters, but utilizes structural MRI and generalized cognitive scales (MoCA) instead of MEG-derived parameters.	Excluded due to incorrect outcomes, as the study does not assess cognitive tasks using MEG-derived parameters.
Hsu et al. (2023) [2]	The trial evaluates MS patients undergoing transcranial alternating current stimulation, but the primary outcome measures information processing speed via the Symbol Digit Modalities Test.	Excluded for lacking relevant MEG-derived parameters, focusing instead on processing speed and intervention tolerability.
Liang et al. (2023) [3]	The study analyzes acute and remitting MS patient data against healthy controls using a support vector machine model to evaluate resting-state fMRI amplitude fluctuations.	Excluded because the outcomes are strictly based on neuroimaging classification model performance and fail to evaluate MEG-derived parameters (Liang et al., 2023).
Linnhoff et al. (2023) [4]	The research includes MS population and healthy controls, matching P and C criteria, but evaluates fatigability-related EEG oscillatory brain activity during sustained attention tasks.	Excluded because the intervention and outcomes assess physical/mental exhaustion and reaction time variability rather than MEG-derived parameters.
Martí-Juan et al. (2022) [5]	The study analyzes structural and functional connectivity in MS patients via whole-brain models compared with SDMT and EDSS scores (Martí-Juan et al., 2022).	Excluded because the outcome metrics map generalized cognitive impairment and disability without targeting cognitive tasks using MEG-derived parameters.
Motolese et al. (2023) [6]	The trial involves MS patients and assesses psychological statuses such as perceived stress, rumination, depression, and fatigue using clinical questionnaires and EEG.	Excluded because the study evaluates broad psychological functioning and stress responses rather than specific cognitive functions using MEG-derived parameters.

Riem et al. (2022) [7]	The study assesses MS patients and controls walking on a treadmill, focusing on step width, center of mass, and fall risks.	Excluded due to entirely biomechanical and motor function outcomes, containing no MEG or neuropsychological evaluations (Riem et al., 2022).
Aine (2014) [8]	The text discusses generalized magnetoencephalography (MEG) stimulus parameters and data analysis methodologies.	Excluded because it lacks an MS patient population, clinical intervention, and cognitive outcomes.
Anninos (2016) [9]	The document contains only raw numerical data arrays for MEG/EEG baseline runs without clinical context.	Excluded for lacking an identified MS population, comparative analysis, and specific cognitive outcome measures.
Capone et al. (2020) [10]	The study compares MS patients to healthy controls during fatiguing motor tasks by evaluating high-frequency oscillations and somatosensory evoked potentials.	Excluded because the research endpoints are purely neurophysiological and strength-based, remaining unrelated to cognition.
Figuerola-Vargas et al. (2020) [11]	The research evaluates early-stage RRMS patients and healthy controls during working memory encoding and maintenance tasks using EEG.	Excluded because it specifically tests visuospatial and verbal working memory rather than cognitive MEG-derived parameters.

MS: Multiple Sclerosis; MoCA: Montreal Cognitive Assessment; SDMT: Symbol Digit Modalities Test; fMRI: Functional Magnetic Resonance Imaging; EEG: Electroencephalography; MEG: Magnetoencephalography; EDSS: Expanded Disability Status Scale; RRMS: Relapsing-Remitting Multiple Sclerosis; MRI: Magnetic Resonance Imaging; PICO: Population, Intervention, Comparison, Outcome

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