INPLASY PROTOCOL

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Conflicts of interest:
None declared.

Neural mechanisms of bimanual coordination in humans and application of neuromodulation therapy: a scoping review

Wu, JY[1]; Li, J[2]; Sidarta, A[3]; Kwong, PWH[4].

Background: **Bimanual coordination deficits are one of the most common characteristics of people with stroke, which have an adverse influence on their independence of activities daily living and other occupational activities. Existing studies and reviews mainly focused on how to improve motor impairment of the affected limb and cortical activation and functional connectivity in the impaired brain hemisphere by a series of rehabilitation strategies, e.g., non-invasive brain stimulation and rehabilitation robotics. It should be noted that functional bilateral abilities are not a simple compound and a combination of one-handed skills. Therefore, the bimanual coordination dysfunctions still need to be explored and addressed in clinical practice. Better understandings of the neural mechanisms underlying bilateral cooperative tasks in healthy subjects and changes in neural activities in stroke patients help foster the development of effective rehabilitation strategies, such as TMS and tDCS, and enhance the bimanual coordination through stimulating altered cortical areas, which is essential for boosting the independence and quality of daily life in stroke individuals.**

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 22 May 2023 and was last updated on 22 May 2023 (registration number INPLASY202350080).

INTRODUCTION

Review question / Objective: **We aimed to review the neural mechanisms behind upper limb bilateral movements with a common goal in healthy individuals and detect the differences in brain activity between healthy individuals and stroke patients undergoing upper limb bilateral movements. Finally, this study aimed to explore the effects of advanced neuromodulation therapy applied to stroke or healthy individuals to improve bimanual coordination.**

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METHODS

Strategy of data synthesis: Electronic databases: PubMed, EMBASE, MEDLINE, and Web of Science terms: stroke, CVA, hemiplegia, cerebrovascular accidents, cerebrovascular disorder, paresis, healthy volunteers, healthy participants, healthy subjects, normal volunteer; bilateral coordination, bimanual coordination, cooperative, bimanual cooperative, coordination, symmetric, asymmetric, out-of-phase; upper limb, upper extremities, upper limbs, upper extremity, hand, hands; functional imaging, fMRI, functional magnetic resonance imaging, brain imaging, MRI, EEG, electromyography, near-infrared spectrometry, NIRS, TMS, transcranial magnetic stimulation.

Eligibility criteria: If accorded with any of the following criteria, studies were included from the review: (P): studies recruiting adult participants diagnosed with stroke only or healthy subjects only; studies recruiting adult stroke patients and normal volunteers; Intervention (I): bilateral movements with a common goal vs. rest; Outcomes (O): studies that provided at least one outcome assessing the upper limb neural functions (EEG or neuroimaging outcomes) If accorded with any of the following criteria, studies were excluded from the review: (1) the goal of neuromodulation therapy was not to promote cooperative bilateral function; (2) studies recruited patients without diagnosis of stroke or infants, children, and adolescents; (4) studies published as research protocols, conference proceedings, or conference abstracts; and (5) studies published with using the non-English language.

Source of evidence screening and selection: Two authors independently extracted the following information from each article: (1) the first author and publication year; (2) the patient's characteristics (age, time since stroke, initial impairment level) and the healthy characteristics (age, handedness); (3) the interventions used for both groups, including the type of intervention, duration of the intervention, and details regarding the measurements; (4) the modalities of the functional neuroimaging and/or transcranial magnetic stimulation used in the study; and (5) the outcome data, including brain activation, the modulation of excitation and inhibition on inter-/intra-hemispheres, and functional interaction. Any disagreements between the two authors were settled by a discussion with the third author.

Data management: Using SPSS 26.0 performed all statistical analyses. Utilizing hierarchical clustering analysis with Ward's Model classified bimanual coordination into different groups according to specific activated brain regions in each study. The number of groups was as a k value (the number of clusters) for later K-means analysis.

Reporting results / Analysis of the evidence: None.

Presentation of the results: flowchart, figure, table

Language restriction: English.

Country(ies) involved: Hong Kong, China; Mainland, China; Singapore.

Keywords: stroke; bimanual coordination; activation; neuromodulation; healthy.

Dissemination plans: None.

Contributions of each author:

Author 1 - Jingyi WU - Author 1 contributed to the conceptualization, methodology, formal analysis, and the manuscript.
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