INPLASY PROTOCOL

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Conflicts of interest:
None declared.

The Neural Mechanism of Working Memory Training: A meta-analysis of Functional Neuroimaging Studies

Zhang, Y[1]; Zhao, X[2].

Review question / Objective: **Working memory (WM) represents one's ability to maintain and manipulate information in a short period and correlates with other higher-order cognitions. Owing to its critical role in cognition, researchers have attempted to find ways to improve WM ability and evidence suggests that WM capacity can increase through working memory training (WMT). WMT induces neuroplasticity, but its specific mechanism remains unclear. To explore the brain activation pattern changes induced by WMT.**
Condition being studied: **We conducted a meta-analysis of functional magnetic resonance imaging (fMRI) studies of WM training. To explore the brain activation pattern changes induced by working memory.**

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 23 February 2023 and was last updated on 23 February 2023 (registration number INPLASY202320105).

INTRODUCTION

Review question / Objective: **Working memory (WM) represents one's ability to maintain and manipulate information in a short period and correlates with other higher-order cognitions. Owing to its critical role in cognition, researchers have attempted to find ways to improve WM ability and evidence suggests that WM capacity can increase through working memory training (WMT). WMT induces neuroplasticity, but its specific mechanism remains unclear. To explore the brain**

activation pattern changes induced by WMT.

Condition being studied: We conducted a meta-analysis of functional magnetic resonance imaging (fMRI) studies of WM training. To explore the brain activation pattern changes induced by working memory.

METHODS

Search strategy: Sources: PubMed, Web of Science and CNKI

Key terms used in the searches are 工作记忆训练、认知训练、fMRI、PET; working memory training、cognitive training、fMRI、PET.

Only peer-reviewed articles written between 2000 and 2022 will be selected. To identify all relevant literature, references from review articles and eligible articles will also be screened. Citation searches will be conducted on included studies.

Participant or population: Inclusion: healthy adults Exclusion: Participants with brain disorders and child.

Intervention: Studies that use functional magnetic resonance imaging (fMRI) or positron emission tomography (PET) to investigate working memory training.

Comparator: Post-training is compared with pre-training; training group compared to the control group post-training.

Study designs to be included: We will only include fMRI or PET studies using working memory training tasks. All studies are published in Chinese and English.

Eligibility criteria: The inclusion and exclusion criteria of the literature were as follows: (1) study type: the literature should be empirical research, excluding review and meta-analysis studies; (2) Study subjects: study participants are health adults, excluding patients and children; (3) Research methods: the study uses fMRI or PET methods, excluding Diffusion Tensor Imaging (DTI) and magnetic resonance imaging (MRI) studies aimed at analyzing the white matter and gray matter of the brain and studies using brain waves as imaging indicators, such as EEG studies (Electroencephalograph); (4) Data analysis: the study used whole-brain analysis, excluding studies that only carried out Region of interest (ROI) analysis; (5) Result reporting: Studies using standardized Talairach or MNI space to report activation results of brain regions, excluding studies that did not report the coordinates of activation regions.

Information sources: Sources: PubMed, Web of Science and CNKI in the paper, if the author didn't report the standard space or the foci clearly, we will email the author for the information.

Main outcome(s): We first performed a meta-analysis including all the foci demonstrating neural changes associated with working memory training. Then subsidiary analysis was conducted based on the direction of pattern change. we conducted subsidiary analyses of brief and more prolonged training regimens separately. In terms of types of working memory tasks, the most commonly used WM tasks in the studies included were the Sternberg and N-back. we discrepancies in brain activity change due to will also explore the task type.

Additional outcome(s): None.

Quality assessment / Risk of bias analysis: Two reviewers will independently assess the quality and risk of bias of included studies using the guidelines on assessing quality neuroimaging studies for meta-analysis (Müller et al., 2018) 《Ten simple rules for neuroimaging meta-analysis》.

Strategy of data synthesis: A meta-analysis will be conducted via Ginger-ALE 3.0.2 software; Data presented in Talairach coordinates will be converted to MNI coordinates. We will conduct cluster-level familywise error (FWE) (cluster p=0.05, 1000 permutations, uncorrected p= 0.001).

Subgroup analysis: we conducted subsidiary analyses of brief and more prolonged training regimens separately. We also conducted subsidiary analyses of working memory task type (updating task or maintenance task).

Sensitivity analysis: Not applicable.

Country(ies) involved: China.

Keywords: Working memory training, ALE meta-analysis, neural mechanism.

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