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Effects of Exercise on Inhibitory Control in Methamphetamine Addicts: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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ADMINISTRATIVE INFORMATION

Support - Collaborative Governance of Multiple Subjects in the Community to Promote the Social Rehabilitation of Adult Drug Users in the Context of Body-Medicine Integration.(grant number::22BTY064).

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 25 February 2025 and was last updated on 25 February 2025.

INTRODUCTION

Review question / Objective Objective: To explore the effects of inhibitory control on exercise and methamphetamine(MA) addicts and its regulatory mechanisms, to integrate an effective exercise prescription to promote MA addiction withdrawal, and to provide theoretical and practical guidance for the future of exercise addiction treatment.

Condition being studied Effects of Exercise on Inhibitory Control in Methamphetamine Addicts.

METHODS

Search strategy Two researchers conducted a systematic literature search using the PubMed, Web of Science, and China National Knowledge Infrastructure (CNKI) databases. Guided by the PICOS (Population, Intervention, Comparison,

Outcomes, Study Design) framework, the search strategy incorporated Chinese subject terms and free-text keywords, including "methamphetamine," "methamphetamine use disorder," "addiction," "inhibitory control," "executive function," "drug dependence," "physical activity," and "exercise intervention." The search spanned publications from January 1, 2000, to January 1, 2025.

Participant or population The literature screening, inclusion, and exclusion criteria were developed in accordance with the PICOS framework (Population, Intervention, Comparator, Outcomes, Study Design).

Inclusion criteria comprised: 1) Study design: Randomized controlled trials (RCTs) in which participants met the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for MA dependence. 2) Intervention: Structured exercise prescriptions adhering to the American College of Sports Medicine (ACSM)

guidelines, incorporating physical activities such as sports, exercise regimens, or recreational programs. 3) Comparator: Control groups receiving no intervention or engaging in routine daily activities. 4) Outcomes: Measures of inhibitory control and severity of MA dependence. Exclusion criteria were: 1) Non-English or non-Chinese publications. 2) Non-experimental designs (reviews, qualitative studies, dissertations, conference abstracts). 3) Studies lacking pre- and post-intervention assessments in control groups. 4) Irrelevant research foci (e.g., unrelated to exercise interventions, MA craving, or executive function). 5) Unavailable or incomplete data.

Intervention Structured exercise prescriptions adhering to the American College of Sports Medicine (ACSM) guidelines, incorporating physical activities such as sports, exercise regimens, or recreational programs.

Comparator Control groups receiving no intervention or engaging in routine daily activities.

Study designs to be included Study design: Randomized controlled trials (RCTs) in which participants met the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for MA dependence.

Eligibility criteria The literature screening, inclusion, and exclusion criteria were developed in accordance with the PICOS framework (Population, Intervention, Comparator, Outcomes, Study Design).

Inclusion criteria comprised: 1) Study design: Randomized controlled trials (RCTs) in which participants met the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for MA dependence. 2) Intervention: Structured exercise prescriptions adhering to the American College of Sports Medicine (ACSM) guidelines, incorporating physical activities such as sports, exercise regimens, or recreational programs. 3) Comparator: Control groups receiving no intervention or engaging in routine daily activities. 4) Outcomes: Measures of inhibitory control and severity of MA dependence. Exclusion criteria were: 1) Non-English or non-Chinese publications. 2) Non-experimental designs (reviews, qualitative studies, dissertations, conference abstracts). 3) Studies lacking pre- and post-intervention assessments in control groups. 4) Irrelevant research foci (e.g., unrelated

to exercise interventions, MA craving, or executive function). 5) Unavailable or incomplete data.

Information sources Two researchers conducted a systematic literature search using the PubMed, Web of Science, and China National Knowledge Infrastructure (CNKI) databases.

Main outcome(s) Inhibitory control.

Quality assessment / Risk of bias analysis The methodological quality of included studies was evaluated using the Cochrane Risk of Bias Assessment Tool for systematic reviews. The quality assessment revealed that all seven studies demonstrated varying degrees of methodological bias, primarily originating from non-implementation of double-blind procedures. This limitation stems from the inherent challenges associated with blinding participants and research personnel in exercise intervention trials, as visually summarized in Figure 2.

Strategy of data synthesis Statistical analyses were performed using Review Manager (RevMan) software version 5.4. The continuous outcome measures from included studies were analyzed through two validated neuropsychological tasks assessing inhibitory control: the Go/No-Go task and Stroop task. In both paradigms, lower values reflected faster response times, indicating better performance. Effect sizes were calculated as standardized mean differences (SMDs) with 95% confidence intervals, with statistical significance set at $\alpha \leq 0.05$.

Subgroup analysis

2.2.2 Subgroup analysis of the effect of different exercise intensities on inhibitory control in methamphetamine addicts

2.2.1 Subgroup analysis of the effect of different duration of exercise on inhibitory control in methamphetamine addicts.

Sensitivity analysis A sensitivity analysis was performed on the seven included studies. This involved sequentially excluding individual studies, modifying the analytical approach, and reassessing the magnitude and variation of effect sizes. The results demonstrated that the removal of any single study did not significantly alter the outcome measures, suggesting that the meta-analytic findings are robust and methodologically credible.

Country(ies) involved China.

Keywords exercise; inhibitory control; methamphetamine; addiction; drug craving; brainmechanisms.

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