INPLASY

Music-Based Interventions Improve Motor Function in Stroke Patients: A Systematic Review and Meta-Analysis

INPLASY202550065
doi: 10.37766/inplasy2025.5.0065
Received: 22 May 2025
Published: 22 May 2025

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ADMINISTRATIVE INFORMATION

Support - No.

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

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202550065

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 22 May 2025 and was last updated on 22 May 2025.

INTRODUCTION

Review question / Objective Stroke is the second leading cause of death and a major contributor to disability worldwide, with approximately 15 million people experiencing stroke annually—5.5 million resulting in death and another 5 million leading to permanent disability. Motor dysfunction is one of the most common post-stroke sequelae, significantly impairing patients' activities of daily living (ADLs) and quality of life. Although conventional motor rehabilitation approaches based on neuroplasticity demonstrate some efficacy, many stroke survivors still exhibit residual functional impairments due to various factors. In recent years, music-based interventions have emerged as an adjunctive therapy in stroke rehabilitation; however, the comparability and generalizability of existing research findings remain limited.

This study aimed to systematically evaluate and meta-analyze published literature to clarify the role and clinical value of music interventions in stroke rehabilitation, optimize therapeutic strategies, and provide guidance for future clinical research.

Condition being studied Stroke is the second leading cause of death and a major contributor to disability worldwide, with approximately 15 million people experiencing stroke annually—5.5 million resulting in death and another 5 million leading to permanent disability. Motor dysfunction is one of the most common post-stroke sequelae, significantly impairing patients' activities of daily living (ADLs) and quality of life. Although conventional motor rehabilitation approaches based on neuroplasticity demonstrate some efficacy, many stroke survivors still exhibit residual functional impairments due to various factors. In recent years, music-based interventions have emerged as an adjunctive therapy in stroke rehabilitation; however, the comparability and generalizability of existing research findings remain limited.

METHODS

Participant or population Studies were selected based on predefined PICOS criteria: Participants were adult stroke patients (≥18 years) without severe cognitive impairment or hearing loss.

Intervention Interventions included any form of music-based therapy targeting motor recovery.
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Comparator ; Comparators were standard rehabilitation or other non-musical interventions.

Study designs to be included ; Study designs were limited to randomized controlled trials. We excluded non-randomized studies, case reports, review articles, animal studies, and trials with insufficient outcome data or unclear methodology.

Eligibility criteria Studies were selected based on predefined PICOS criteria: Participants were adult stroke patients (≥18 years) without severe cognitive impairment or hearing loss; Interventions included any form of music-based therapy targeting motor recovery; Comparators were standard rehabilitation or other non-musical interventions; Outcomes of interest were quantitative measures of gait function; Study designs were limited to randomized controlled trials. We excluded non-randomized studies, case reports, review articles, animal studies, and trials with insufficient outcome data or unclear methodology.

Information sources An extensive search of the literature was conducted across multiple databases to identify relevant studies. Four primary electronic databases—PubMed, EMBASE, Cochrane Library, and Web of Science—were systematically queried for records published from their inception until April 30, 2025. The search strategy incorporated both controlled vocabulary (MeSH terms) and free-text keywords, including but not limited to "music-based intervention," "cerebrovascular accident," "walking function," and "RCT" (randomized controlled trial).
Two investigators independently performed the screening process following a predefined protocol. Following duplicate removal, preliminary eligibility was determined by reviewing titles and abstracts. Articles deemed potentially relevant were retrieved in full text and assessed for compliance with the inclusion criteria. A customized data collection form was created and tested to systematically record study details, including authorship, publication year, country of origin, participant characteristics, intervention parameters (e.g., session frequency, total duration, intensity), control conditions, outcome variables, and significant results. Disagreements between reviewers were addressed through consensus or, if needed, by involving a third researcher.

Main outcome(s) ; Outcomes of interest were quantitative measures of gait function. A total of 1,426 records were screened, with 12 studies (388 participants) meeting inclusion criteria. Meta-analysis revealed that music interventions significantly improved gait speed (SMD = 0.81, 95% CI: 0.36–1.26), stride length (SMD = 0.80, 95% CI: 0.33–1.28), and step frequency (SMD = 0.89, 95% CI: 0.05–1.73). Significant heterogeneity was observed, warranting random-effects models. Sensitivity analyses confirmed robust effects for gait speed and stride length, while step frequency exhibited instability. Funnel plots and Egger's tests suggested no significant publication bias for gait speed or stride length, but notable bias for step frequency.

Quality assessment / Risk of bias analysis For quantitative synthesis, treatment effects for continuous outcomes were reported as standardized mean differences (SMDs) accompanied by 95% confidence intervals. Inter-study variability was quantified using the I^2 index and chi-square test, with I^2 thresholds of 25%, 50%, and 75% indicating mild, moderate, and substantial heterogeneity, respectively. A random-effects approach was employed when significant heterogeneity was detected ($I^2 > 50\%$); otherwise, a fixed-effects model was utilized. Predefined subgroup analyses explored variations in intervention design (e.g., music therapy modality, treatment duration) and participant attributes (e.g., post-stroke interval, initial severity). Sensitivity testing evaluated result stability by omitting high-bias studies or outliers contributing to heterogeneity. When at least 10 studies were available for an outcome, publication bias was investigated via funnel plot visualization and Egger's regression analysis. All computations were executed using RevMan (v5.4, RevMan is developed by Cochrane Collaboration, located in London, UK.)and Stata (v17.0, StataCorp LLC, located in College Station, Texas, USA.) software platforms.

Strategy of data synthesis For quantitative synthesis, treatment effects for continuous outcomes were reported as standardized mean differences (SMDs) accompanied by 95% confidence intervals. Inter-study variability was quantified using the I^2 index and chi-square test, with I^2 thresholds of 25%, 50%, and 75%

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Subgroup analysis For quantitative synthesis, treatment effects for continuous outcomes were reported as standardized mean differences (SMDs) accompanied by 95% confidence intervals. Inter-study variability was quantified using the I^2 index and chi-square test, with I^2 thresholds of 25%, 50%, and 75% indicating mild, moderate, and substantial heterogeneity, respectively. A random-effects approach was employed when significant heterogeneity was detected ($I^2 > 50\%$); otherwise, a fixed-effects model was utilized. Predefined subgroup analyses explored variations in intervention design (e.g., music therapy modality, treatment duration) and participant attributes (e.g., post-stroke interval, initial severity). Sensitivity testing evaluated result stability by omitting high-bias studies or outliers contributing to heterogeneity. When at least 10 studies were available for an outcome, publication bias was investigated via funnel plot visualization and Egger's regression analysis. All computations were executed using RevMan (v5.4, RevMan is developed by Cochrane Collaboration, located in London, UK.)and Stata (v17.0, StataCorp LLC, located in College Station, Texas, USA.) software platforms.

Sensitivity analysis For quantitative synthesis, treatment effects for continuous outcomes were reported as standardized mean differences (SMDs) accompanied by 95% confidence intervals. Inter-study variability was quantified using the I^2 index and chi-square test, with I^2 thresholds of 25%, 50%, and 75% indicating mild, moderate, and substantial heterogeneity, respectively. A random-effects approach was employed when significant heterogeneity was detected ($I^2 > 50\%$); otherwise, a fixed-effects model was utilized. Predefined subgroup analyses explored variations in intervention design (e.g., music therapy modality, treatment duration) and participant attributes (e.g., post-stroke interval, initial severity). Sensitivity testing evaluated result stability by omitting high-bias studies or outliers contributing to heterogeneity. When at least 10 studies were available for an outcome, publication bias was investigated via funnel plot visualization and Egger's regression analysis. All computations were executed using RevMan (v5.4, RevMan is developed by Cochrane Collaboration, located in London, UK.)and Stata (v17.0, StataCorp LLC, located in College Station, Texas, USA.) software platforms.

Country(ies) involved China.

Keywords stroke rehabilitation, music therapy, motor function, gait analysis, neuroplasticity, meta-analysis.

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