INPLASY

Effects of Sling Exercise Training on Walking Ability and Balance Function in Patients with Stroke: A Systematic Review and Meta-analysis

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ADMINISTRATIVE INFORMATION

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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 21 August 2025 and was last updated on 21 August 2025.

INTRODUCTION

Review question / Objective This atudy aims to assess the effectiveness of sling exercise training on walking ability, balance function, and activities of daily living in patients with stroke.

Condition being studied Stroke is one of the most common disabling diseases globally, posing a severe threat to public health and socio-economic development. According to statistics from the World Health Organization (WHO), approximately 17 million people experience their first stroke each year worldwide, resulting in nearly 6 million deaths and leaving around 10 million individuals with long-term disabilities. With the acceleration of population aging, the incidence of stroke and the associated socio-economic burden are on an upward trend annually, especially in developing countries, where this issue is more pronounced. Post-stroke sequelae not only include motor impairment, balance impairment, and speech disorders but may also be accompanied by cognitive decline and emotional disturbances, significantly affecting patients' daily lives and social participation capabilities.

METHODS

Participant or population Patients with stroke.

Intervention The inclusion criteria encompassed randomized controlled trials that investigated the effects of sling exercise training or related suspension exercise interventions in patients with stroke. Studies were required to have a control group receiving routine rehabilitation training. The primary outcomes of interest included measures of balance function, walking ability, and activities of daily living, specifically assessed through validated instruments such as the Berg Balance Scale (BBS), Fugl-Meyer Assessment (FMA), Activities of Daily Living (ADL) scale, Fugl-Meyer Balance (FMB), and Holden functional walking rating.

Comparator Sling exercise training or related suspension exercise interventions.

Study designs to be included Studies were considered eligible if they met specific inclusion criteria carefully developed to ensure the quality and relevance of the evidence. The inclusion criteria encompassed randomized controlled trials that investigated the effects of sling exercise training or related suspension exercise interventions in patients with stroke. Studies were required to have a control group receiving routine rehabilitation training.

Eligibility criteria Studies were excluded if (1) the population was not post-stroke adults, (2) the intervention was not suspension-based exercise (e.g., conventional physiotherapy, pharmacological therapy, acupuncture), (3) the design was non-RCT, case series, conference abstract or animal/in-vitro research, or (4) no clinical outcomes of balance, gait or ADL were reported.

Information sources A comprehensive systematic search was conducted across multiple electronic databases including PubMed, Embase, Cochrane Library, Web of Science, Sinomed, CNKI, and Wanfang Database from their inception to January 2025. The search strategy combined Medical Subject Headings (MeSH) terms and free-text terms related to stroke and sling exercise therapy. For PubMed, the following search string was used: ("Stroke"[MeSH Terms] OR "Cerebrovascular Disorders"[MeSH Terms] OR "Cerebral Ischemia"[MeSH Terms] OR "Cerebral Hemorrhage"[MeSH Terms] OR "Cerebral Infarction"[MeSH Terms] OR "Cerebral Embolism"[MeSH Terms]) AND ("Body Weight Support"[MeSH Terms] OR "sling exercise therapy" OR "sling exercise" OR "suspension exercise training" OR "sling exercise training" OR "suspension training" OR "suspension therapy" OR "suspension system" OR "body weight-supported treadmill training"). Similar search strategies were adapted for other databases, with appropriate adjustments made for Chinese databases to include relevant Chinese terms. Additional relevant studies were identified through manual searching of reference lists from included articles and relevant reviews.

Main outcome(s) Sling Exercise Training (SET) has significantly positive effects in the rehabilitation process of patients with stroke, particularly in balance function, lower limb motor function, and walking ability. These findings provide strong support for SET as an effective rehabilitation intervention and offer important reference points for clinical practice and research in the field of stroke rehabilitation.

Quality assessment / Risk of bias analysis A standardized, pre-piloted form was used to extract data from the included studies. The extracted information included study characteristics (author, year of publication, study design), participant demographics (sample size, age, gender, stroke characteristics), intervention details (type, duration, frequency, intensity of sling exercise training), control group characteristics, outcome measures, and results. The methodological quality of included studies was assessed using the Cochrane risk of bias tool, which evaluates seven domains: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of bias. Each domain was rated as low risk, high risk, or unclear risk of bias.

Strategy of data synthesis All computations were conducted in RevMan 5.4.1. The meta-analysis was conducted using standardized mean differences (SMD) with 95% confidence intervals (CI) to account for the different scales used across studies. Statistical heterogeneity among studies was assessed using the I^2 statistic, with values of 25%, 50%, and 75% suggesting low, moderate, and high heterogeneity, respectively. Random-effects models were employed when significant heterogeneity was present ($I^2 > 50\%$), while fixed-effects models were used for analyses with low heterogeneity. Consistent with Cochrane Handbook (v6.4), an $I^2 > 50$ % was interpreted as at least moderate heterogeneity; therefore we applied a random-effects model beyond this threshold. Fixed-effect analyses used the Mantel-Haenszel inverse-variance method; random-effects analyses adopted the DerSimonian-Laird estimator for τ^2 with Hartung-Knapp adjustment for the 95 % CI."

Subgroup analysis The study selection process followed a systematic, two-phase approach. Initially, two independent reviewers screened titles and abstracts of all identified records against the predetermined eligibility criteria. Following the initial screening, full texts of potentially eligible studies were retrieved and independently evaluated by the same reviewers. Any disagreements between reviewers were resolved through discussion with a third reviewer until consensus was reached. The selection process was documented using a PRISMA flow diagram, which transparently reported the number of studies identified, included, and excluded at each stage of

the review process, along with reasons for exclusion.

Sensitivity analysis Sensitivity analyses were performed to explore the impact of individual studies on the overall effect size, and subgroup analyses were conducted when sufficient data were available to investigate potential sources of heterogeneity. Publication bias was assessed through visual inspection of funnel plots and statistical tests when appropriate. All statistical analyses were performed using comprehensive meta-analysis software, with a significance level set at $P < 0.05$.

Country(ies) involved China.

Keywords Stroke rehabilitation; sling exercise training; balance function; walking ability; meta-analysis.

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