INPLASY

Comparative Efficacy and Ranking of Trunk, Hip, and Knee Strengthening Exercises for Patellofemoral Pain Syndrome: A Systematic Review and Network Meta-Analysis of Randomized Controlled Trials

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ADMINISTRATIVE INFORMATION

Support - None.

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 6 May 2026 and was last updated on 6 May 2026.

INTRODUCTION

Review question / Objective This network meta-analysis was conducted to determine the relative ranking of different regional strengthening interventions, whether applied individually or in combination, with respect to their effects on pain intensity, functional disability, and knee extensor muscle strength in individuals with patellofemoral pain syndrome.

Rationale Patellofemoral pain syndrome is a prevalent and often persistent musculoskeletal condition characterized by anterior knee pain during load-bearing activities, particularly in women. Exercise therapy, including knee, hip, and trunk strengthening, is strongly recommended in clinical guidelines due to its role in improving neuromuscular control and reducing joint stress. However, previous pairwise meta-analyses cannot determine the relative superiority of these approaches, whereas network meta-analysis enables comparative evaluation and hierarchical ranking by integrating direct and indirect evidence.

Condition being studied The PICO (population, intervention, comparison, outcome) setting of the current network meta-analysis included: (P) individuals diagnosed with patellofemoral pain syndrome; (I) interventions including knee, hip, and trunk strengthening (either in isolation or combination); (C) comparator consisting of no intervention, sham therapy, or patient education; and (O) outcomes comprising changes in pain intensity, disability, and knee extensor strength.

METHODS

Search strategy Two reviewers across PubMed, Scopus, MEDLINE-Ovid, Web of Science and the Physiotherapy Evidence Database. The search encompassed all available studies up to March 2026. Search terms included (“trunk muscle training” OR “core muscle strengthening exercise” OR “knee extensor strengthening exercise” OR “quadriceps strengthening exercise” OR “gluteal muscle strengthening exercise” OR “hip muscle strengthening exercise”) AND (“patellofemoral pain

syndrome" OR "patellofemoral disorder" OR and "patellofemoral joint pain").

Participant or population Patellofemoral pain syndrome.

Intervention Knee, hip, or trunk strengthening exercises.

Comparator No intervention, sham therapy, or education.

Study designs to be included Randomized controlled trials.

Eligibility criteria (1) randomized controlled trials evaluating pain intensity, functional disability, or knee extensor strength; (2) participants were adults diagnosed with patellofemoral pain syndrome; and (3) intervention protocols involved knee, hip, or trunk strengthening exercises, administered either individually or in combination.

Information sources Two reviewers across PubMed, Scopus, MEDLINE-Ovid, Web of Science and the Physiotherapy Evidence Database. The search encompassed all available studies up to March 2026. Search terms included ("trunk muscle training" OR "core muscle strengthening exercise" OR "knee extensor strengthening exercise" OR "quadriceps strengthening exercise" OR "gluteal muscle strengthening exercise" OR "hip muscle strengthening exercise") AND ("patellofemoral pain syndrome" OR "patellofemoral disorder" OR and "patellofemoral joint pain").

Main outcome(s) Pain intensity was the primary outcome, assessed using validated instruments (the Visual Analog Scale and the Numeric Rating Scale) to quantify pain severity in clinical settings.

Additional outcome(s) Secondary outcomes were functional disability and knee extensor strength. Disability was assessed using the Anterior Knee Pain Scale, Western Ontario and McMaster Universities Osteoarthritis Index, or Lower Extremity Functional Scale, with scores standardized so that higher values indicated better function and total scores prioritized; standardized mean differences were used due to differing scales. Knee extensor strength (isometric, isokinetic, eccentric) was derived from various instruments and reported as torque or force.

Data management Two reviewers independently collected data on study characteristics, interventions, and outcomes, with any disagreements resolved through consensus or by involving a third reviewer. When multiple assessment points were available, data obtained immediately after the intervention were selected. Missing data were requested from the original authors, and non-parametric results were converted to means and standard deviations according to recommendations from the Cochrane Handbook.

Quality assessment / Risk of bias analysis Methodological quality was assessed using the Physiotherapy Evidence Database scale, which evaluates 10 methodological criteria, excluding the eligibility item from the total score.

Strategy of data synthesis A frequentist random-effects model implemented in Stata (version 19.5; StataCorp) was used to estimate standardized mean differences with 95% confidence intervals, quantify heterogeneity using Tau-squared, and generate treatment rankings based on surface under the cumulative ranking curve values. Inconsistency was evaluated using the side-splitting approach, with a significance threshold set at $p < 0.05$. Meta-regression analyses was conducted to explore the potential influence of effect modifiers (e.g., treatment duration, frequency, proportion of female participants, and symptom stage) on treatment effects. Consistency between direct and indirect evidence was evaluated using a node-splitting approach. Global inconsistency was assessed with the design-by-treatment interaction model, while loop-specific methods were applied to examine inconsistency within closed loops.

Subgroup analysis N/A.

Sensitivity analysis N/A.

Country(ies) involved Taiwan (R.O.C).

Keywords patellofemoral pain syndrome, exercise therapy, network meta-analysis, physical therapy.

Contributions of each author

Author 1 - Long-Huei Lin - Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Writing – original draft.
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Author 3 - Jong-Shyan Wang - Writing – review & editing.
Author 4 - Yi-Ling Peng - Conceptualization Supervision, Writing – review & editing.