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A Systematic Review and Meta-analysis of Core Muscle Training on Clubhead Speed among Golfers

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Liu, HH; Lin, LH; Lin, TY; Wu, WT; Chang, KV.

Corresponding author:
Hsing-Hui Liu

liouhsinghui891023@gmail.com

Author Affiliation:
Department of Physical Medicine and Rehabilitation, National Taiwan University Hospital, Bei-Hu Branch, Taipei, Taiwan.

ADMINISTRATIVE INFORMATION

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

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202680072

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 18 August 2026 and was last updated on 18 August 2026.

INTRODUCTION

Review question / Objective To evaluate the effects of physical training incorporating core muscle training on clubhead speed (CHS) in healthy golfers. Specifically, this study aims to (1) investigate the overall treatment effect, (2) perform subgroup analyses according to training specificity (golf-specific swing-simulated core training [GSCT] vs. non-GSCT), (3) evaluate the impact of combining core training with extremity conditioning, and (4) perform meta-regressions on potential continuous moderators (intervention length, frequency, age, and sex).

Rationale Golf is a globally popular sport where CHS serves as a key indicator of playing ability and performance. The core musculature plays a critical role in the rotational kinetic chain during a golf swing, providing proximal stability to facilitate distal mobility of the extremities and minimize energy leaks. Although current systematic reviews confirm that physical training improves CHS, they have not specifically analyzed the isolated effects of incorporating core muscle training or distinguished between GSCT and non-GSCT regimens. This study addresses this critical gap through a sport-specific quantitative synthesis.

Condition being studied The PICO (population, intervention, comparison, outcome) setting of the current meta-analysis will include: (1) Population: Healthy golfers of any skill level, age, or sex; (2) Intervention: Physical training incorporating core muscle training; (3) Comparison: Traditional training, active control, or placebo control; and (4) Outcome: Quantitative assessment of change in CHS.

METHODS

Search strategy Two authors will make independent electronic searches in PubMed, Embase, Cochrane CENTRAL, Web of Science, Scopus, and Google Scholar with keywords of ("Golf" OR "Golfer") AND ("Core training" OR "Core stability" OR "Core exercise" OR "Trunk training" OR "Trunk stability" OR "Lumbopelvic" OR "Spinal stabilization" OR "Plyometric" OR "Resistance training" OR "Strength training" OR "Functional training" OR "Corrective exercise" OR "Weight ball" OR "Medicine ball") through the earliest record to June 30, 2026.

Participant or population Two authors will make independent electronic searches in PubMed, Embase, Cochrane CENTRAL, Web of Science, Scopus, and Google Scholar with keywords of ("Golf" OR "Golfer") AND ("Core training" OR "Core stability" OR "Core exercise" OR "Trunk training" OR "Trunk stability" OR "Lumbopelvic" OR "Spinal stabilization" OR "Plyometric" OR "Resistance training" OR "Strength training" OR "Functional training" OR "Corrective exercise" OR "Weight ball" OR "Medicine ball") through the earliest record to June 30, 2026.

Intervention Physical training incorporating core muscle training.

Comparator Traditional training, active control, or placebo control.

Study designs to be included Controlled trials (both randomized and non-randomized controlled trials).

Eligibility criteria Inclusion Criteria:
1. Controlled trials (randomized or non-randomized) enrolling healthy golfers of any skill level, age, or sex.
2. Physical training interventions that incorporate core muscle training.
3. Presence of a traditional training, active control, or placebo control comparator.
4. Quantitative assessment of CHS before and after the intervention.
Exclusion Criteria:
1. Observational studies, case reports, or cohort studies.
2. Studies incorporating participants with acute musculoskeletal injuries.
3. Lack of an appropriate control group.
4. Insufficient quantitative data available for meta-analysis.

Information sources Two authors will make independent electronic searches in PubMed, Embase, Cochrane CENTRAL, Web of Science, ClinicalTrials.gov, Scopus, and Google Scholar with keyword of ("Golf" OR "Golfer") AND ("Core training" OR "Core stability" OR "Core exercise" OR "Trunk training" OR "Trunk stability" OR "Lumbopelvic" OR "Spinal stabilization" OR "Plyometric" OR "Resistance training" OR "Strength training" OR "Functional training" OR "Corrective exercise" OR "Weight ball" OR "Medicine ball") through the earliest record to June 30, 2026.

Main outcome(s) The change in CHS following the intervention, uniformly converted to meters per second as the standard SI unit.

Data management Two independent authors will extract participant demographics, study design, training protocols, core exercise details, training specificity (GSCT vs. non-GSCT), control conditions, and outcomes. The evaluators will ensure effect direction consistency (higher CHS indicates performance improvement) and convert speed units to m/s. In situations where the data is unavailable in the published articles, we will contact the corresponding authors to obtain the original data.

Quality assessment / Risk of bias analysis To investigate the methodological quality of recruited studies, we will use the Cochrane risk-of-bias tool for randomized trials, version 2 (RoB 2), which consists of 6 main items: randomization process, intervention adherence, missing outcome data, outcome measurement, selective reporting, and overall risk of bias. In the intervention adherence section of RoB 2, there are two options for literature assessment: intention-to-treat (intervention assignment) or per-protocol (intervention adherence). In this meta-analysis, we will choose the per-protocol evaluation, since it fits the design of our included studies.

Strategy of data synthesis Meta-analysis conducted using a random-effects model using Comprehensive Meta-Analysis (CMA) software, version 3 (Biostat, Englewood, NJ, USA). Continuous outcomes pooled as Hedges' g with 95% confidence intervals (CIs). A two-tailed p-value < 0.05 is considered statistically significant. Heterogeneity evaluated using the Cochran Q statistic and I^2 index (with 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively).

Subgroup analysis Subgroup analyses will compare interventions incorporating GSCT vs. non-GSCT, and core training combined with extremity training vs. core training alone. Meta-regressions will analyze the effects of intervention length, training frequency, participant age, and sex.

Sensitivity analysis To confirm the robustness of the meta-analysis, the sensitivity analyses will be performed using one-study removal method to see if there is a significant change in the summary effect size after removing a particular trial from the analysis.

Language restriction No language limit.

Country(ies) involved Taiwan.

Keywords Golf; core muscle training; exercise; physical education; sports.

Contributions of each author
Author 1 - Hsing-Hui Liu.
Author 2 - Long-Huei Lin.
Author 3 - Ting-Yu Lin.
Author 4 - Wei-Ting Wu.
Author 5 - Ke-Vin Chang.