INPLASY PROTOCOL

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None declared.

Effects of Plyometric Training on Technical Skill Performance among Athletes: A Systematic Review and Meta-Analysis

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Review question / Objective: **What are the effects of plyometric training on athletes' technical skill performance?**
Eligibility criteria: **To qualify for inclusion in the meta-analysis, studies were required to include i) a plyometric training programme of at least 4 weeks, ii) healthy athletes, with no restriction for sex, age or sport, iii) a active control group, iv) a measure of technical skill (e.g., soccer kicking, handball throwing).**

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 13 February 2023 and was last updated on 03 May 2023 (registration number INPLASY202320052).

INTRODUCTION

Review question / Objective: **What are the effects of plyometric training on athletes' technical skill performance?**

Rationale: **Plyometric training is a training method often used to improve athlete's physical performance, including strength, power, agility, speed, and balance. Given the increased scientific awareness of the relevance of plyometric training, the lack of comprehensive analyses of their technical skills after plyometric training.**

Condition being studied: **Successful performance in sports is commonly attributed to a unique combination of gifted and trained physical, technical, tactical, and psychosocial skills. Measuring these multidimensional qualities could offer practitioners insight into game or sport demands, and identify areas for continued player development. Sport-specific technical skills are considered to be**

actions involving a specific task or goal that require the coordination of multiple motor competencies relative to a time horizon and context. Examples may include kicking a soccer ball to another player to move the ball down field or pitching a baseball to strike out an opponent. Indeed, designing optimal training programs aimed at improving technical skill performance is of paramount importance for coaches and sport scientists. Over recent years, plyometric training has emerged as an effective, time-efficient, and easy way to implement training. Classical plyometric exercises include the various jump and throwing exercises, which are the natural parts of most sports movements.

METHODS

Search strategy: Database searches were conducted using PubMed, SPORTDiscus, Web of Science Core Collection, and SCOPUS electronic databases from inception until 3 May 2023. A systematic investigation of the topic was carried out utilizing the Boolean operations AND and OR. Experts' opinions and previous reviews were used to help define our search strategy. The keywords are as follows: ("plyometric training" OR "plyometric exercise*" OR "stretch-shortening cycle" OR "jump training") AND (“athletic performance” OR “technical skill⁎” OR “skill⁎” OR “technique” OR “performance”) AND (athlete* OR player*). Furthermore, to find additional literature that might not have shown up in the search results using the four databases, additional hand-searches were conducted on Google Scholar and based on the reference lists of selected papers.

Participant or population: Athletes, with no restrictions on their sports background, sex, or age.

Intervention: A plyometric training programme of at least 4 weeks, defined as lower body unilateral or bilateral bounds, jumps, hops and/or medicine ball exercises, push-ups that commonly utilise a pre-stretch or countermovement which incites usage of the stretch–shortening cycle.

Comparator: Active control group.

Study designs to be included: Randomized Controlled Trials.

Eligibility criteria: To qualify for inclusion in the meta-analysis, studies were required to include i) a plyometric training programme of at least 4 weeks, ii) healthy athletes, with no restriction for sex, age or sport, iii) a active control group, iv) a measure of technical skill (e.g., soccer kicking, handball throwing).

Information sources: Reported one or more sport-specific technical skill performance (e.g., soccer kicking velocity). A technical skill outcome was defined as an action due to a task or goal produced by coordinated motor abilities relative to a sport-specific context. For studies to be included, the pre- and post-test values or treatment effect for a technical skill outcome were reported. Studies that only examined time trial performance outcomes of a sport (e.g. running , swimming time trial), rather than a sport-specific technical skill, were excluded. Means and standard deviations for a measure of pre-post-intervention performance were used in the analyses, converted to Hedge`s g effect size (ES).

Main outcome(s): Reported one or more sport skill performance (e.g., tennis serve velocity).

Data management: Data were extracted from included articles, using a form created in Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). In cases where the data required were not clearly or completely reported, the authors of the article were contacted for clarification.

Quality assessment / Risk of bias analysis: The Physiotherapy Evidence Database (PEDro) scale was used to assess the methodological quality of the randomized controlled trials included in this systematic review. The scale scores the internal study validity in a range of 0 (low methodological quality) to 10 (high methodological quality). Eleven items are measured in the scale. Criterion 1 is not included in the final score. Points for items 2 to 11 were only attributed when a criterion was clearly satisfied. Two of the authors independently scored the selected articles. Disagreements in the rating between both authors were resolved through discussion with a third author.

Strategy of data synthesis: For analysis and interpretation of results, meta-analyses were conducted if at least three studies provided data for the same parameter. Means and standard deviations (SD) for a measure of pre-post-intervention performance were used to calculate effect sizes (ES; Edge's g). The data were standardized using the post-intervention data for a relevant measure of performance. When data values from a study were not available (omitted or in graphical form), that study's corresponding author was contacted to retrieve the relevant information. When data were displayed in a figure and no numerical data were provided by the authors, software (WebPlot- Digitizer, version 4.5) was used to derive numerical data from the respective figures. The inverse variance random-effects model for meta-analyses was used because it allocates a proportionate weight to trials based on the size of their individual standard errors, and facilitates analysis while accounting for heterogeneity across studies. The ESs were pre- sented alongside 95% confidence intervals (95%CIs). The calculated ESs were interpreted using the conventions outlined for standardised mean differences: 0.6–1.2, moderate; >1.2–2.0, large; >2.0–4.0, very large; >4.0, extremely large. In some studies in which there was more than one intervention group, the control group was proportionately divided to facilitate comparison across all participants. The impact of study heterogeneity was assessed using the I2 statistics, with values of < 25%, 25–75%, and > 75% representing low, moderate, and high levels of heterogeneity, respectively. Heterogeneity was assessed using the I2 statistic. I2 values of < 25%, 25–75%, and > 75%, were considered to represent low, moderate and high levels of heterogeneity, respectively. The risk of publication bias was explored using the extended Egger's test. The threshold of statistical significance was defined to be $p < 0.05$. In the case of a significant Egger's test, a sensitivity analysis was performed. All analyses were carried out using the Comprehensive Meta-Analysis program (version 3; Biostat, Englewood, NJ, USA). The statistical significance threshold was set at $p < 0.05$.

Subgroup analysis: The moderator variables of programme duration, training frequency, and total number of training sessions were chosen based on the accepted influence of these variables on adaptations to exercise. In addition, participant's age and sex were also considered as potential moderator variables. When appropriate, participants were divided using a median split. Meta analyses stratification by each of these factors was performed, with a p value of <0.05 considered as the threshold for statistical significance.

Sensitivity analysis: In the case of a significant Egger's test, a sensitivity analysis was performed.

Language restriction: Only articles published in English were considered.

Country(ies) involved: Malaysia; China.

Keywords: plyometric exercise; sports; skill; athletic performance; stretch-shortening cycle.

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