# INPLASY PROTOCOL

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**Conflicts of interest:**
**None.**

# EFFECTS OF PLYOMETRIC JUMP TRAINING ON THE PHYSICAL FITNESS OF BASKETBALL PLAYERS: A SYSTEMATIC REVIEW AND META-ANALYSIS STUDY PROTOCOL

Ramirez-Campillo, R[1]; Garcia-Hermoso, A[2]; Moran, J[3]; Chaabene, H[4]; Negra, Y[5]; Scanlan, A[6].

**Review question / Objective:** **What are the effects of plyometric jump training on basketball players' physical fitness?**
**Condition being studied:** **Basketball is one of the most popular sports, with more than 200 officially organized national federations worldwide, involving an important potential talent pool of athletes who compete in elite basketball. As a result, there has been significant improvement in player technical and physical skills, placing great emphasis on better development of speed and power abilities, since speedy and fast-pace activities are common characteristics of both defensive and offensive game situations. Accordingly, modern basketball requires players to effectively and repeatedly perform numerous explosive motor tasks such as acceleration, deceleration, jumping, change of direction, throws, sprint, strength-related, and demanding technical and tactical skills. Therefore, designing optimal training programs aimed at improving these qualities (i.e., physical fitness) is of paramount importance for coaches and sport scientists. Studies involving the physical development of basketball athletes have primarily focused on improvement in muscle power, which is popularly evaluated and developed through the systematic use of jump exercises, a training method known as plyometric jump training (PJT).**

**INPLASY registration number:** This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 15 April 2020 and was last updated on 15 April 2020 (registration number INPLASY202040088).

## INTRODUCTION

**Review question / Objective:** **What are the effects of plyometric jump training on basketball players' physical fitness?**

**Rationale:** **Basketball requires players with high physical fitness. Given the increased scientific awareness of the relevance of plyometric jump training (PJT), the lack of**

systematic reviews and meta-analysis (SRMA) studies targeted at basketball players, and the lack of comprehensive analyses of their physical fitness (other than vertical jump) after PJT, with no specific moderator analyses (e.g., training frequency, volume), it is appropriate to analyse studies focused on describing these effects.

**Condition being studied:** Basketball is one of the most popular sports, with more than 200 officially organized national federations worldwide, involving an important potential talent pool of athletes who compete in elite basketball. As a result, there has been significant improvement in player technical and physical skills, placing great emphasis on better development of speed and power abilities, since speedy and fast-pace activities are common characteristics of both defensive and offensive game situations. Accordingly, modern basketball requires players to effectively and repeatedly perform numerous explosive motor tasks such as acceleration, deceleration, jumping, change of direction, throws, sprint, strength-related, and demanding technical and tactical skills. Therefore, designing optimal training programs aimed at improving these qualities (i.e., physical fitness) is of paramount importance for coaches and sport scientists. Studies involving the physical development of basketball athletes have primarily focused on improvement in muscle power, which is popularly evaluated and developed through the systematic use of jump exercises, a training method known as plyometric jump training (PJT).

## METHODS

**Search strategy:** Database searches were conducted using PubMed, MEDLINE, Web of Science Core Collection, and SCOPUS electronic databases from inception until 3 January 2020. Only articles published in the English language were considered. The search was conducted using the Boolean expressions AND, OR, and the following keywords: “ballistic”, “training”, “complex”, “explosive”, “force”, “velocity”, “plyometric”, “stretch”, “jump”, “shortening”, “basketball”, and “cycle”. Following is an example of a PubMed search: (((((((("randomized controlled trial"[Publication Type]) OR "controlled clinical trial"[Publication Type]) OR "randomized"[Title/Abstract]) OR "trial"[Title]) OR "clinical trials as topic"[MeSH Major Topic]) AND "basketball"[Title/Abstract]) OR "basketball players"[Title/Abstract]) OR "basketball teams"[Title/Abstract]) AND "training"[Title/Abstract]) OR "plyometric"[Title/Abstract]. Duplicates were removed and the search results were analysed according to the eligibility criteria. In selecting studies for inclusion, a review of all relevant titles was conducted before examination of the abstracts and then the full texts. Only peer-reviewed articles were included in the meta-analysis. Following the formal systematic searches, additional hand-searches were conducted. After an initial search, accounts were created in the respective databases. Through these accounts, the lead investigator received automatically generated emails for updates regarding the search terms used. These updates were received on a daily basis (if available), and studies were eligible for inclusion until the initiation of manuscript preparation.

**Participant or population:** Cohorts of healthy basketball players, with no restriction for sex or age.

**Intervention:** A PJT programme of at least 2 weeks, defined as lower body unilateral or bilateral bounds, jumps, and hops that commonly utilise a pre-stretch or countermovement which incites usage of the stretch–shortening cycle.

**Comparator:** A control group of basketball players.

**Study designs to be included:** Randomized and controlled trials.

**Eligibility criteria:** To qualify for inclusion in the meta-analysis, studies were required to include i) a PJT programme of at least 2 weeks, ii) cohorts of healthy basketball

players, with no restriction for sex or age, iii) a control group of basketball players, iv) a measure of physical fitness (e.g., sprinting speed, change of direction speed [CODS])

**Information sources:** Database searches were conducted using PubMed, MEDLINE, Web of Science Core Collection, and SCOPUS electronic databases. Only peer-reviewed articles were included in the meta-analysis. Following the formal systematic searches, additional hand-searches were conducted.

**Main outcome(s):** Physical fitness outcomes such as sprinting, jumping, CODS are appropriate measures of muscular power, requiring a fast transition between the eccentric and concentric phases of a muscle action, thus requiring utilization of the stretch–shortening cycle. Such measures also present very high test–retest reliability and were, therefore, chosen on the basis of establishing a degree of consistency between analysed studies. 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).

**Additional outcome(s):** Physiological and biomechanical data was also considered, as they were related to measures of physical fitness.

**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 eligible studies included in the SRMA. This scale evaluates internal study validity on a scale from 0 (high risk of bias) to 10 (low risk of bias). The quality assessment was interpreted using the following 10-point scale: ≤3 points was considered poor quality, 4–5 points moderate quality, and 6–10 points high quality. If trials had already been assessed and listed on the PEDro database, these scores were adopted. However, methodological quality was not an inclusion criterion.

**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. Meta-analytical comparisons were carried out in the Comprehensive Meta-Analysis program (version 2; Biostat, Englewood, NJ, USA). Means and standard deviations for a measure of pre-post-intervention performance were used in the analyses. The inverse variance random-effects model for meta-analyses was used. In addition, Hedge`s g effect size (ES) calculations were represented by the standardized mean difference and are presented with 95% confidence intervals (CIs). The calculated ESs were interpreted using the conventions outlined for standardized mean differences by Hopkins et al. for sport-related studies (0.6–1.2, moderate; >1.2–2.0, large; >2.0–4.0, very large; >4.0, extremely large). To gauge the degree of heterogeneity amongst the included studies, the I2 statistic was referred to low, moderate, and high levels of heterogeneity correspond to I2 values of 25, 50, and 75%, respectively. Risk of bias across studies was assessed using the extended Egger's test.

**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.

**Sensibility analysis:** Sensitivity analyses were conducted to assess the robustness of the summary estimates in order to

**determine whether a particular study accounted for the heterogeneity. Thus, in order to examine the effects of each result from each study on the overall findings, results were analysed with each study deleted from the model once. It is acknowledged that other factors, such as differences in trial quality or true study heterogeneity, could produce asymmetry.**

**Language:** **Only articles published in the English language were considered.**

**Country(ies) involved:** **Chile; Spain; United Kingdom; Germany; Tunisia; Australia.**

**Keywords:** **Human physical conditioning; resistance training; plyometric exercise; stretch reflex; sports; exercise therapy.**