A systematic review: plyometric training programs for young children  
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CRD summary
The authors concluded that plyometric training had a large effect on improvement of the ability of children to jump and run, but only a small effect on improvement of strength. The possibility of error and biases during the review and the low quality of the included studies mean that the authors' conclusions cannot be considered reliable.

Authors' objectives
To evaluate the safety and efficacy of plyometric training for improving motor performance in children, and to determine whether plyometric training might be used to improve the motor performance of children with low motor competence.

Searching
CINAHL, MEDLINE, HealthSource and SPORTDiscus databases were searched from 1998 (month not reported) until March 2010; search terms were reported. Reference lists of included articles were handsearched to identify further studies.

Study selection
Eligible studies were randomised controlled trials (RCTs) or quasi-experimental studies of plyometric exercise interventions, administered to prepubertal children (aged five to 14 years). Outcomes had to include measures of balance, strength, jumping ability, agility, and running speed.

The mean age of included children ranged from eight to 14 years (where reported). Most studies tested children of one gender. Study populations were developing children or athletes with average or above average motor abilities. Intervention durations ranged from eight weeks to nine months. The number of exercise sessions ranged from one to three times a week. Outcome measures reported were isokinetic dynamometry, static balance, running velocity, agility testing, kicking distance, food intake and various tests of jumping ability.

The authors did not state how many reviewers selected studies for inclusion.

Assessment of study quality
Study quality was assessed using the Physiotherapy Evidence Database (PEDro) scale, which covered specification of eligibility criteria, randomisation methods, allocation concealment, similarity between groups at baseline, blinding (of participants, coaches and assessors), key measurements (85% of participants receiving at least one), intention-to-treat analyses, statistical significance reporting (for at least one key outcome), and effect sizes (Cohen's $d$) or confidence levels reported.

One reviewer conducted the quality assessment; a sample of included studies were checked by another reviewer.

Data extraction
Means and standard deviation for outcome measures were extracted to calculate Cohen's $d$ effect sizes. Cohen's description was used to classify the effect sizes of studies as small, medium or large.

The authors did not state how many reviewers extracted the data.

Methods of synthesis
Concepts of consistency and directness from the GRADE (Grades of Recommendation Assessment, Development and Evaluation) method were used to combine the individual effect sizes from the studies in a narrative synthesis. Findings on the efficacy of plyometric training for improving motor performance, optimum exercise dosage, and intervention safety were reported.

Results of the review
Eight studies were included in the review (over 275 participants; sample size not reported for one study). There were two randomised studies (86 participants) and five quasi-experimental studies (189 participants); the design of one study was not reported. No studies that examined children with developmental coordination disorder, low motor competence, or low motor proficiency were identified.

All eight studies were judged as being of low quality (scored 3 to 6 out of 10 points).

Five of six studies that assessed the ability to jump found statistically significant improvements after plyometric training; three reported a large effect size.

Four studies that assessed running velocity found statistically significant improvements after plyometric training.

Two of three studies that assessed strength and power reported statistically significant improvements.

One study each assessed throwing ability, agility, kicking and balance; there was a statistically significant improvement after plyometric training for agility, kicking and balance.

Two studies reported that there were no injuries or complaints of muscle soreness.

**Authors’ conclusions**
The results suggest that plyometric training had a large effect on improvement of the ability to jump and run, but only a small effect on improvement of strength.

**CRD commentary**
The review question was clear. The inclusion criteria appeared sufficiently replicable. Relevant databases were used in the search; publication and language biases may have been present, so studies may have been missed. Lack of information on the number of reviewers involved in study selection and data extraction meant that the presence of reviewer error and bias was unclear.

A suitable quality assessment tool was used. Study details for seven of the eight included studies were adequately presented. The method of synthesis seemed appropriate, although the quality assessment revealed that the included studies were all of low methodological quality.

The possibility of error and biases during the review and the low quality of the included studies mean that the authors’ conclusions cannot be considered reliable.

**Implications of the review for practice and research**
**Practice:** The authors stated that the plyometric training programs used in the studies included in this review could be used to design exercise programs; detailed recommendations were listed in the paper.

**Research:** The authors stated that further research was necessary to determine whether plyometric training programs should have strength or motor skill achievement prerequisites, to replicate the efficacy and safety of plyometric training for prepubertal children, and to identify appropriate exercise load progression during plyometric training.

**Funding**
Not stated.

**Bibliographic details**

**PubMedID**
21849911

**DOI**
10.1519/JSC.0b013e318204caa0
Original Paper URL
http://journals.lww.com/nsca-jscr/Abstract/2011/09000/A_Systematic_Review_/_Plyometric_Training_Programs.35.aspx

Indexing Status
Subject indexing assigned by NLM

MeSH
Adolescent; Athletic Performance /physiology; Child; Female; Humans; Male; Muscle Strength /physiology; Muscle, Skeletal /physiology; Physical Fitness /physiology; Plyometric Exercise /methods; Postural Balance /physiology; Randomized Controlled Trials as Topic; Running /physiology

AccessionNumber
12012000502

Date bibliographic record published
27/03/2012

Date abstract record published
27/07/2012

Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.