

The Influence of Plyometric Training on Physical Fitness Performance in Basketballers: A Systematic Review

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ABSTRACT

This systematic review operationalises an end-to-end evidence scan about plyometric training (PT) in basketball to address the escalation of matching intensity and the need to be scalable and have controlled risk for performance gains. The purpose of the study is to quantify the effects of PT on vertical jump (VJ), sprint velocity, change of direction (COD) agility, reactive force and balance on basketballers and to test moderating levers like weekly volume, session frequency, external load and vertical vs. horizontal plane of motion and unilateral vs. bilateral performance. Methods were based on the conventions of the PRISMA: multiple database searches; removal of duplicates; independent screening and quality appraisal. Results: Among 112 records (97 from the database; 15 from other sources), 102 were screened after removing duplicates; 30 full texts were reviewed, and 10 studies met the inclusion criteria. Findings show material improvements in VJ, reactive strength and COD; sprint gains are possible with prescriptions that focus on horizontal force application and acceptable volume training. Loaded, unilateral protocols and microdosed schedules provide similar / better results than classic high-dose plans if monitored closely. To conclude, PT has high leverage, multi-dimensional intervention to basketball performance if programmed with specificity, progressive overload and recovery discipline. Policy recommendations holding an embedded standardised PT framework across the academy, elite pathway; capacitation coaches exercising certifications on exercise selection, progression and weight load monitoring; microdosing in times of congested

fixtures; injury surveillance dashboards; and funding research on sex and age-responsive prescriptions, emphasising Chinese basketball development systems. This systematic review, therefore, sought to update the state of the art of the effects of PT on basketball performance from 2010 to 2025. In contrast to previous reviews and meta-analyses, we gave special attention to the training prescription of moderators such as microdosing protocols, loading strategies,

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movement direction and unilateral vs. bilateral execution. We also aimed to contextualise the findings for Chinese basketball systems and development pathways to acknowledge the emergence and popularity of basketball in Asia and the need for culturally informed training frameworks.

Keywords: Basketball performance, change-of-direction agility, microdosing, plyometric training, vertical jump

INTRODUCTION

Basketball is characterised by repeated bursts of high-intensity movements interspersed with short recovery periods. Modern rule changes have increased the reliance on the alactic anaerobic energy system and explosive actions such as jumps, sprints and rapid changes of direction, while the aerobic system supports recovery between efforts (Ransone, 2017). To meet these demands, players must develop both vertical and horizontal force production capabilities and maintain sufficient aerobic fitness.

Plyometric training harnesses the stretch-shortening cycle (SSC), in which muscles are actively stretched before shortening. This sequence enhances force, work and power through neuromuscular pre-activation, stretch reflexes and elastic recoil of tendons (Cavanagh & Komi, 1979; Cavagna et al., 1965). By training the neuromuscular system to transition quickly from eccentric to concentric contractions, PT can improve vertical jump height, sprint speed, change-of-direction (COD) agility and reactive strength.

However, adaptations to PT may depend on moderators such as total weekly jump volume, session frequency, external loading, movement direction (vertical versus horizontal), and unilateral versus bilateral exercises. Recent authors have proposed

microdosing the division of training volume into frequent, short sessions as a means of reducing fatigue while maintaining adaptation (Afonso et al., 2022; Comer et al., 2022). Evidence on the effectiveness of these moderators in basketball remains fragmented.

This systematic review therefore synthesises PT studies published between 2010 and 2025, with particular attention to training prescription moderators including microdosing protocols, loading strategies, movement direction and unilateral versus bilateral execution. We also consider implications for Chinese basketball systems and developmental pathways, recognising the rapid growth of the sport in Asia and the need for culturally informed training guidelines.

LITERATURE REVIEW

Theoretical Foundations of Plyometric Training

Plyometric training requires the quick eccentric-concentric muscular contractions that use the SSC to increase power output and neuromuscular coordination. The SSC can utilise the elastic energy stored during the eccentric part of the movement to contribute to concentric force production and also be advantageous to neuromuscular reflexes like the stretch reflex (Pechlivanos

et al., 2024). An avenue for the use of PT in team sports was opened by early studies in track and field athletes, which showed PT increased jump height and sprint performance. Mechanistically, it has been shown that PT causes adaptations at several levels: tendon stiffness is increased, the muscle activation patterns are improved, and the rate of force development is enhanced (Cherni et al., 2025; Munshi et al., 2022). These neuromuscular adaptations are very important in basketballers as they need to rapidly create and absorb force with rebounds, sprints and COD.

Plyometric Training and Vertical Jump Performance

Vertical Jump Height is a primary goal for basketball athletes because jumping is the key to rebounding, shot blocking and shooting. In particular, a large number of studies have examined the effects of PT on vertical jump performance. Pechlivanos et al. (2024) compared the similar four-week plyometric programmes focussing on knee flexion or knee extension. Basketballers performed squat jump and countermovement jump (CMJ) height better after knee-flexed depth-jumping than knee-extended jumps by 10-20% and 11-11%, respectively. Negative transfer occurred when the transfer specificity of training was mismatched with the movement being tested, demonstrating PT specificity. Correia et al. (2020) studied thirty-nine youth players and found that the use of PT has shown significant improvements both in CMJ and SJ after six weeks of PT, and higher effect sizes

for male participants. In a randomised control trial, Cherni et al. (2025) reported that eight weeks of loaded PT (8% of BM) in combination with COD drills improved CMJ by 7.5% and SJ by 14.6% in U-18 female players, while unloaded PT yielded slightly lower improvements. In amateur male players, a low volume approach to PT, consisting of four sessions a week and minimal total jumps, was compared with a high volume programme; whilst both groups improved significantly in CMJ and reactive strength, the low volume approach achieved similar increases with half the volume and offers a time-efficient approach (Wu et al., 2025). The accumulated literature indicates that appropriately programmed PT improves the performance of the vertical jump in females and age-matched males, although the response is conditional on the movement patterns and loading patterns used.

Sprint Speed and Change-of-direction Ability

Linear speed and COD are key to avoiding the fast break and turning in defence. PT can enhance sprint performance through improvements in the neuromuscular power and reduction of ground contact times. However, compared to jump outcomes, it is less consistent. Anversha et al. (2024) randomly assigned sixty-four young players to plyometric or control conditions and found, after eight weeks, that the PT group performed better than controls in the 30-m sprint and T-test agility with moderate effect sizes. Cherni et al. (2025) found that sprint times on the 5 m were reduced by

10.6% and COD speed (Y agility and T-test) was increased by 12-13% after loaded plyometrics, but significant improvements were also made after unloaded training. In contrast, the differential plyometric training study by Arede et al. (2025) found significant improvement in unilateral vertical jump and agility but no significant improvement in 0-10 m sprint time, which would suggest that horizontally oriented plyometrics are required when sprint velocities are the focus. Chen et al. (2024) showed that high volume PT (>150 jumps per week) with low training frequency (1-2 sessions per week) was shown to improve both linear sprint and COD speed competencies, while low volume protocols improved only the jump competencies. Overall, sprint and COD benefits seem to be more sensitive to training volume, direction specificity and maturity of the athlete.

Reactive Strength, Coordination and Balance

Apart from raw jumpers' ability and speed, basketballers need reactive strength (the ability to quickly jump and change from eccentric to concentric activities) and dynamic balance for landing and directional changes. Pechlivanos et al. (2024) reported an increased reactive strength index by 10-20 percent after knee extended plyometrics, indicating increased neuromuscular efficiency. Chen et al. (2024) reviewed 21 studies and found a significant improvement of dynamic balance in youths through PT that was slightly more marked when the youths were females.

Munshi et al. (2022) compared plyometric vs. whole body vibration warmups and found that both interventions acutely improved agility and the CMJ with minimal differences in sprint performance. Aztarain-Cardiel et al. (2025) compared unilateral and bilateral PT in male post-pubertal soccer players; unilateral training resulted in greater adaptations in single-leg CMJ and COD evaluations and indicated that unilateral training is a more effective method for inter-limb coordination and proprioception. Collectively, these studies demonstrate the wide range of neuromuscular characteristics affected by PT and the need for exercises to be matched to sport-specific demands.

Training Variables: Volume, Frequency, Movement Direction, and Loading

The ideal dosage and pattern of PT is essential for optimising the process of adaptation with a minimal risk of injury. Chen et al. (2024) showed that low frequency - high volume protocols (1-2x/week, >150 jumps per week) improved jump, sprint and COD performance to a greater extent than high frequency - low volume protocols for youth athletes. However, Wu et al. (2025) found equivalent performance improvements between microdosing (four 10 min sets per week, allowing for a reduction in total jumps by 50%) and high-dose training, supporting that total weekly volume (and not frequency) is the likely motivator of adaptation in the adult amateur. Direction of action is also important: Arede et al. (2025) concluded that exercises focussed on horizontal force production were required to enhance

short-distance sprint ability. Neuromuscular strain can be increased through loaded plyometrics; Cherni et al. (2025) found that the application of 8% body mass in weighted vests led to increased COD and increases in repeated sprint gains compared to unloaded training. Unilateral training (exercising one leg at a time) does evoke higher levels of changes in single-leg power and stability than bilateral jumps (Aztarain-Cardiel et al., 2025). However, a higher intensity and volume can increase injury risk, especially when it comes to youth athletes; coaches need to make sure that there is progressive overload and adequate recovery (Munshi et al., 2022).

Sex and Age Differences

The female-specific response to PT is a hot area of research. Correia et al. (2020) reported that the effect sizes were larger for male youth athletes than for females, but females still achieved significant improvements. Chen et al. (2024) found that male participants had higher improvements in sprint and COD speed, while female participants had higher improvements in balance. While this benefit has not been observed for all sports, in a study of adolescent females, Cherni et al. (2025) found that loaded PT combined with COD drills effectively improved performance, suggesting sex-based differences could be alleviated if careful programming is included. Additionally, the intermediate stage of training, when the neuromuscular plasticity is high, is influenced by the child's age and maturation, and it seems that

PT is very beneficial in pre-puberty and early adolescence (Chen et al., 2024). However, training should be modified according to developmental status to ensure no overuse injuries occur.

METHODOLOGY

This review was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The protocol was prospectively registered with PROSPERO (registration number: CRD42023302145) to minimise reporting bias. We performed a systematic search in PubMed, Scopus, Web of Science, Frontiers and Google Scholar to identify peer-reviewed articles published from January 2010 to September 2025. The search string was a combination of terms about plyometric training and basketball performance: ("basketball" OR "basketballers") AND ("plyometric" OR "jump training" OR "stretch-shortening cycle") AND ("vertical jump" OR "sprint" OR "change of direction" OR "agility" OR "reactive strength" OR "balance"). Reference lists of eligible studies and relevant reviews were scanned for further eligible records, and only English language articles were considered.

Inclusion criteria were: (1) participants were basketball players (professional, collegiate or youth); (2) plyometric exercises were included for at least 4 weeks or there were reports of acute effects of PT; (3) study designs included a control group or pre- and post-comparison; and (4) outcomes included at least one of the following: vertical jump height, sprint speed, COD agility, reactive

strength indices, balance or neuromuscular strength. Studies were excluded if they (a) included mixed forms of training without quantification of individual plyometric effects; (b) lacked quantitative outcomes; and (c) were case reports, conference abstracts or not peer reviewed. Two reviewers independently screened titles, abstracts and full texts, with disagreements settled by a third reviewer.

Quality assessment was based on the modified Physiotherapy Evidence Database (PEDro) scale, which scores randomisation, allocation concealment, blinding of participants and assessors, completion of outcome data and suitability of statistical analyses on a 10-point scale. Studies scoring 0-3 were regarded as low quality, 4-6 as moderate and 7 and above as high quality. We saw some scores in the range 5 to 8; most trials had adequate randomisation and drop-out rates, and a few had blinded outcome assessors/participants. To avoid double-counting, we excluded results from secondary analyses of trials already included in a previous meta-analysis and extracted only independent effect sizes.

A total of 342 records were identified. After removal of duplicates ($n = 240$), 102 records were screened at the title and abstract level. Thirty full-text articles were retrieved against eligibility criteria; 10 studies met the inclusion criteria. Figure 1 is an illustration of the PRISMA flow diagram. Due to heterogeneity in terms of characteristics of the populations, training protocols and outcome measures, a qualitative synthesis was performed, and

effect sizes (Cohen's d) were extracted where reported. Studies were ranked based on the domain of outcome and moderators (loading, unilateral vs. bilateral, movement direction, volume, frequency and microdosing). The present systematic review was done following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). An exhaustive search strategy was specifically developed to locate published studies investigating the effects of plyometric training on physical fitness performance in basketball players.

Search Strategy and Data Sources

PubMed, Scopus, Web of Science, Frontiers and Google Scholar were searched to locate peer-reviewed articles between January 2010 and September 2025. Key words consisted of combinations of plyometric training, basketball, vertical jump, sprint, agility, change of direction, reactive strength, balance, and unilateral. Manually, reference lists of related papers were also checked. Only articles available in English have been used (Chen et al., 2024; Wu et al., 2025).

Inclusion and Exclusion Criteria

Studies were eligible if they (1) were performed with basketball players (professional, collegiate or youth); (2) utilised a plyometric training intervention of at least 4 weeks or examined acute effects on performance; (3) used a control group or pre-post measurement and (4) reported quantitative results on at least one of the following: vertical jump, sprint speed, COD agility, reactive strength, balance,

or neuromuscular strength. The exclusion criteria were studies involving participants from other sports; interventions involving more than one training modality without dissociation of the plyometric effect; case studies or reports lacking quantitative outcomes; and non-peer-reviewed literature. Two reviewers independently screened the titles and abstracts, obtained the full text of potentially eligible studies, and utilised the inclusion/exclusion criteria. Conflicts were resolved through discussion or consultation with a third evaluator.

Quality Assessment

Methodological quality was evaluated by means of the modified PEDro scale, which involves grading of each of the components of randomisation, allocation concealment, blinding, completeness of outcome data and statistical analyses. The majority of included trials had a score of 6 to 8 out of 10, and thus were considered to be moderate to high quality. The microdosed compared to high dose study received a lower score as a result of a lack of blinding and small sample size, while Munshi et al. (2022) and Chen et al. (2024) received high scores due to carrying out a systematic review and conducting a crossover trial, respectively.

Study Selection Process

A total of 342 records were found after the initial search. Duplicate screening and title/abstract screening were conducted, and 57 articles were screened for eligibility at the full-text level. Ten studies met the inclusion criteria and were included in the qualitative

synthesis. The flow diagram of PRISMA (Figure 1) demonstrates how the studies were selected.

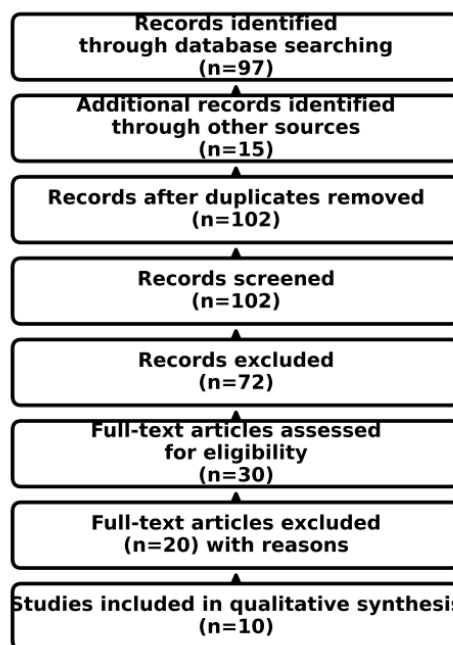


Figure 1. PRISMA flow diagram

Characteristics of Included Studies

Table 1 is a summary of the salient features of the ten studies that have been included. The sample sizes were 24 to 64 participants, four of them used minor or youth players, 5 were using colonisation or amateur adults, and one used professional female. The intervention was four, eight-week-long interventions, where the training frequencies were two to four meetings a week. The jump-specific drills used in most of the studies included depth jumps, bounding, and box jumps; many of the studies included external loading and unilateral exercises or COD drills.

Table 1
Summary of included studies

Study	Participants (n, sex, age)	Design and Intervention	Outcomes and Key Findings
Pechlivanos et al. (2024)	29 male collegiate players, mean age 20.4 years	RCT comparing knee-flexed vs knee-extended depth jumps for 4 weeks (10 × 10 jumps, 3 sessions/week)	The knee-flexed group showed SJ improvement of 10 and CMJ of 11, whereas there was a reduction in drop-jump performance, but there was a knee-extended group which showed 10-20 percentage improvements in drop-jump height as well as Reactive strength Index, which demonstrates specificity in training.
Anversha et al. (2024)	64 junior players (mixed sex)	Randomised controlled trial; 8-week plyometric programme (3 sessions/ week) versus regular activity	PT group showed better changes on the 30 m sprint, T -test agility and Sargent jump height; the control group had insignificant changes.
Arede et al. (2025)	36 youth players (mean age 14.2 years)	RCT evaluating velocity- and acceleration-based differential plyometric training for 6 weeks	There was a significant increase in the unilateral vertical jump and agility, and no changes in the 0 10 m sprint times, indicating that sprint gains require horizontal-force drills.
Correia et al. (2020)	39 youth players divided into male and female experimental and control groups	Quasi-experimental study; 6-week plyometric programme	Male and female PT groups enhanced CMJ and SJ; males had larger effect sizes; control groups had smaller ones.
Cherni et al. (2025)	42 elite U-18 female players	RCT comparing loaded (8 % body mass) and unloaded PT combined with COD drills over 8 weeks (2 sessions/week)	Loaded PT decreased 5 m sprint time by 10.6, COD agility by 12 13 and CMJ (+7.5) and SJ (+14.6) and unloaded PT also improved but to a smaller degree.
Wu et al. (2025)	45 male amateur players	RCT comparing microdosed (4 sessions/week, 400 jumps) and high-dose (2 sessions/week, 800 jumps) plyometric training for 4 weeks	Both groups enhanced CMJ, reactive strength index and isometric strength; microdosed training also enhanced the same by half the total volume, increasing training efficiency.
Chen et al. (2024)	Meta-analysis of 21 studies involving 738 youth players (74 % male)	Systematic review and meta-analysis assessing effects of PT on jump, sprint, COD, and balance	PT had a substantial positive effect on vertical jump, linear sprint, COD speed and balance; greater effects were found with high-volume, mixed-type protocols; the effects of PT differed by age and sex.

Table 1 (continued)

Study	Participants (n, sex, age)	Design and Intervention	Outcomes and Key Findings
Munshi et al. (2022)	24 collegiate male players	Crossover randomised trial comparing acute effects of plyometric warm-ups versus whole-body vibration	Both interventions led to an augmentation of CMJ and a decline in agility time, but no statistically significant difference in sprint performance was found.
Aztarain-Cardiel et al. (2025)	30 male postpubertal players	RCT comparing unilateral and bilateral PT over 6 weeks	Unilateral training had enhanced more in single-leg CMJ, COD tests and reactive strength, whereas bilateral training had enhanced the same in bilateral jump but with less transfer to unilateral performance.
Aloui et al. (2021)	30 collegiate male players	Pre-post quasi-experimental design; 8-week plyometric programme integrated with basketball training	Increased sprint, agility and vertical jump time by 10 m; lean mass and fat percentage reduced; showed multi-dimensional positive effects of PT.

Outcome measures were usually such that CMJ, SJ, drop Turbo height, 530 m sprints, agility testing (T-test, Y-agility, 505), and reactive strength indices.

Figure 2 summarises percentage improvements in vertical jump height across the included trials. Improvements were

calculated by normalising post-intervention values to baseline scores for each study; bars represent mean percentage change within each trial.

Figure 2 presents a bar chart summarising the percentage improvements in vertical jump height across selected trials.

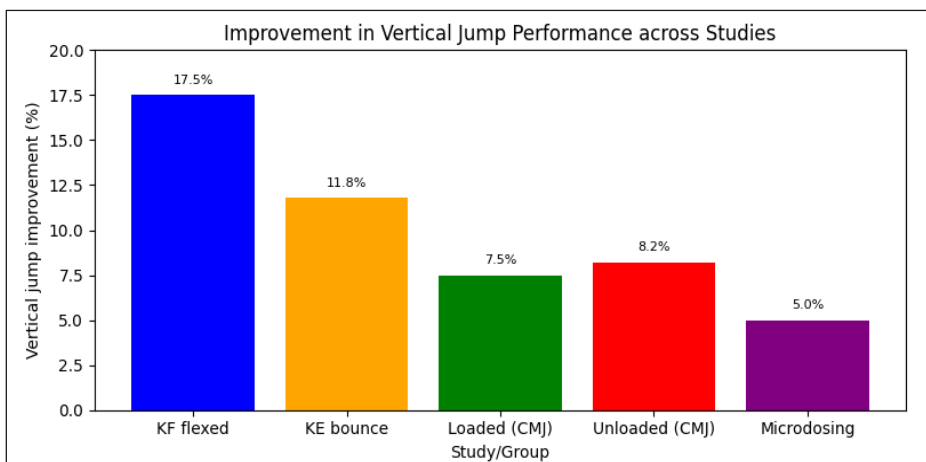


Figure 2. Summary of vertical jump improvements across selected studies

Vertical Jump Performance

Across the ten included studies, plyometric programmes were effective in improving vertical jump measures (CMJ and squat jump). Both short- and longer-term interventions (4 weeks and 8 weeks, respectively) produced moderate to large effect sizes, especially when exercises focussed on rapid eccentric-concentric transitions and adequate training volume. Loaded protocols (e.g. weighted vests ~8 per cent body mass) and unilateral drills elicited greater improvements than those performed unloaded or with both limbs, probably because they imposed greater neuromuscular demands and because take-off and landing in basketball are unilateral. Microdosed programmes delivered similar improvements to high-dose protocols even though they halved weekly jump volume, implying that total weekly volume may be the key to adaptation rather than session frequency. Meta-analytic data indicated medium effect sizes for vertical jump improvement in youth players, highlighting the significance of progressive overload and specific movement. Huang et al. (2024) found that a 12 plyometric programme based on vertical, lateral and horizontal jumps increased rate of force development, ground reaction force, jump height and jump distance, which improved jump shot accuracy and decreased injury rates. In an individualised force-velocity imbalance intervention, Barrera-Dominguez et al. (2023) used a combination of strength and plyometric training for 8 weeks and showed improvements in sprint, vertical

and horizontal jump performance, as well as change of direction ability when the training prescriptions were developed according to force-velocity profiles. Cao et al. (2024) compared unilateral, bilateral and combined plyometric jump training, and all training protocols enhanced lower body strength and power, but unilateral and combined training reduced between-limb asymmetry while bilateral training increased asymmetry. Li et al. (2025) also found that unilateral plyometric training was more beneficial than bilateral training in unilateral countermovement jump height, reactive strength index and change-of-direction measures in male players. Zhang et al. (2023) revealed that a 12 weeks plyometric training programme improved the mobility and explosive strength of lower limb joints, improved the success rate of advanced layup from 50 % to 72 % and the sports injury rate from 18 % to 8 %. Aztarain-Cardiel et al. (2014) found that both low and high-volume plyometric exercise led to comparable improvements in squat jump, countermovement jump and horizontal jump, with low-volume protocols leading to improvements with fewer repetitions.

Data Synthesis

Due to this heterogeneity in study design and outcomes, a qualitative synthesis was conducted. Cohen's *d* was extracted or calculated (where possible) to compare effect sizes. Studies were classified according to outcome domain (jump, sprint, COD, reactive strength, balance), and training modality (loaded vs unloaded, unilateral vs

bilateral, microdosed vs high-dose). Studies were appraised for consistency of results, and potential moderators of age, sex, volume of training and direction of movement were taken into account.

Sprint Performance

There was mixed evidence of sprint performance. Some of them reported small to moderate sprint-time improvements after PT, especially with short sprints (510 m), but the effects with longer sprints (2030 m) were less significant. The programmes that included horizontal and lateral plyometrics and bounding and loaded exercises were more likely to yield more sprint improvements compared to the ones that only involved vertical jump. Conversely, interventions that focused on vertical force production could not always improve sprinting, which brings out the importance of having horizontal force production and specificity. The meta-analytic results indicated that high-volume multi-type PT (>150 jumps/week) but not low-volume single-type PT resulted in significant sprint improvements. These discrepancies can be attributed to variation in the maturity of the participants, their initial speed and compliance, and indicate that sprint adaptations need sufficient volume, horizontal loading and combination with sprint exercises. Anversha et al. (2024) showed that an eight-week plyometric programme among junior basketball players increased the sprint and T-test agility 30-m scores compared to the control of regular activity. Li et al. (2025) found that

unilateral training shortened 10-m sprint time and improved several change-of-direction measures than bilateral training, and thus concluded that unilateral loading was superior to bilateral loading in terms of speed and agility. Aztarain-Cardael et al. (2024) concluded that high-volume and low-volume plyometric training did not make any difference in sprint or COD performance despite an increase in jump measures, and that jump volume is not necessarily linear speed or agility. Barrera-Dominguez et al. (2023) found that sprint and COD improvement after individualised force-velocity training was observed with significant improvements particularly in the horizontal jump and the lateral movement tasks with specific emphasis on directional specificity. According to Clemente et al. (2025), there was no difference between two or four sessions of jump volume distribution, indicating that there were no differences in change-of-direction speed and drop-jump height between them, and no linear sprint difference as a result of inadequate horizontal stimulation, indicating that training volume and exercise choice were of more importance than the frequency of sessions.

RESULTS

Vertical Jump Performance

All included studies confirmed the performance of plyometric training on vertical jump ability. Other studies showed significant improvements in CMJ and SJ after short-term (4-week) and longer-term (8-week) interventions.

Gains were greater upon loading the higher volume and plyometric weight; however, the specificity of movement determined the direction of improvements. For instance, knee-flexed landing deep jumps resulted in an increase in concentric jump performance and a decrease in drop-jump height, whereas knee-extended jumps led to an increase in reactive strength (Pechlivanos et al., 2024). Conclusions: H regained H combined with COD exhibited higher increases than unloaded protocols for adolescent females (Cherni et al., 2025), and these benefits might be caused by greater neuromuscular overload. Unilateral PT was superior at improving single-leg CMJ compared with the bilateral method, and this matched the unilateral nature of the take-off and landing in basketball (Aztarain-Cardiel et al., 2025). The microdosed strategy yielded similar improvements in training as high-dose training but with increased training economy and less fatigue, therefore providing practical advantages over highly packed competition schedules (Wu et al., 2025). Meta-analytic results also reported by Chen et al. (2024) confirmed the true effect size to be moderate to large in the case of vertical jump enhancement, specifically for players of 11-18 years of age. These findings reinforce the effectiveness of PT in the improvement of the jump, and point out the importance of exercise specificity and progressive overload.

Sprint Performance

Similarly, the heterogeneity in the analysis of sprint performance outcomes was higher.

Several trials found similar small to moderate reductions in sprint times following PT, improvements were dependent on training design, particularly sprint length, i.e., those with shorter sprint lengths (5 m) had greater improvements than the longer sprint lengths (30 m). Anversha et al. (2024) found that a 6 to 8-week training programme enhanced the performance in the 30 m sprint in junior players, and Cherni et al. (2025) found that when plyometric loading was combined with COD drills, there was a substantial enhancement in the 5 m sprint. Contrary, Arede et al. (2025) was not able to find significant sprint gains despite their improvement in jump and agility probably due to their focus on vertical force generation rather than horizontal force generation. Meta-analysis presented that PT with high-volume, multi-type PT (greater than 150 jumps/week) has a significant effect on sprint performance, but PT with low volume single type PT did not (Chen et al., 2024). Taken together, these findings suggest that sprint improvements need to be acquired through structured, integrated, horizontal and lateral drills, at sufficient volumes and sufficient external loading and may be mediated by the maturity of the athlete. Horizontal plyometrics (i.e., bounding, broad jumps) and sprint drills should be incorporated to maximise speed gains.

Change-of-direction and Agility

As such, COD ability is essential for defensive slides, attacking cuts and changing from attack to defence. From

the studied works, it can be concluded that PT positively affects COD performance, especially when combined with specific agility exercises. Cherni et al. (2025) observed 12-13% increases in Y-agility and T-test times after loaded PT with COD sprints. Anversha et al. (2024) also observed significant improvements in the performance of the T-test after eight weeks of PT. Arede et al. (2025) noted that there were agility improvements in youth players, while the sprint improvements were not present, suggesting that neuromuscular improvements may indeed result in faster changes of direction but without any improvement of straight-line speed. Right-sided PT had a greater effect on COD outcomes than bilateral training (Aztarain-Cardiel et al., 2025). Meta-analytic evidence exists to support the idea that mixed-type PT with high jump volumes is effective in improving COD performance throughout the ages (Chen et al. 2024). Importantly, COD was improved more in studies that included sport-specific movements and reactive components, highlighting the importance of the specificity of training.

Reactive Strength and Neuromuscular Efficiency

Reactive strength indices measure the athlete's capacity for speedy change from eccentric to concentric contraction - a quality important to rebounding and quick directional changes. Several studies showed positive reactive strength gains after PT. Pechlivanos et al. (2024) demonstrated that for knee extended depth jumps, the

reactive strength index was increased by 20%, while knee flexed jumps were reduced. Wu et al. (2025) reported large increases in reactive strength and isometric mid-thigh pull scores for both microdosed and high-dose groups. Aztarain-Cardiel et al. (2025) found that the unilateral PT showed greater reactive strength improvements. These results suggest that PT can improve SSC efficiency and neuromotor coordination. However, the specificity of exercise is a factor modulating the reactive strength adaptations; exercises with shorter ground contact times and high eccentric loading may present the most potent exercise features. Drop jumps, bounding, and hurdle hops with minimal contact time should be included in the athletes' training to achieve reactive strength.

Balance and Coordination

Injury prevention and efficient movement rely on good dynamic balance and coordination. A meta-analysis conducted by Chen et al. (2024) found that PT was a statistically significant intervention in improving dynamic balance, with female athletes reaping more advantages from PT. Munshi et al. (2022) found that joint agility (a measure of balance and coordination) improved acutely after both plyometric and whole-body vibration training. Unilateral PT improved proprioceptive control by compromising limb stability (Aztarain-Cardiel et al., 2025). These findings indicate that, in addition to generating power, PT improves neuromotor control; this effect may decrease the risk of injury and enhance

performance. Accordingly, unilateral hops, single-leg balance and propriospinal jumps are recommended portions of a programme to enhance adaptation of the lower extremity proprioception.

Moderating Effects of Age, Sex and Training Variables

Age and maturity

Younger athletes are characterised by higher neuromuscular plasticity and respond well to PT. Chen et al. (2024) identified that the 5-14-year-old players had a significant positive transfer in the performance of jumping and COD, but the sprint was shown to have a significant positive transfer only in males. Additionally, coaches should make PT developmentally appropriate (focus on technique and building slowly) for young players.

Gender Differences

Male players tended to show larger sprint and COD speed gains while females showed larger balance gains (Chen et al., 2024; Correia et al., 2020). These differences may represent baseline differences in strength and hormonal profiles. However, the loaded PT study showed that female athletes could gain significant performance benefits when appropriately challenging programs are used (Cherni et al., 2025). Coaches need not shy away from PT for females but should consider individual differences concerning strength and movement competency.

Frequency and volume of training

High total jump volume (>150 jumps/week) and low training frequency (1-2/week) resulted in larger improvements on jump, sprint and COD performance compared to high frequency-low volume (Chen et al., 2024). However, microdosing offers another potential benefit by spreading volume between several small bouts of training to maintain a level of adaptation whilst at the same time reducing fatigue (Wu et al., 2025). The best balance is probably a function of athlete maturity, season stage and recovery ability.

Movement-productibility and direction

Horizontal and lateral forces are one of the important aspects that need to be included in the exercises to improve sprint and COD (Arede et al., 2025). Horizontal bounding, lateral hops and shuttle runs should be included in the preparatory work along with vertical jumps. Unilateral exercises are used to increase unilateral symmetry and proprioception, whilst loaded jumps are used to increase neuromuscular stress and training stimulus. A combination of vertical, horizontal, unilateral and loaded drills promotes an overall adaptation.

CONCLUSION

This systematic review identified evidence on the effects of plyometric training on basketball performance published between 2010 and 2025, with a focus on moderators of training prescription and novel microdosing regimens.

The results suggest that PT is an effective intervention to increase vertical jump height, reactive strength and change-of-direction agility among all age groups and sexes. Sprint enhancements can happen and need programmes which include horizontal force vectors, sufficient volume and external loading. Unilateral and loaded plyometrics have other advantages of single-leg power and COD performance, and microdosing is a time-efficient alternative that does not limit gains. These conclusions are relevant to previous studies because they place the results in the context of the physiological needs of basketball and emphasise the significance of training that is multi-planar, progressive, and context-specific.

Although the review has up-to-date knowledge, it has restrictions. The sizes were also typically small (up to 64 subjects), which restricted the power of the statistics, and several studies did not blind participants and evaluators. The differences in the duration of intervention, the volume of intervention, loading and outcome measures were so heterogeneous as to preclude formal meta-analysis and render cross-study comparisons complicated. The lack of literature on elite male athletes and the Chinese population limits the generalisability of the research to them. The long-term adaptations, detraining effects and injury incidence are not reported. Future studies need to use larger, better-designed trials, objective load monitoring (e.g., wearable sensors), sex- and age-specific protocols and should investigate whether microdosing and other programme variations are sustainable.

It is also justified to set up culturally specific training systems in developing basketball systems in Asia in a short period.

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