Research article

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The added value of upper-body power training in vertical jump development: a comparative evidence-based review

Abstract

Background: The vertical jump (VJ) is a key indicator of lower-limb power and is widely used for performance monitoring in sports. While most VJ training programs focus on lower-body exercises, biomechanical evidence indicates that upper-body motion—particularly arm swing—can enhance take-off velocity, impulse, and jump height. However, the comparative effectiveness of lower-body-only (LB) versus combined upper- and lower-body (CULB) training remains underexplored.

Objective: To review and synthesize post-2010 evidence on the effects of integrating upper-body power training into VJ programs, comparing outcomes with LB-only approaches, and to provide evidence-based programming recommendations for practitioners.

Methods: A narrative–systematic hybrid review was conducted following PRISMA 2020 principles. Searches of PubMed, Scopus, Web of Science, SPORT Discus and Google Scholar (2010–2024) identified studies involving healthy adults or athletes undergoing ≥4-week VJ-focused interventions, either LB-only or CULB. Eligible studies reported at least one standardized VJ outcome. Data were synthesized qualitatively, with effect sizes noted where applicable.

Results: LB-only programs consistently improved CMJ/SJ height by ~4–12% over 6–12 weeks. CULB programs, particularly those incorporating upper-body plyometrics, Olympic-derivative lifts, and trunk-stiffness training, often yielded an additional ~3–8% improvement—especially when testing allowed arm swing (CMJa, approach jumps). Benefits were linked to trainable arm-swing power, enhanced trunk force transmission, and improved whole-system rate of force development and movement sequencing. Greater effects were observed in sports where arm use is integral (e.g., volleyball, basketball) and in athletes with underdeveloped upper-body power.

Conclusions: Adding targeted upper-body power and trunk-stiffness training to established lower-body VJ programs offers a modest but meaningful performance advantage in applied sport contexts. Practitioners should retain foundational lower-body strength and plyometrics while integrating 1–2 upper-body power elements per session, with weekly volumes of 40–70 explosive repetitions. This integrated approach better reflects the full-body nature of sport-specific jumps and is more likely to optimize realized performance.

Keywords: vertical jump, arm swing, upper-body power, plyometric training, countermovement jump, complex training, trunk stiffness

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Introduction

Physical fitness is a multidimensional construct comprising cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, body composition, and neuromuscular coordination. Among these, muscular strength plays a pivotal role across the lifespan, supporting daily activities such as lifting, carrying, and stabilizing, as well as underpinning sport-specific performance. In athletic contexts, the vertical jump (VJ) is a widely used indicator of lower-limb power and is essential for monitoring performance, talent identification, and training evaluation in sports such as basketball, volleyball, soccer, and track and field.

Although jump height primarily depends on explosive triple extension of the hips, knees, and ankles, upper-body contribution—particularly arm swing and trunk stiffness—significantly influences propulsion and take-off velocity. Biomechanical studies indicate that arm swing alone can contribute 6–13% of total jump height by generating additional upward momentum, enhancing stretch–shortening synergy, and improving force transfer through the kinetic chain (Lees et al., 2010; Hara et al., 2016; Siahkouhian et al., 2020).

Despite this evidence, most VJ training programs emphasize lower-body strength and plyometrics (e.g., squats, lunges, jump drills) while neglecting upper-body and trunk-specific work. This approach overlooks the potential additive benefits of integrated, whole-body training. Recent research suggests that incorporating upper-body strength and power exercises can further improve jump performance through increased arm-swing power, better trunk stability, and enhanced neuromuscular coordination.

Problem statement

A gap exists in both research and practice regarding the comparative effects of lower-body-only training versus combined upper- and lower-body training on VJ performance. Without systematic integration of upper-body exercises, athletes may be missing an opportunity to maximize jump outcomes.

Aim of the study

The purpose of this review is to:

- Synthesize findings from studies conducted since 2010 that have evaluated VJ performance following lower-body-only programs versus programs incorporating both upper- and lower-body exercises.
- Provide practical recommendations for exercise selection, programming, and periodization when targeting VJ enhancement.
- Offer evidence-based guidance for coaches, athletes, and sport scientists regarding the potential additive effects of upper-body training on jump height.

The overarching objective is to determine whether adding upper-body training to a VJ program produces superior performance gains compared to traditional lower-body-only approaches, and to present a practical framework for implementation in applied sport settings.

Methods

Study design

This work was conducted as a narrative and systematic hybrid review aimed at synthesizing evidence from peer-reviewed studies examining the effects of lower-body-only training versus combined lower- and upper-body training on vertical jump (VJ) performance. The review adhered to the PRISMA 2020 guidelines for transparent reporting of systematic reviews where applicable, while maintaining a narrative structure to integrate practical recommendations relevant to coaches and athletes.

Search strategy

A comprehensive literature search was conducted across PubMed, Scopus, Web of Science, SPORTD iscus, and Google Scholar to identify relevant studies published between January 2010 and December 2024. The search combined Boolean operators and keywords related to vertical jump training and exercise selection:

("vertical jump" OR "jump performance" OR "countermovement jump" OR "squat jump")

AND ("upper body" OR "arm swing" OR "upper-limb strength" OR "upper-body power")

AND ("lower body" OR "lower-limb strength" OR "plyometrics")

AND ("training program" OR "resistance training" OR "strength training" OR "combined training")

Reference lists of retrieved studies and relevant reviews were also hand-searched to identify additional eligible studies.

Inclusion criteria

Studies were included if they met the following criteria:

Population: Healthy adults or athletes (≥18 years) engaged in sports requiring explosive lower-limb performance.

Intervention: Structured training programs lasting ≥4 weeks that targeted VJ improvement and included:

1. Lower-body-only training protocols, or
2. Combined lower- and upper-body training protocols.

Comparison: Direct or indirect comparison between the two approaches, or longitudinal measurement of performance change following one of them.

Outcome measures: At least one standardized VJ assessment (e.g., CMJ height, SJ height, approach jump).

Study design: Randomized controlled trials (RCTs), controlled trials, or pre-post intervention studies.

Publication type: Peer-reviewed journal articles in English.

Exclusion criteria

Studies were excluded if they:

- Focused solely on rehabilitation populations with clinical limitations.
- Did not measure VJ height or related explosive performance variables.
- Included non-exercise interventions only (e.g., nutrition, supplementation).
- Were conference abstracts, dissertations, or unpublished reports.

Data extraction

From each included study, the following data were extracted:

- Author(s), publication year, and country.
- Participant characteristics (sample size, sex, age, sport background).
- Training program details (duration, frequency, exercise selection, intensity, progression).
- Whether upper-body training was included and type of exercises used.
- VJ performance outcomes (mean changes, effect sizes).
- Statistical significance and practical effect interpretation.

Data synthesis

Given the heterogeneity of training protocols, populations, and measurement techniques, a qualitative synthesis was prioritized over meta-analysis. However, where multiple studies employed comparable methods, effect size ranges (Cohen's d) were noted. Studies were grouped into:

1. Lower-body-only programs
2. Combined upper- and lower-body programs

Practical recommendations were generated by integrating the quantitative evidence with biomechanical principles and applied coaching experience.

Literature review and deep analysis

This section integrates mechanistic (biomechanics, neuromuscular control) and intervention evidence to address the study's problem: whether adding upper-body training to a vertical-jump (VJ) program yields greater improvements than lower-body-only training. We first summarize how the upper body contributes to jump mechanics and measurement outcomes, then synthesize results of training studies since 2010 and compare lower-body-only (LB) versus combined upper+lower-body (CULB) programs.

Biomechanics of the arm swing and trunk contribution to VJ

Across jumping tasks, the arm swing augments vertical impulse by increasing propulsion time and take-off velocity, while the trunk helps regulate posture and stiffness for efficient force transmission. Modern analyses confirm several consistent patterns:

1. Impulse and timing effects. With arms free, the countermovement and propulsion phases are longer and feature higher mean force, producing a larger net impulse and higher.[3] The arm swing also supports a more favorable center-of-mass (COM) trajectory and joint sequencing, particularly in the hip and ankle, increasing total mechanical work.

2. Kinetic chain integration. The upper limbs and shoulder girdle contribute positive work to the system and modulate the proximal-to-distal sequence (shoulder → hip → knee → ankle). EMG and inverse dynamics work since 2010 indicate that the arm swing increases whole-body mechanical output without necessarily increasing lower-limb muscle activation, implying synergy rather than compensation.[3,4]

3. Trunk stiffness and posture. Trunk extensors and deep core musculature (e.g., thoracolumbar extensors, obliques) increase segmental stiffness, stabilizing the pelvis and spine so the lower limbs can express force efficiently under high rates of loading.[5,6] This reduces "energy leaks" and improves force direction at take-off.

4. Task specificity. Arm involvement varies by jump type. Countermovement jumps with arm swing (CMJa) typically gain the most from upper-body contributions, followed by approach jumps; hands-on-hips CMJ/SJ minimize the effect. Therefore, training the upper body should be most impactful for sports that use the arms in performance (e.g., volleyball spike/rebound, basketball rebound/shot contest).

Implication for programs. If arms and trunk can meaningfully increase impulse and COM velocity, then trainable upper-body power (medicine-ball throws, explosive pressing, shoulder-dominant weightlifting derivatives) and core stiffness work should add to adaptations from traditional lower-body plyometrics and strength training.

Lower-body-only programs: what they achieve

Since 2010, aggregated evidence shows LB programs (plyometrics, heavy resistance, weightlifting derivatives) reliably improve CMJ/SJ ~4–12% over 6–12 weeks in trained samples, with variation due to training age, loading, and exercise selection.[7,8] Plyometric-only interventions in court/field athletes commonly produce small-to-moderate improvements; mixed resistance+plyometric or weightlifting-derivative approaches often yield moderate effects when properly periodized.[9,10] In short, LB alone works well—the question is whether adding upper-body work yields more.

Programs that include upper-body work: what's added?

Evidence since 2010 indicates that combined upper+lower programs (CULB) tend to produce equal or greater VJ gains than LB alone, especially in tasks with arm swing allowed:

1. Combined plyometrics (upper + lower). Systematic review/meta-analysis of upper- and lower-limb plyometric training (ULLPT) shows moderate–large effects on CMJ/SJ performance and larger effects for CMJa—consistent with training the muscles that actually accelerate the arms.[11,12] Effects on upper-body strength/power also improve concurrently, suggesting broader neuromuscular benefits without sacrificing lower-body outcomes.

2. Complex or hybrid programs. When heavy resistance or weightlifting derivatives are paired with plyometrics (complex training), VJ gains often exceed plyometric-only approaches in trained athletes, likely due to postactivation performance enhancement and broader power adaptations.[10,13] Programs that explicitly include upper-body explosive work (push press, MB throws, explosive push-ups) report additional improvements in CMJ/CMJa beyond LB-only comparators of similar duration.[12]

3. Direct comparisons. Trials in team-sport athletes show combined strength+plyometric or upper+lower-body plyometric groups achieve greater jump height increases than plyometric-only, and may maintain force characteristics better (e.g., female basketball cohorts), whereas plyometric-only sometimes improves velocity at the expense of force.[9,10] Where CMJa is tested, gains are typically larger—consistent with the transfer of trained arm/trunk power to the measured task.

Magnitude of benefit. Across studies using comparable durations (6–10 weeks) and trained samples, adding upper-body power typically yields an additional ~3–8% relative improvement in CMJ/CMJa compared with LB alone when training and testing allow arm use (Deng et al., 2022; García-Carrillo et al., 2023). The effect is context-dependent: better technical arm swing, greater trunk control, and sport tasks that exploit arm use (volleyball, basketball) tend to show more benefit.

Mechanistic links between training and measured improvement

Why does adding upper-body work help? Three complementary explanations emerge:

Arm-swing power is trainable. Medicine-ball throws, explosive push-ups, and push press/jerk increase shoulder/upper-back/triceps power and arm-swing velocity, lengthening and strengthening propulsion, particularly in CMJa. Kinematic work shows arm swing does not need to increase lower-limb EMG to lift performance—its contribution is primarily mechanical and coordinative (Mosier et al., 2019; Kovács et al., 2023).

Trunk stiffness facilitates force transfer. Integrated programs commonly include anti-extension/anti-rotation core work and Olympic-derivative lifts that "teach" the trunk to transmit force. Improved lumbopelvic control reduces energy loss and enhances force orientation in take-off.[5,6]

Whole-system RFD and sequencing. Complex/hybrid training raises rate of force development across joints and improves sequencing (shoulder/hip/knee/ankle), which is especially useful in fast, reactive jumps.[12,13]

Moderators: who benefits most from adding upper-body work?

Sport/task specificity. Athletes whose competition jumps use the arms (volleyball spiking/blocking; basketball rebounding) show larger realized benefits than athletes assessed exclusively with hands-on-hips CMJ.

Training age and baseline strength. Stronger lower limbs with under-trained trunk/upper-body often show disproportionate benefit from adding upper-body power.

Sex and age. Female and youth cohorts sometimes display relatively greater gains from integrated programs, potentially due to coordination and arm-swing timing improvements, though results are mixed and warrant more RCTs.[9,12]

Measurement considerations and interpretation

Because CMJ performance is sensitive to testing protocol, studies must specify whether arms were restricted (hands on hips) or free. CMJa and approach jumps most clearly reveal the transfer from upper-body work. Conversely, hands-on-hips CMJ/SJ isolate lower-limb changes and may underestimate realized performance gains from CULB programs. For practitioners, this means using both: a hands-on-hips jump to monitor lower-limb progress and a CMJa/approach jump to track whole-body performance.

Practical application

Below, each exercise (or category) is presented first with an academic rationale—biomechanics/physiology, transfer pathway to vertical jump (VJ), and typical responses observed in post-2010 literature—followed by a coaching application—how to teach, load, dose, and progress in a way that plays nicely with lower-body jump work. Exercises are organized by primary function: (A) Upper-body power drivers that influence arm swing, (B) Trunk stiffness and force-transfer enhancers, and (C) Lower-body "must-haves" that form the foundation. Throughout, remember that transfer to VJ is maximized when the testing task allows arm use (CMJ with arm swing; approach jump).

Upper-body power drivers (arm swing and whole-body impulse)

Medicine-ball (MB) overhead throw (standing or countermovement)

- ***Academic rationale.*** Rapid shoulder flexion and trunk extension increase the upward momentum of the arms and thorax. Regular practice increases arm-swing velocity and lengthens propulsion, which is where CMJ with arms (CMJa) benefits most (e.g., combined upper+lower plyometric programs consistently report larger effects for CMJa than hands-on-hips CMJ). Training with relatively light MBs (≈1–3 kg) preserves movement velocity and rate of force development (RFD).
- ***Coaching application***. 3–5 sets × 5–8 throws; full intent every rep; cue "reach tall and fast." Start with 1–2 kg; only progress load if velocity is preserved. Pair with CMJa practice to groove timing.

Chest pass / scoop toss (forward and upward)

- ***Academic rationale***. Trains shoulder horizontal flexion and trunk extension/flexion sequencing. When performed with a countermovement, reinforces the proximal-to-distal pattern that underpins explosive tasks.
- ***Coaching application***. 3–4 × 6–8 throws, short rests (60–90 s). Use 2–3 kg. Emphasize fast release and minimal deceleration. Useful on "integrated" days with jumps.

Explosive push-ups (band-assisted or clap)

- ***Academic rationale***. Improves upper-limb RFD, contributing to faster arm acceleration and more forceful terminal extension of the kinetic chain. Upper-body plyometric training has shown small-to-moderate gains in explosive upper-body tests, and, when paired with lower-body plyometrics, augments jump outcomes in combined programs.
- ***Coaching application***. 3–5 × 4–6 reps; full intent; long rest (90–120 s). Band assistance helps maintain velocity for stronger transfer.

Push press / push jerk (from rack)

- ***Academic rationale***. A weightlifting derivative that couples leg drive with shoulder power; enhances system-wide RFD and sequencing (ankle/knee/hip → shoulder/elbow). Hybrid/complex programs that include such derivatives often outperform plyometric-only for VJ in trained athletes when well-dosed.
- ***Coaching application***. 3–5 × 3–5 reps @ ~50–70% 1RM (bar speed priority). Avoid fatigue that would degrade jump quality that week.

Seated MB throw (strict)

- ***Academic rationale***. Removes leg contribution to target shoulder/elbow RFD. Useful when athletes already have strong legs but underpowered arm swing.
- ***Coaching application***. 3–4 × 5–6 throws; 1–2 kg; velocity focus.

Trunk stiffness and force-transfer enhancers

Anti-extension isometrics (hollow hold, RKC plank) & anti-rotation (Pallof press)

- ***Academic rationale***. CMJ propulsion quality depends on lumbopelvic stiffness and efficient force orientation. Anti-extension/anti-rotation work upgrades trunk stiffness without excessive fatigue, reducing "energy leaks." This is frequently included in successful combined programs.
- ***Coaching application***. 2–3 exercises/session; 2–3 sets × 20–30 s (isometrics) or 8–12 reps (Pallof). Place after main explosive lifts.

Loaded carries (front-rack / suitcase)

- ***Academic rationale***. Enhance whole-body stiffness and frontal/transverse-plane control—useful for maintaining torso integrity during rapid countermovement.
- ***Coaching application***. 2–3 × 20–30 m. Moderate load; crisp posture.

Lower-body "must-haves" (foundation for both groups)

Olympic-lift derivatives (mid-thigh pull, jump shrug)

- ***Academic rationale***. High RFD; strong transfer to jump performance in modern syntheses when well-programmed.
- ***Coaching application***. 3–5 × 3–4 reps; barbell velocity priority.

Squats (back/front) and trap-bar jump

- ***Academic rationale.*** Raise force capacity; when paired with plyometrics or loaded jumps, improve the force–velocity spectrum.
- ***Coaching application***. Heavy day (≥80% 1RM) early in week; loaded jump day (20–40% 1RM or body-mass with trap bar) later.

Plyometrics (depth/box/CMJ progressions)

- ***Academic rationale***. Upgrade SSC behavior; when combined with upper-body plyometrics, the whole-body jump improves more than legs-only.

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- ***Coaching application***. Control volumes; emphasize low-to-moderate drop heights for quality (e.g., 20–45 cm).

Integrated, periodized protocol (8–10 weeks)

Two templates are offered. Template A separates heavy lower-body and explosive upper-body emphases across the week. Template B integrates them within sessions. Choose based on logistics and athlete tolerance. Intensities are written to preserve bar speed and jump quality. All jump assessments in this program should include hands-on-hips CMJ (track lower-limb change) and CMJa (track realized whole-body performance).

Global parameters

Duration: 8–10 weeks

Frequency: 3 sessions/week (Mon–Wed–Fri or Tue–Thu–Sat)

Warm-up: 8–10 min (mobility, pogo hops, snap downs, 2–3 build-up CMJs)

Loading heuristics:

- Heavy strength: 80–90% 1RM; RIR 1–3; stop sets if bar speed drops >15%.
- Explosive derivatives: 50–70% 1RM or load that permits fast execution.
- Plyometrics: quality before quantity; stop if ground contacts slow or landings degrade.
- Upper-body plyos/MB: 1–3 kg for throws; power > load.

Template A (Split Emphasis: LB / UB / Integrated)

Weeks 1–2 (Foundation and Skill)

- **Day 1 (LBstrength+basicplyo):** Back squat 4×5 @ 80%; CMJ (hands on hips) 4×5; Low box jumps 3×6; Anti-extension plank 3×25 s.
- **Day 2 (UBpower):** Push press 4×4 @ ~60%; MB overhead throw 4×6; Explosive push-ups 4×5; Pallof press 3×10/side.
- **Day 3 (Integrated):** Mid-thigh clean pull 4×3 (fast); CMJa 4×5 (cue arm timing); MB scoop toss 3×6; Suitcase carry 3×25 m.

Weeks 3–4 (Force & Velocity Development)

- **Day 1:** Front squat 5×3 @ 85%; Trap-bar jump 4×4 (light-moderate); Depth jump 3×5 (30–40 cm).
- **Day 2:** Push jerk 5×3 @ 60–65%; Seated MB chest throw 4×5; Band-assisted plyo push-ups 4×4; Anti-rotation 3×8/side.
- **Day 3:** Jump shrug 5×3; CMJa 5×4; MB overhead throw 3×6; Front-rack carry 3×20 m.

Weeks 5–6 (Power Emphasis)

- **Day 1:** Back squat 4×3 @ 85–88%; Loaded CMJ 4×4 (10–20% body mass); Box jump 3×5 (moderate height).
- **Day 2:** Push press 5×3 @ 65–70%; MB overhead throw 4×5; Explosive push-ups 4×4; Hollow hold 3×25–30 s.
- **Day 3:** Mid-thigh pull 5×2 (fast); CMJa 5×3 (max intent); MB scoop toss 3×5; Suitcase carry 3×20 m.

Weeks 7–8 (Peaking / Realization)

- **Day 1:** Front squat 3×2 @ 80–85%; Depth jump 3×4 (20–30 cm); CMJ 3×3 (fast).
- **Day 2:** Push jerk 4×2 @ 60%; MB overhead throw 3×4; Explosive push-ups 3×3.
- **Day 3:** Jump shrug 3×2; CMJa 4×3 (video cue timing); MB scoop toss 3×4; Light carries 2×20 m.

Monitoring: Record CMJ (hands on hips) and CMJa weekly (first warm-up set; best of 3). Expect earlier rises in CMJa as arm swing timing improves, and steadier CMJ gains when strength and loaded jump work accumulate.

Template B (Integrated within sessions)

Session format: (1) Explosive derivative → (2) Lower-body plyometric → (3) Upper-body power → (4) Trunk stiffness

Example week:

- **Wk1–2:** Jump shrug 4×3 → CMJ 4×5 → MB overhead 4×6 → Pall of 3×10/side
- **Wk3–4:** Mid-thigh pull 5×3 → Depth jump 3×5 → Explosive push-ups 4×5 → Hollow hold 3×25 s
- **Wk5–6:** Push press 5×3 → Loaded CMJ 4×4 → MB chest 4×5 → Carries 3×20 m
- **Wk7–8:** Push jerk 4×2 → CMJa 4×3 → MB scoop 3×4 → Core circuits 2×

Volume guide (contacts/throws per week):

- Plyometric foot contacts: 60–100 (intermediate), 100–140 (advanced).
- Upper-body throws/plyo reps: 40–70 total.
- Reduce volumes 30–40% in Week 7 (taper) if a test/competition follows.

Limitations

Evidence base heterogeneity. Interventions differ in duration, exercise selection, and progression; some group "combined training" with minimal upper-body work, while others have robust upper-body plyometrics and weightlifting derivatives. This heterogeneity limits strong meta-analytic inferences about exact added centimeters across contexts.

Testing protocol sensitivity. Many studies mix hands-on-hips CMJ and CMJa (or do not report restrictions). Because arm use inflates measured height, the magnitude of improvement is not directly comparable unless protocols are harmonized. For practice, this is a feature (it's the sport's reality), but for research it complicates pooling.

Training-age and sex differences. Fewer RCTs directly compare LB vs. CULB in well-trained female athletes, or in older competitive populations. Youth and sub-elite cohorts may respond differently due to coordination gains and neural plasticity; more stratified analyses are needed.

Specificity vs. interference. If total load is not controlled, adding upper-body work can raise fatigue and potentially blunt jump quality. Successful studies equate volume and emphasize velocity for upper-body power (e.g., light MBs). Poorly balanced designs can understate the true benefit.

Mechanistic gaps. While it's clear that CMJa benefits from arm swing, fewer trials quantify how increases in upper-body power (measured independently) predict changes in CMJa after matched lower-body content. More work combining motion capture, inverse dynamics, and EMG would clarify causal pathways.

Future directions

Head-to-head trials: Randomized comparisons where lower-body content is identical across groups and only the presence/absence of upper-body power differs, with matched external load and monitoring of fatigue.

Mechanistic coupling: Joint-level power analyses and EMG mapping to quantify how increases in arm/trunk power influence propulsion impulse and take-off velocity.

Sex- and sport-specific programs: Volleyball, basketball, and handball athletes may realize larger practical gains; female cohorts deserve targeted trials.

Profiling and individualization: Integrate force–velocity profiling and arm-swing timing screens to decide who benefits most from extra upper-body power.

Longer interventions (12–16 weeks): Determine durability of gains and retention after taper, including injury surveillance and workload analytics.

Conclusion

This review addressed a practical yet often overlooked question in jump training: Does adding upper-body work to a vertical-jump program improve outcomes beyond lower-body-only training? Post-2010 evidence indicates yes, in most applied contexts—particularly when the measured or competitive task allows and exploits arm use (CMJa, approach jumps). Lower-body-only training remains foundational, consistently delivering meaningful improvements in jump height via increases in force and SSC efficiency. However, combined upper+lower programs tend to produce gains—commonly an additional ~3–8% relative improvement—through three interacting pathways:

- Trainable arm-swing power that increases propulsion time and take-off velocity.
- Enhanced trunk stiffness and force transmission, reducing energy leaks and improving force orientation.
- Whole-system RFD and sequencing benefits from complex/hybrid programming that pair explosive upper-body actions (MB throws, explosive pressing) with proven lower-body strength and plyometrics.

From a coaching standpoint, the cost of inclusion is modest (1–2 focused upper-body power elements per session, 40–70 total UB explosive reps weekly). The upside is improved realized performance in the jumps athletes actually perform in sport. The practical consequence is simple: Stop training the jump as a lower-body-only skill. Preserve the heavy squats, Olympic-derivative pulls, and quality plyometrics—but add targeted upper-body power and trunk stiffness work and practice the arm swing within CMJa. When programmed with velocity intent and sensible loads, the combined approach is more likely to move the needle on performance tests that matter to athletes and coaches.

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Conflicts of interest

Authors declare that there is no conflict of interest.

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