PLYOMAT

A COACH'S GUIDE

PLYOMAT GUIDES

THE BILATERAL DEFICIT

Why one leg plus one leg beats two legs together, what the gap should be, and what to do about it. Built on measured standards and the published research.

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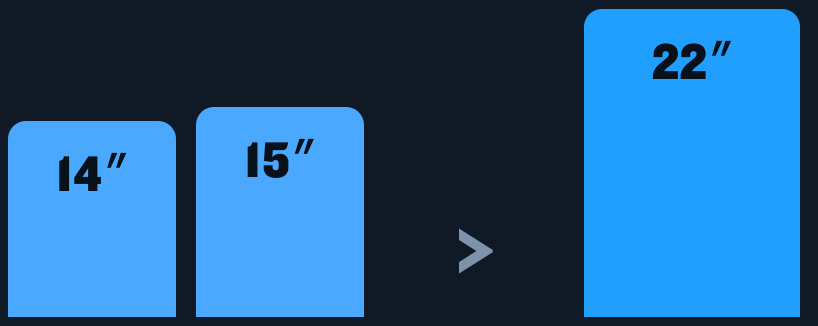
WHAT IS INSIDE

This guide moves from the measurement to the mechanism to the training decision. If you only read one page, read the athlete types on page 9 and the training considerations on page 11.

THE DEFICIT, MEASURED

Test an athlete's left leg alone, then the right leg alone, then both legs together. Add the two single-leg jumps. On the protocol in this guide that sum almost always beats the two-leg jump. **That difference is the bilateral deficit, and it is normal.** How big it looks depends on how you test, which is the subject of the next page.



LEFT + RIGHT
29″

TWO-LEG JUMP
22″

76%

The parts beat the pair. Neither leg alone beats the two-leg jump, only their sum does. **A 76% bilateral index, right in the typical range.**

WHY IT HAPPENS · IT IS MECHANICS, NOT WEAKNESS

The intuitive explanation is that the nervous system cannot fully drive both limbs at once. That is part of the story for single-joint isometric tests, but for jumping the evidence points somewhere else. Bobbert and colleagues measured work per leg in one-leg and two-leg squat jumps and found each leg produced more than 20% less work in the two-leg jump. Roughly three quarters of that difference was explained by **higher muscle shortening velocities** in the two-leg condition, a force-velocity effect, with the remainder from a lower muscle active state.

Bobbert et al., 2006, Journal of Applied Physiology 100:493-499. Explanation of the bilateral deficit in human vertical squat jumping. The deficit in jumping is primarily a force-velocity phenomenon rather than a failure of neural drive.

Practically: a single-leg jump moves the body more slowly against one limb, which sits at a more favourable point on the force-velocity curve, so that limb expresses more of what it has. **The deficit is a window into capacity the two-leg number hides.**

WHAT ONE LEG IS ACTUALLY WORTH

A rule of thumb says a balanced athlete should produce half their two-leg score on one leg. **It is wrong, and wrong in different directions depending which number you look at.** A 2026 force-plate study of 348 athletes measured the whole spectrum at once.

Median single-leg value as a percentage of the same athlete's two-leg value. The dashed line marks the intuitive 50% assumption; almost nothing actually sits on it.

WHY THE NUMBERS LAND WHERE THEY DO

Force and gross impulse look high, and it is tempting to read that as strong single-leg capability. It is not. **One leg supports nearly the whole body instead of half of it**, roughly doubling its load before the jump starts, and those metrics include body weight so they begin from body mass rather than zero. A high number there is a mechanical obligation. Power and jump height fall furthest because one limb cannot move the same mass at the same speed, and athletes compensate with **time**: time to takeoff stretched to about 114% and braking to about 127%. Buying impulse with duration rather than force is a poor trade on a time-limited sport action.

Kruczek, Gabbett, Lake & Nowak, 2026, Sports 14(8):323. 348 athletes, dual force plates, hands on hips with no free-leg swing. Values are medians expressed as a percentage of bilateral capacity.

YOUR NUMBER WILL NOT MATCH THEIRS, AND THAT IS THE POINT

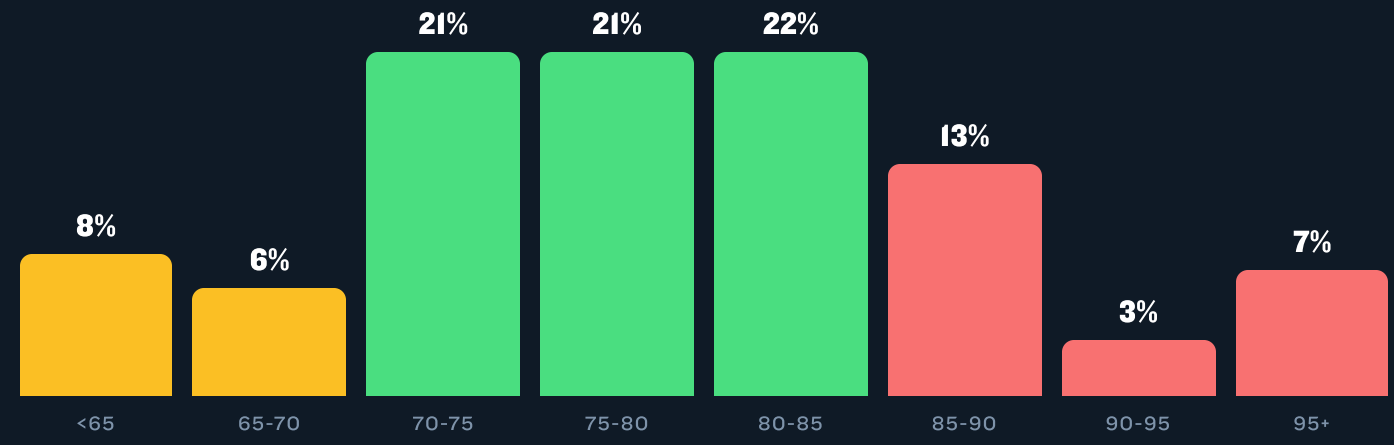
In that study a single leg produced **45%** of the two-leg jump height. In our own testing it sits nearer **64%**. Neither is wrong: their athletes were trained adults on force plates with the free leg pinned, ours are youth on a mat swinging the free leg naturally, which adds real height. **Change the protocol and you change the number, by more than any training block will.** Compare an athlete to their own history on one fixed protocol, never to a published figure from a different one.

THE STANDARDS

Bilateral index = two-leg jump ÷ (left + right) × 100. A lower index means a bigger deficit, so the single legs are collectively ahead. A higher index means the two-leg jump nearly matches the parts, so the single legs are the thing that lags.

	LOW	BELOW AVG	TYPICAL	ABOVE AVG	HIGH
MALE	68%	72%	78%	83%	88%
FEMALE	59%	62%	74%	80%	95%

HOW A GROUP OF ATHLETES DISTRIBUTES



This is a sample of youth athletes tested in a structured development program. Two thirds sit between 70% and 85%, which is the honest working range. The tails are where the coaching decision lives: the athletes under 70% and the athletes over 85% need opposite things, and the two-leg jump alone would not have told you which was which.

TESTING PROTOCOL

The index is a ratio of three jumps, so it is only as good as the consistency between them. **Every rule below exists to keep the three jumps comparable.**

1 **WARM UP, THEN TEST FRESH**

General warm-up, then a few submaximal jumps on each condition. Test before any heavy or fatiguing work. Fatigue moves the single-leg jumps more than the two-leg jump, which inflates the index and makes an athlete look like something they are not.

2 **FIX THE ARM RULE AND NEVER CHANGE IT**

Hands on hips for all three jumps is the recommended standard. See the next page for why. Whatever you choose, the two-leg jump and both single-leg jumps must use the same rule, or the ratio is meaningless.

3 **TWO-LEG COUNTERMOVEMENT JUMP**

Three reps, best counts. Land where you launched, stick the landing tall. A tucked landing inflates flight time and therefore height.

4 **SINGLE-LEG JUMP, EACH SIDE**

Three reps per leg, best counts per leg. Alternate sides rather than doing all reps on one leg, so fatigue lands evenly. **Decide the free-leg rule and write it down.** Held still is the stricter standard and the one the research uses; allowing a natural swing is defensible and is what many facilities do, but it lifts the single-leg number substantially. Either is fine. Mixing them across retests is not.

5 **COMPUTE AND RECORD**

Index = two-leg ÷ (left + right) × 100. Record the arm condition next to the number. Retest on the same protocol, same time of day, same point in the training week.

WHAT INVALIDATES A TEST

- Mixing arm conditions across the three jumps, for example an arms-free two-leg jump against hands-on-hips single legs. This inflates the index by roughly a tenth on its own.
- Testing single legs after a session that already loaded them.
- Swinging the free leg on the single-leg jump, which converts it into a partial two-limb action.
- Comparing an index measured on one system to an index measured on another without checking both use the same height method.

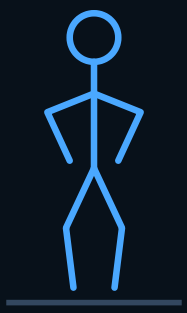
ARMS FREE OR HANDS ON HIPS

This is the single most common reason two coaches get different numbers from the same athlete. The arm swing is worth real height, and it is worth a different amount to different athletes.

WHAT THE ARM SWING IS WORTH

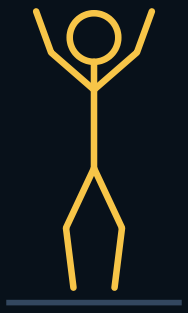
Arm swing adds roughly **10% to 12%** to countermovement jump height in most controlled work, with some athletes reaching closer to 20%. Lees and colleagues decomposed the gain: about 28% of it comes from a higher centre of mass at takeoff, and about 72% from a higher takeoff velocity, driven by energy stored in the arms early and transferred late, plus additional hip work.

Harman et al., 1990, Medicine & Science in Sports & Exercise, the foundational quantification of the arm and countermovement contribution. **Lees, Vanrenterghem & De Clercq, 2004, Journal of Biomechanics**, mechanism of the arm swing benefit.



HANDS ON HIPS

Removes arm skill from the result. **Lower number, cleaner signal**, better repeatability between test days and between athletes. Use this for the index.



ARMS FREE

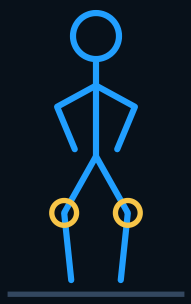
The athlete's real ceiling and the number they care about. **Higher, but noisier**, because arm timing is a skill that differs by athlete and by day. Track it as its own metric.

THE RECOMMENDATION

Use **hands on hips for the bilateral index and for asymmetry**, because you want the legs isolated and the noise low. Capture an **arms-free two-leg jump separately** as the performance ceiling. Never mix the two inside one index calculation, and always write the condition next to the number.

SINGLE LEG VS DOUBLE LEG

The two jumps are not the same movement scaled down. The coordination changes, the balance demand changes, and the joints share the work differently.



DOUBLE LEG

Trunk stays more upright, both knees drive. Higher shortening velocity per limb, so each leg gives up force to speed. **Relatively more knee.**

SINGLE LEG

Trunk leans, the hip works through more range, the ankle does more to hold the base. **Relatively more hip and ankle**, plus a real stability cost.

BEING HONEST ABOUT THE MECHANISM

The coaching shorthand is that single-leg jumping is hip dominant and double-leg jumping is knee dominant. That is **directionally reasonable but not the whole truth**. The strongest propulsion evidence describes a coordination and force-velocity change rather than a fixed switch from one joint to another, and the ankle takes on a larger role in the single-leg case as it helps control a much smaller base of support. Kariyama and Zushi showed that hip-dominant and knee-dominant strategies are postures an athlete can adopt in either condition, which is exactly why standardizing the test matters.

Kariyama & Zushi, 2023, Journal of Human Kinetics, squat and countermovement jump dynamics using knee-dominant or hip-dominant strategies. **Bobbert et al., 2006**, work per leg and the force-velocity account.

WHAT THIS CHANGES FOR YOU

DO NOT EXPECT THE SAME POSTURE

A more forward trunk on the single-leg jump is **normal mechanics**, not a fault to coach out. Judge it on landing control, not on looking like the two-leg jump.

COACH THE ANKLE AND THE BASE

Stability limits one leg. **Own the landing first**, then hops in place, then jumps for height.

STANDARDIZE, BECAUSE STRATEGY DRIFTS

Athletes can shift hip-dominant or knee-dominant at will. **Same cue, same depth, same arm rule** every retest or you measure the strategy, not the athlete.

EXPECT THE SINGLE-LEG NUMBER TO BE LOWER

On our protocol, roughly **two thirds of the two-leg jump** per leg. Under that is capacity to claim; over it means the pair is lagging.

THE THREE ATHLETE TYPES

Three athletes with the **same 22 inch two-leg jump**. The two-leg number cannot tell them apart. The index can, and it names what each one needs to build.

71%

BILATERAL BUILDER

Two-leg **22″**

Left 16″ + Right 15″ = 31″

22 ÷ 31 = 71%

The parts clearly beat the pair. Each leg is individually capable, but the athlete does not express it when both are on the floor.

79%

BALANCED BASE

Two-leg **22″**

Left 14″ + Right 14″ = 28″

22 ÷ 28 = 79%

The typical gap. Nothing to correct here. Keep developing both qualities and train toward the demands of the sport.

88%

SINGLE-LEG BUILDER

Two-leg **22″**

Left 11″ + Right 14″ = 25″

22 ÷ 25 = 88%

The two-leg jump is carrying the athlete. Individual limbs lag, and here a large left-right gap is hiding underneath as well.

WHY THE NAMES SAY THE WORK

The older language, single legs ahead or single legs behind, describes the measurement but not the decision. **The name should tell the coach what to build.** A Bilateral Builder needs two-leg expression, coordination, and intent. A Single-Leg Builder needs per-limb capacity and a closer look at asymmetry. A Balanced Base needs neither corrected, so train the sport.

READ THE INDEX AND THE ASYMMETRY TOGETHER

The third athlete above has both a high index and an 11 versus 14 inch gap between legs. A high index tells you the limbs lag collectively; the left-right gap tells you one of them lags much more. **A strong two-leg jump can hide both at once**, which is the entire argument for testing single legs at all.

WHERE EACH TYPE USUALLY COMES FROM

BILATERAL BUILDER

Common in athletes with a **heavy single-leg training history** and little recent two-leg power work, and in athletes who are strong but jump with poor intent.

SINGLE-LEG BUILDER

Common in **bilaterally trained, weight-room-strong** athletes, and after a period where one limb was protected or unloaded. Check history before programming.

WHICH TEST TELLS YOU MORE

If you had to keep one, which is more telling of athletic performance? The bilateral vertical gets all the attention. **The single-leg vertical is the more diagnostic test, and the more sport-specific one.**

> Sport happens on one leg at a time. Sprinting, cutting, and landing are alternating single-limb tasks, so a symmetric two-leg jump shares less with them than a single-leg jump does.
>
> THE TASK-SPECIFICITY ARGUMENT

WHAT THE EVIDENCE SUPPORTS

SPRINT AND CHANGE OF DIRECTION

Unilateral vertical jumps relate to sprint performance, with correlations reported around **r = -0.52 to -0.73**. Single-leg jumps across planes predict 10 m sprint and change of direction, and are reliable.

ASYMMETRY, VISIBLE ONLY ONE LEG AT A TIME

A bilateral jump lets a strong limb mask a weak one. **Only single-leg testing exposes the left-right gap**, and inter-limb asymmetry is associated with slower sprint and change of direction.

WHERE BILATERAL STILL WINS

The two-leg countermovement jump is the **most reliable, lowest-noise** field jump. It is the better tool for tracking training load response, fatigue, and readiness over time.

THE HONEST LIMIT

Asymmetry's negative relationship is clear for sprint and change of direction but **weak and inconsistent for the vertical jump itself**. Do not claim asymmetry uniformly harms jumping.

Maulder & Cronin, 2005, Physical Therapy in Sport, unilateral jump and sprint relationships. **Meylan, McMaster, Cronin et al., 2009, JSCR**, single-leg lateral, horizontal and vertical jump assessment. **Bishop, Turner & Read, 2018, Journal of Sports Sciences**, effects of inter-limb asymmetries on physical and sports performance. **Guan et al., 2023, PLoS One**, meta-analysis, effect clearer for sprint and change of direction than for vertical jump.

The verdict: keep the bilateral jump as your monitoring baseline because it is stable and cheap to repeat. Add the single-leg jump because it predicts the qualities that decide games, and because it is the only one that shows you the gap between limbs. They answer different questions, and the single-leg battery answers the more useful one.

TRAINING CONSIDERATIONS

The index does not tell you an athlete is broken. It tells you which end of the system has room. Program to the end with room, and keep testing the other end so you know you have not traded one for the other.

Under 72%
BILATERAL BUILDER

The limbs are capable; the two-leg expression is not. Build the pair.

Emphasis: bilateral strength and power expression, and two-leg takeoff timing. Squat and trap-bar patterns loaded for intent, jump squats, countermovement and depth jumps with a clear cue to be fast off the floor. **Cue the intent**, since much of this athlete's gap is coordination and rate, not tissue.

Keep: a maintenance dose of single-leg work so the parts do not decay while you build the pair. **Retest in 4 to 6 weeks.**

72 to 85%
BALANCED BASE

Nothing to correct. Train the sport and the athlete's actual limiter.

Emphasis: a mixed program. Bilateral strength for the ceiling, unilateral work for transfer and resilience, plyometrics dosed by the reactive profile rather than by the index.

Watch: the index drifting over a season. A steady climb toward the high end usually means single-leg work has quietly fallen out of the program.

Over 85%
SINGLE-LEG BUILDER

The pair carries the athlete. Build per-limb capacity, and screen the gap.

Emphasis: unilateral strength and power. Split squats, rear-foot elevated split squats, step-ups, single-leg RDLs, then single-leg landings, hops in place, and single-leg bounding once landings are owned. Progress in that order.

Also: check left versus right. Past a 15% gap, address the lagging side directly before stacking reactive load on it. **Retest in 4 to 6 weeks.**

DOSE IT LIKE TRAINING, NOT LIKE A CORRECTION

None of these are six-week fixes to be run once and forgotten. The index is a dial, not a diagnosis. Shift the emphasis, hold it for a block, retest on the same protocol, and read the direction of travel rather than a single number.

WHAT THE FIELD SAYS

The bilateral deficit has been used to argue for unilateral training for decades. The argument is sound, and it is often overstated in both directions.

THE UNILATERAL CASE

Michael Boyle is the most prominent advocate of unilateral lower-body training, and he invokes the bilateral deficit directly: because the summed unilateral load can exceed the bilateral load, single-leg work loads each limb harder at a lower spinal and systemic cost. Worth representing him accurately, though: **he does not abandon bilateral work.** He retains bilateral power work and both unilateral and bilateral plyometrics. The mainstream position across the field is not a camp war, it is both, sequenced to the athlete's need.

Boyle, Advances in Functional Training (2010) and **New Functional Training for Sports (2016)**, Human Kinetics.

THE PART THAT SURPRISES PEOPLE

Training transfers in both directions, but it is specific and incomplete. Unilateral training builds per-limb capacity and change of direction. **Bilateral training is what actually closes the deficit.** Taniguchi found the bilateral index shifted with training and that bilateral practice reduced the deficit more than unilateral practice did. So increasing unilateral strength can raise bilateral output, and bilateral work can raise unilateral output, but you get most of what you train.

Taniguchi, 1997 and 1998, European Journal of Applied Physiology, training specificity and the bilateral index. **Häkkinen et al., 1996**. **Zhang et al., 2023, Frontiers in Physiology**, meta-analysis of unilateral versus bilateral training.

THE DEFICIT IS TRAINABLE, IN EITHER DIRECTION

This is the practical headline. A bilateral index is not a fixed property of an athlete and it is not a defect to be eliminated. **It moves with what you program**, which is why it is worth measuring on a schedule rather than once. Prescribe by the athlete's need, not by ideology, and let the retest tell you whether the emphasis worked.

THE WHOLE GUIDE, ONE PAGE

THE MEASUREMENT

Index = two-leg ÷ (left + right) × 100. **Typical is 78% male, 74% female.** Two thirds of athletes sit between 70 and 85%.

THE MECHANISM

Mostly a **force-velocity effect**, not failed neural drive. Each leg does over 20% less work in the two-leg jump.

THE PROTOCOL

Hands on hips for all three jumps. Test fresh, alternate sides, three reps each, record the arm condition.

THE MECHANICS

Single leg leans on the **hip and ankle** and costs stability; double leg is relatively more knee. Strategy is trainable, so standardize.

THE THREE TYPES

Bilateral Builder under 72%, **Balanced Base** 72 to 85%, **Single-Leg Builder** over 85%.

THE DECISION

Build the end with room. **Bilateral work closes the deficit**; unilateral work builds per-limb capacity and transfer.

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