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Commentary

Asymmetry in sprinting: The myth of perfection and the reality of performance

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The pursuit of symmetry has long shaped discussions in sports science, particularly in sprinting, where every fraction of a second counts. Yet, the human body is inherently asymmetrical – our hearts are slightly left, most favour one hand or foot, and limb lengths or joint flexibilities are rarely identical. This begs the question: Why do we insist that symmetry is essential for peak sprint performance?

Asymmetry – differences in strength, flexibility, balance, and/or mechanics between body sides – is intrinsic to human movement.[1] While marked and/or persistent asymmetries can disrupt biomechanics and increase (re)injury risk, minor bilateral differences are commonplace and often functional. For example, dominant limb strength allows for efficient movement patterns, even if it creates slight imbalances.[2] Perhaps the relevant question then is not whether asymmetry exists but to what extent it affects human performance.

The relationship between asymmetry and sprint performance remains a subject of debate, with research often comparing kinematic and kinetic gait parameters across the left and right sides.[1] While asymmetry has been a focus in recent research, significant gaps remain. Many studies have narrowly focused on the maximal speed phase,[3,4] overlooking acceleration and deceleration. Additionally, research is predominantly centered on highly trained/national-level (Tier 3)[5] and elite/international-level (Tiers)[6] athletes, with limited data on World-class (Tier 5) sprinters.[7] Sex-based differences also remain under-researched, as studies largely focus on male athletes.[5,7]

As our understanding of asymmetry in sprinting evolves, the conventional belief that an uneven stride slows a runner down prompts an important question: Does stride evenness truly matter for peak performance? This editorial contends that perfect symmetry is neither achievable nor necessary. Instead, the emphasis should shift towards identifying and addressing functional deficits to optimize sprinting mechanics, rather than forcing corrections that may disrupt natural biomechanics.

1. Insights from World-class sprinting

Bissas et al.[7] analyzed the biomechanics of sprinters during the 2017 International Amateur Athletic Federation (IAAF, now World Athletics) 100-m Finals using advanced video calibration and 3D motion analysis. They examined 33 kinematic variables across a stride cycle at maximum velocity, including spatiotemporal measures (e.g., sprint velocity, step rate, step length), joint angles at key gait cycle events (touchdown and toe-off), and vertical and horizontal foot velocities. They found low-to-moderate asymmetry to be a natural feature of the World's fastest sprinters, with no significant impact on overall performance. Asymmetry patterns varied among athletes and across gait phases, such as touchdown (30.0 % ± 26.4 %) and toe-off (2.2 % ± 1.8 %, mean ± SD),[7] underscoring its individualized nature. Analyzing a sprinter's asymmetry thus requires more than quantifying how one limb performs compared to the other.

2. The Usain Bolt case: An asymmetrical champion

Usain Bolt, the fastest man in history, presents a compelling example of functional asymmetry. His biomechanics reveal that his right leg strikes the track with 13 % more force, while his left leg remains on the ground 14 % longer.[8] Bolt's scoliosis, which causes a half-inch difference in leg length, has likely shaped his unique stride mechanics. Bolt's unparalleled success shows that asymmetry does not preclude podium performance.

The question of whether Bolt could have run even faster with a more symmetrical gait remains speculative. Attempting to correct such asymmetry might have disrupted his natural biomechanics, potentially slowing him down. Bolt's case underscores a critical point: Asymmetry into sub-11 s and sub-10 s women

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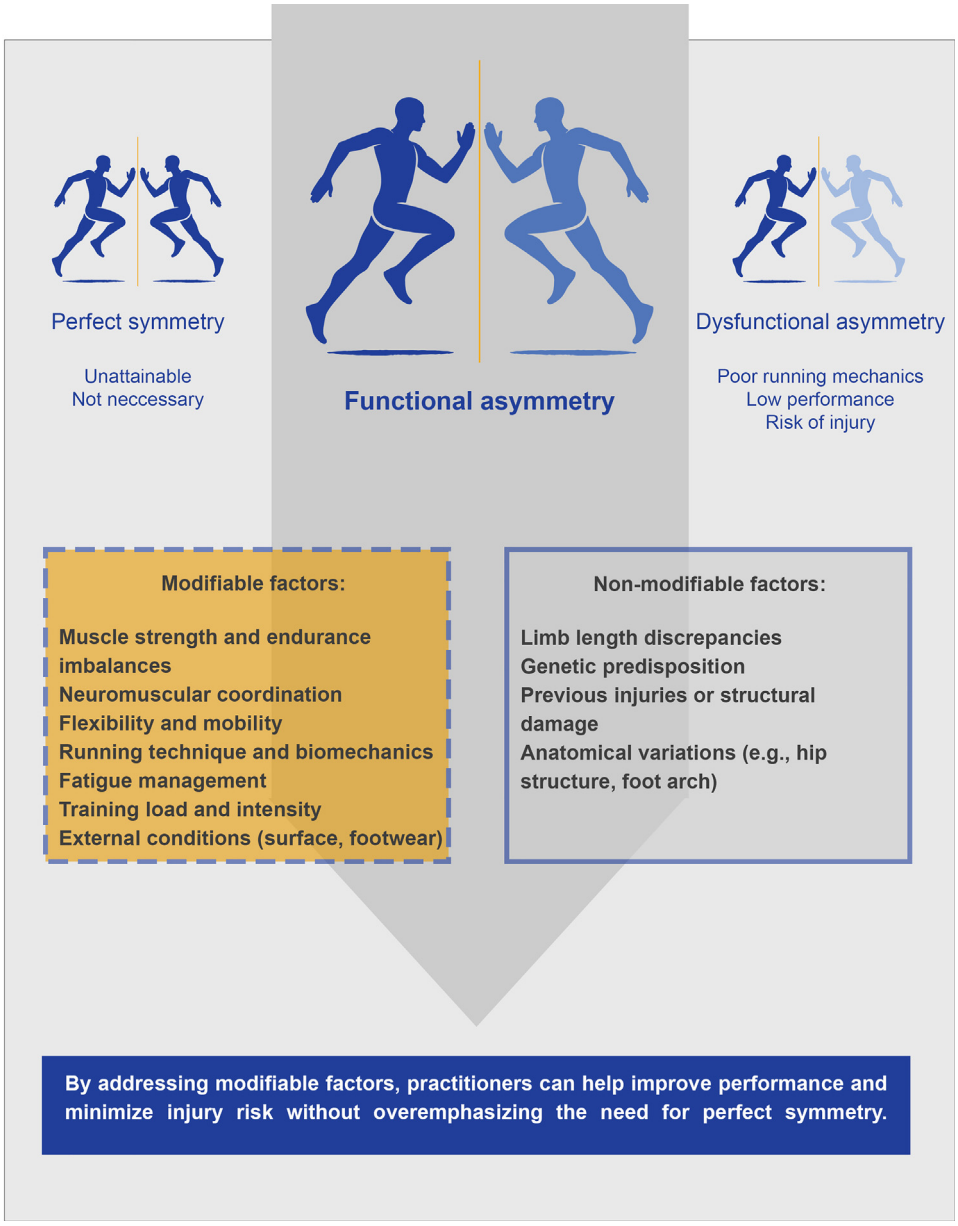

Fig. 1. The spectrum of asymmetry in sprinting.

and men sprinters is not inherently detrimental and, in some cases, may even be an adaptive advantage.[7]

3. Rethinking symmetry and its assessment

The notion that perfect symmetry is essential for optimal performance deserves re-evaluation.[1,9] While extreme asymmetry can increase injury risk and compromise mechanical efficiency, some asymmetries may not impede – and could even enhance – sprint performance. Coaches and medical teams should prioritize addressing modifiable factors,[10] such as strength imbalances, neuromuscular coordination, and running mechanics, rather than striving for unattainable perfection (Fig. 1).

Percentage-based asymmetry benchmarks often rely on arbitrary thresholds, overlooking key aspects of task specificity (acceleration *vs.* peak velocity), population differences (training background), test conditions (type of strength assessed), limb dominance, and measurement metrics (kinetics *vs.* kinematics).[9,11] Non-modifiable factors, such as limb length discrepancies and prior injuries, should be accommodated rather than corrected. Tailored training programs that respect each athlete's unique biomechanics can optimise performance while mitigating injury risk.

Asymmetry assessments must move beyond laboratory settings to account for real-world dynamics. Injuries and performance challenges often emerge during on-track training and official competition, where environmental factors and fatigue play a significant role. Practitioners should adopt a holistic approach that prioritizes function and resilience over symmetry. It is crucial to analyze raw values when tracking inter-limb asymmetries to ensure athletes are not reducing

imbalances by losing strength or function in the dominant limb while preserving the non-dominant one.[12] Addressing functional deficits and tracking movement changes can help optimize performance and minimize injury risk.[9]

4. Conclusion: Embracing imperfection

The long-held belief in perfect symmetry as a cornerstone of podium performance deserves reconsideration. Viewing sprinters on a continuum – from strong and symmetrical (ideal) to weak and asymmetrical (a red flag) – with intermediate states such as weak but symmetrical or strong with slightly asymmetrical, provides a more nuanced perspective.[12] When managed effectively, asymmetry is not a barrier but a natural and functional feature of human performance. By prioritizing functionality over symmetry, practitioners can embrace asymmetry as an intrinsic aspect of human performance. The objective should not be to eliminate asymmetry but to refine training and technique to optimize functional movement while respecting the body's natural biomechanics.

Competing interests

The author declares that he has no competing interests.

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