MODEL HEALTH

Treadmill running analysis report

Subject	Session	Trial	Speed
Antoine Falisse	treadmill_running	run_1	2.8 m/s

Running metrics

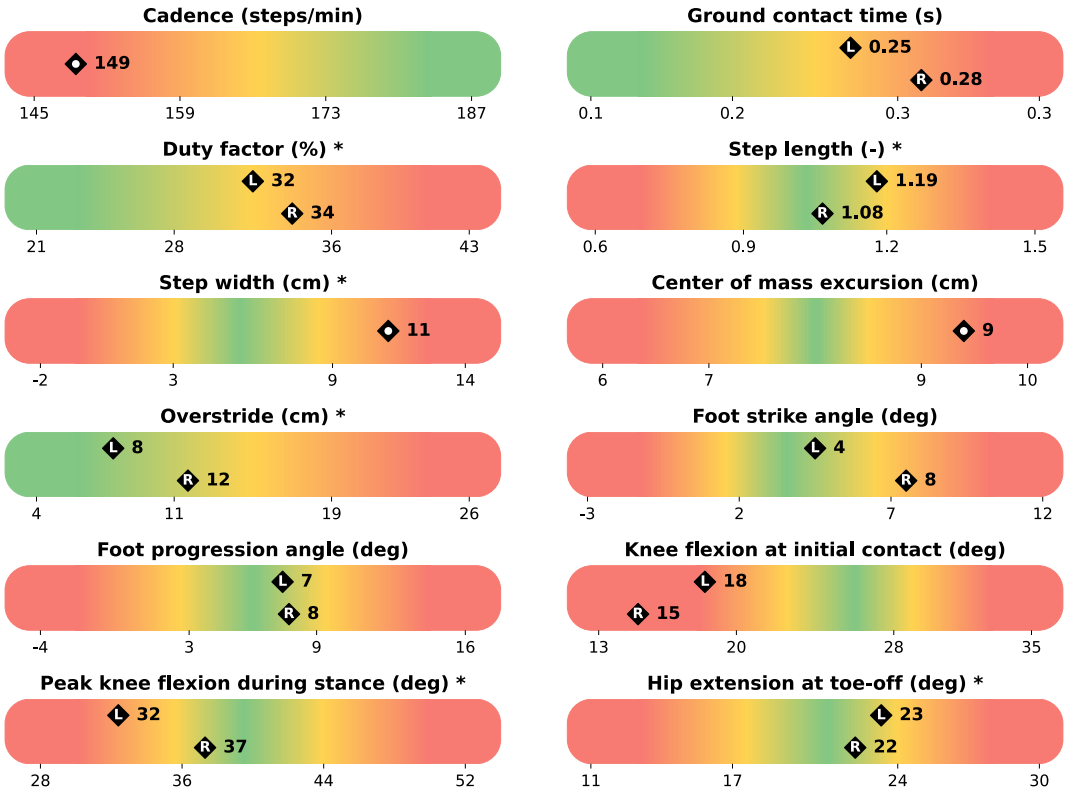

Figure 1: Running metrics are averaged over 32 (right leg) and 33 (left leg) running cycles; bilateral metrics are averaged across both sides. Colors indicate how results compare to normative data from healthy adult populations, comprising both males and females. For directional metrics (where higher or lower is universally better), the top 25% is green, the middle 50% yellow, and the bottom 25% red. For centered metrics (where both extremes are unfavorable), green represents the middle 40% (30th-70th percentile), red the outer extremes (below the 10th or above the 90th percentile), and yellow the transition zones in between. Step length and overstride are normalized by leg length. Key events are detected with a temporal error of <20ms (contact) and <25ms (toe-off), and a contact phase bias of <2ms. *Thresholds depend on running speed (linear regression).

Description of the metrics

- **Cadence** is the number of steps per minute (left and right steps combined). A cadence of near 180 steps/min is commonly associated with reduced injury risk and better running economy, though optimal cadence varies by pace, height, and individual mechanics.
- **Ground contact time** is the duration between initial contact and toe-off of the same foot. Shorter ground contact time is associated with greater leg spring stiffness, higher running speed, and improved running economy. It is the numerator of duty factor and decreases naturally with increasing pace.
- **Duty factor** is the ratio of ground contact time to stride time which is the duration of one complete gait cycle (right initial contact to the next right initial contact). Lower values reflect more elastic, spring-like running mechanics; higher values indicate prolonged ground contact, reduced leg spring stiffness, and greater braking impulse, typically associated with reduced running economy.
- **Step length** is the distance between contralateral heel positions at consecutive initial contacts, normalized by leg length. Excessive values contribute to overstriding and elevated braking impulse; insufficient values limit running speed.
- **Step width** is the average mediolateral distance between ankle joint centers at midstance (40-60% of the stance phase). Narrow step width is associated with increased iliotibial band (ITB) load and elevated injury risk, while excessive step width increases mediolateral center-of-mass displacement and reduces running economy.
- **Center of mass excursion** measures the vertical oscillation of the center of mass during the gait cycle. Both excessive and insufficient values are suboptimal. Higher excursion increases metabolic cost, while lower excursion may reflect reduced leg spring stiffness.
- **Overstride** is the distance between the ankle and the center of mass at initial contact. A lower value is desirable to reduce braking forces and energy loss upon foot contact, and to minimize the risk of bone stress injuries.
- **Foot strike angle** is the angle of the foot segment relative to the ground in the sagittal plane at initial contact. Positive values indicate heel-first (rearfoot) contact, values near zero midfoot strike, and negative values toe-first (forefoot) contact. Rearfoot striking increases vertical loading rate and braking impulse; forefoot striking shifts load to the Achilles tendon and plantar fascia while reducing impact transient.
- **Foot progression angle** is the angle between the running direction and the foot orientation, where positive values indicate toe-out. Excessive toe-out increases knee valgus and patellofemoral load; excessive toe-in elevates iliotibial band (ITB) and plantar fascia stress. Both extremes often reflect altered hip rotator mechanics.
- **Knee flexion at initial contact** is the knee flexion angle in the sagittal plane at initial contact. Sufficient flexion reduces vertical loading rate and supports elastic energy storage; excessive flexion increases quadriceps demand and metabolic cost, and may reflect pain avoidance or neuromuscular fatigue.
- **Peak knee flexion during stance** is the maximum knee flexion angle in the sagittal plane during stance. Sufficient flexion ensures impact load attenuation; insufficient values increase vertical loading rate. Excessive flexion may reflect quadriceps weakness, neuromuscular fatigue, or a pain avoidance strategy, typically accompanied by prolonged ground contact time.
- **Hip extension at toe-off** is the angle between the thigh and the vertical axis at the moment of toe-off, measured in the sagittal plane. Sufficient hip extension is essential for propulsion and running economy; excessive extension may indicate or contribute to reduced lumbopelvic control, manifesting as increased anterior pelvic tilt amplitude and elevated lumbar spine load.

Joint kinematics

Lower-body and lumbar joint angles

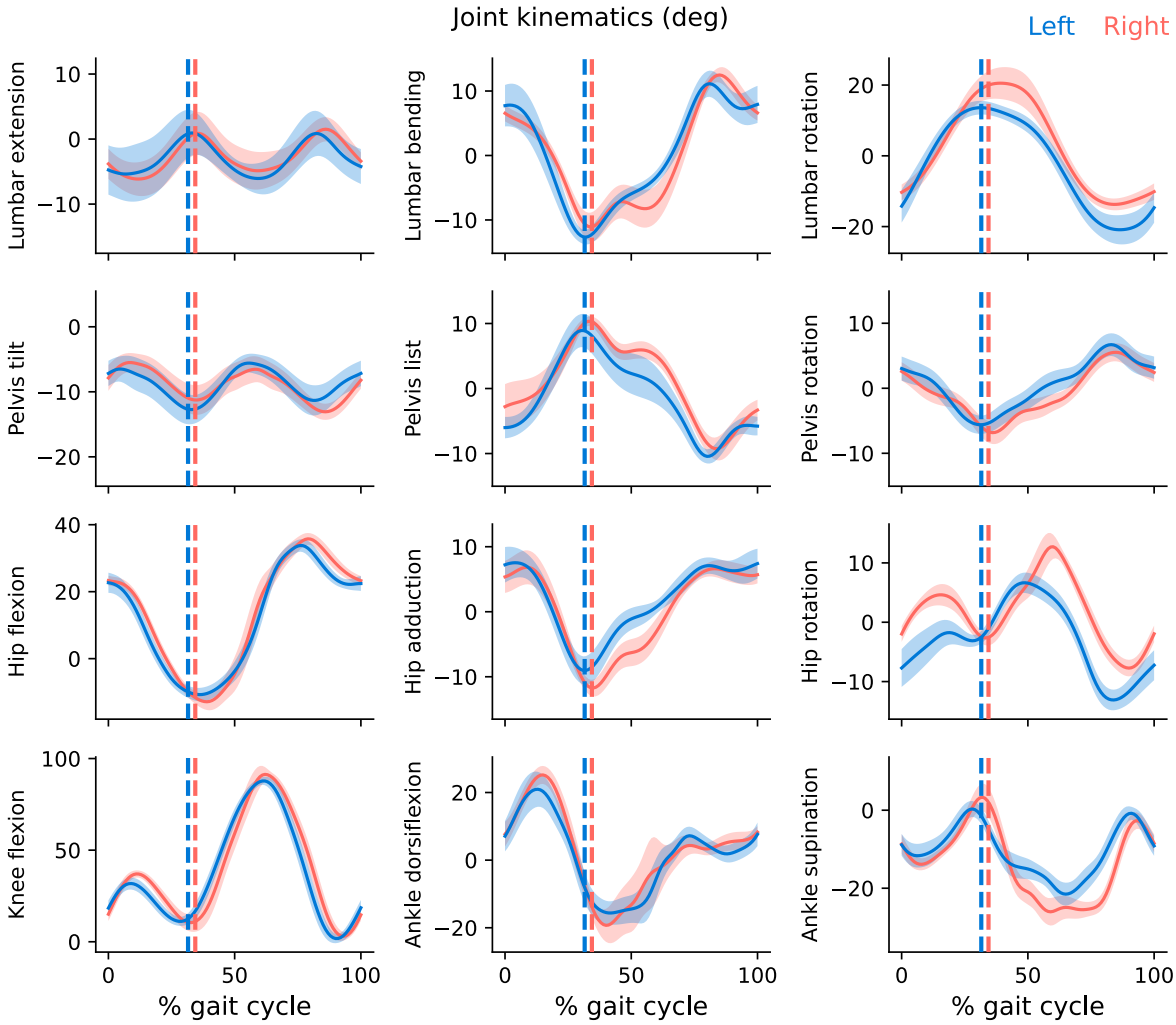

Figure 2: Joint angles (mean ± standard deviation across running cycles) normalized over the running cycle (from initial contact to initial contact). Red and blue curves indicate results averaged over 32 right and 33 left running cycles, respectively. Vertical bars indicate toe off.

- Lumbar extension (sagittal plane) is positive when the trunk extends posteriorly.
- Lumbar bending (frontal plane) is positive when the trunk bends toward the ipsilateral side.
- Lumbar rotation (transverse plane) is positive when the trunk rotates toward the left side.
- Pelvis tilt is positive when the pelvis tilts posteriorly.
- Pelvis list is positive when the contralateral side of the pelvis moves upward.
- Pelvis rotation (transverse plane) is positive when the right side of the pelvis rotates anteriorly.
- Hip rotation is positive when the femur rotates medially (internal rotation).

Pelvis translations

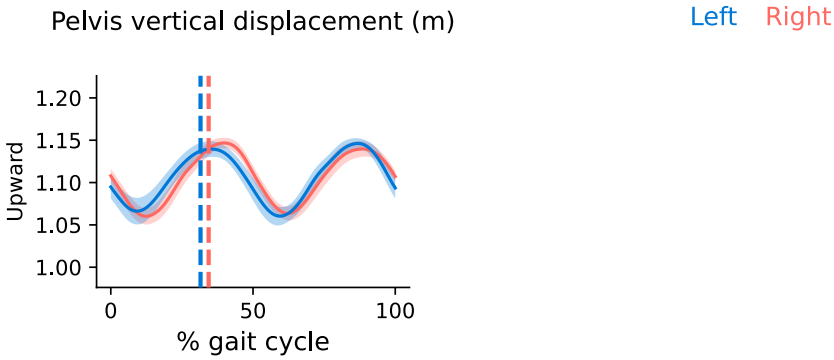

Figure 3: Pelvis translations (mean ± standard deviation across running cycles) normalized over the running cycle (from initial contact to initial contact). Red and blue curves indicate results averaged over 32 right and 33 left running cycles, respectively. Vertical bars indicate toe off.