MODEL HEALTH

Overground walking analysis report

Subject	Session	Trial
tom-admin	demo-overground	walking_1

Walking metrics

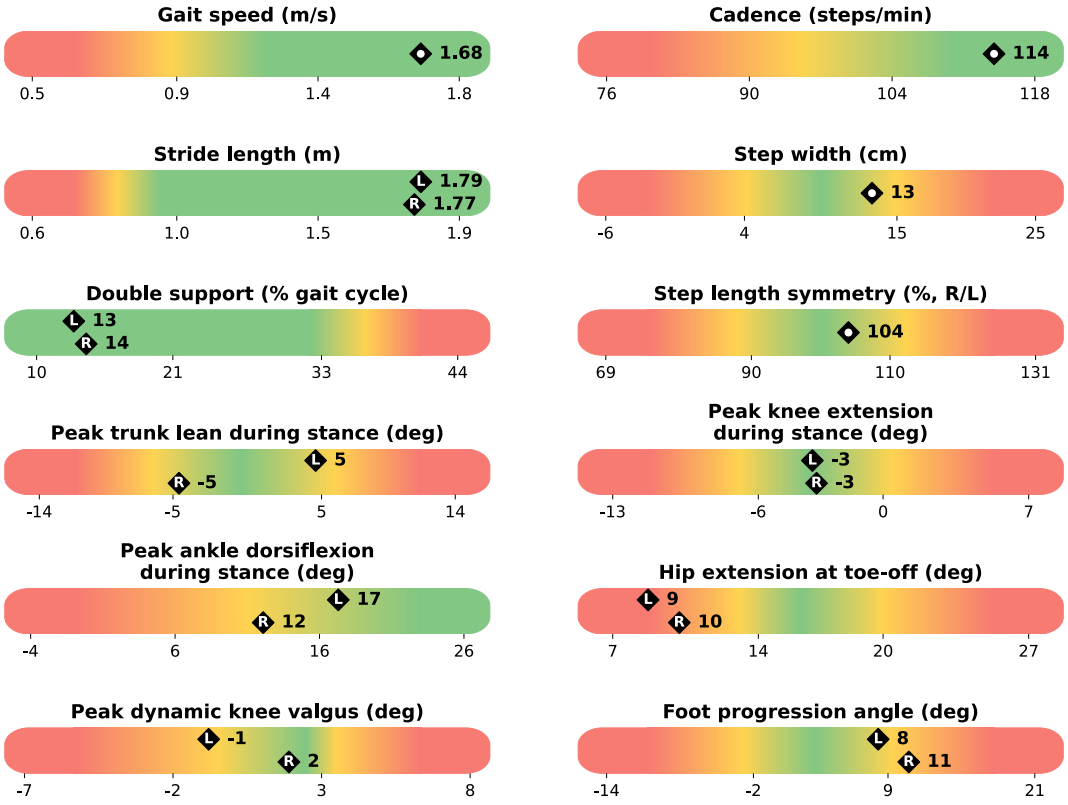

Figure 1: Walking metrics are averaged over 6 (right leg) and 6 (left leg) gait cycles; bilateral metrics are averaged across both sides. Colors indicate how results compare to normative data from healthy adult populations, comprising both males and females. For directional metrics (where higher or lower 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. Key events are detected with a mean absolute temporal error of <25ms (contact) and <15ms (toe-off), and a contact phase error of <30ms.

Description of the metrics

- **Gait speed** is the average walking velocity of the center of mass. Values above 1.0 m/s are considered adequate for community ambulation [Kyrdalen et al. 2019], while values below 0.8 m/s indicate increased risk of adverse health outcomes including falls, hospitalization, and mortality [Van Kan et al. 2009].
- **Cadence** is the number of steps per minute (left and right steps combined). Values above 100 steps/min are associated with sustained and rhythmic ambulatory behavior [Tudor-Locke et al. 2017]; lower values reflect slower, more cautious gait and may indicate reduced propulsive capacity, pain, or balance deficits.
- **Stride length** is the distance between two consecutive ipsilateral foot contact points. Adequate stride length reflects sufficient hip and ankle mobility and push-off power; reduced values are common in cautious, painful, or neurologically impaired gait and are associated with slower speeds and higher fall risk. A value above 1.2 m is generally considered good; a reference norm of above 0.45 times the subject's height has been reported in 65-79 year-old women [Herrero-Larrea et al. 2018].
- **Step width** is the average mediolateral distance between ankle joint centers at midstance (40-60% of the stance phase). Values around 9-13 cm are generally considered normal; a reference norm of 9.4 $\pm$ 3.8 cm has been reported in 65-79 year-old women [Herrero-Larrea et al. 2018]. Very narrow step width increases mediolateral instability and fall risk; excessive step width is associated with impaired balance, hip abductor weakness, or pain avoidance, and increases the metabolic cost of walking.
- **Double support** is the proportion of the gait cycle during which both feet are simultaneously in contact with the ground. Values below 35% are considered good [iPhone Mobility Metrics, 75 y/o cohort]; elevated values reflect a more cautious gait strategy and are associated with reduced walking speed, impaired balance, and neuromuscular deficits. Double support time decreases naturally as walking speed increases.
- **Step length symmetry** quantifies the ratio between right and left step lengths, with 100% indicating perfect symmetry. Values between 90 and 110% are considered good; asymmetries outside this range may reflect unilateral pain, weakness, or neurological involvement, and are associated with uneven limb loading and compensatory gait adaptations.
- **Peak trunk lean during stance** is the peak angle of the trunk relative to the vertical axis in the frontal plane during the stance phase. Positive values correspond to lean towards the stance leg. Excessive lateral trunk lean is a common compensation for hip abductor weakness and is associated with increased lumbar and hip joint loading; insufficient or asymmetric lean may indicate reduced postural control.
- **Peak knee extension during stance** is the maximum knee extension angle in the sagittal plane during the stance phase. Insufficient extension (persistent flexion) contributes to a crouch-like gait pattern, increasing quadriceps demand and joint loading; excessive hyperextension elevates posterior capsule and meniscal stress and is associated with instability and pain.
- **Peak ankle dorsiflexion during stance** is the maximum ankle dorsiflexion angle in the sagittal plane during the stance phase. Adequate dorsiflexion supports controlled tibial progression and load attenuation; restricted dorsiflexion often reflects gastrocnemius-soleus tightness, increasing forefoot and knee joint loading, whereas excessive dorsiflexion may indicate instability or altered neuromuscular control.
- **Hip extension at toe-off** is the angle between the thigh and the vertical axis in the sagittal plane at toe-off. Adequate hip extension is essential for propulsive force generation and forward progression; restricted extension, which is often due to hip flexor tightness or pain, is associated with shorter step length, increased anterior pelvic tilt, and compensatory lumbar lordosis.
- **Peak dynamic knee valgus** is the maximum frontal-plane knee angle during stance. Positive values indicate knee valgus, negative values varus. Higher valgus angles are linked to increased iliotibial band (ITB) and patellofemoral joint loading and a greater risk of overuse injury, whereas more neutral alignment is generally associated with more favorable knee joint loading.
- **Foot progression angle** is the angle between the walking 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.

Joint kinematics

Lower-body and lumbar joint angles

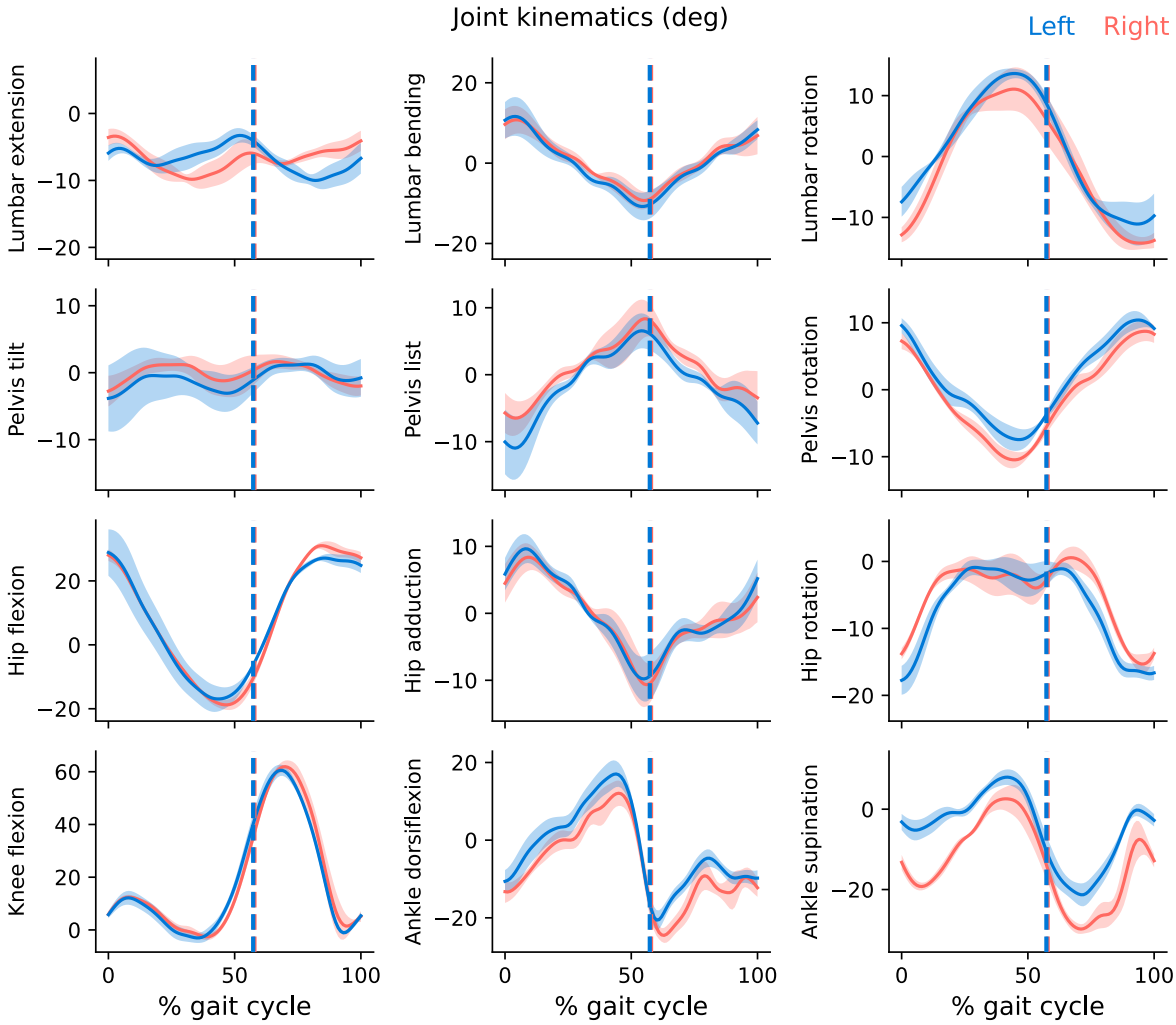

Figure 2: Joint angles (mean ± standard deviation across gait cycles) normalized over the gait cycle (from initial contact to initial contact). Red and blue curves indicate results averaged over 6 right and 6 left gait cycles, respectively. Vertical bars indicate toe off.

- 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

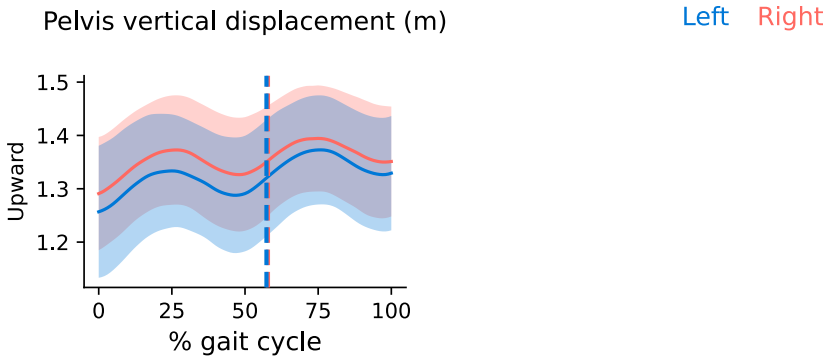

Figure 3: Pelvis translations (mean ± standard deviation across gait cycles) normalized over the gait cycle (from initial contact to initial contact). Red and blue curves indicate results averaged over 6 right and 6 left gait cycles, respectively. Vertical bars indicate toe off.