OneStep

Your Walk Is Your Vital Sign: Deriving Biological Age from Smartphone-Based Gait Analysis

Abstract

Gait analysis is an emerging frontier in functional health assessment. This study introduces *Gait Age*, a novel biomarker derived from real-world gait data collected via smartphone, and proposes its use as a proxy for biological age. Leveraging large-scale normative datasets and real-time motion capture, OneStep enables individualized percentile scoring and early detection of functional decline. This research outlines the relationship between gait parameters and age, presents the rationale behind age- and sex-specific percentiles, and details how aggregated gait parameters can predict an individual's "biological" Gait Age. The findings suggest gait, captured passively and continuously, can serve as an accessible, predictive, and clinically meaningful metric for proactive health monitoring.

1. Introduction

Traditional vital signs—such as blood pressure, heart rate, and cholesterol—are fundamental indicators of physical health. However, recent research suggests that gait, the pattern of how one walks, provides a real-time window into aging and overall function[1]. Gait integrates inputs from the nervous, muscular, and skeletal systems, and subtle alterations often precede clinical symptoms of decline. Notably, gait speed, double support time, and variability have been linked to hospitalization risk, cognitive decline, and loss of independence[2,3].

Conventional gait analysis required lab-based systems with complex instrumentation, limiting clinical accessibility. OneStep has developed a smartphone-based system to capture gait parameters during real-world walking, eliminating the need for wearables or calibration[4]. This paper introduces *Gait Age*, a composite measure indicating the age group whose walking pattern most closely resembles an individual's.

2. Discussion

2.1. Your Walk Is Your Personal Vital Sign — and It Has an Age

For decades, we've tracked health with a familiar set of numbers: blood pressure, cholesterol, heart rate. But what if one of the most powerful indicators of your long-term health has been overlooked?

It's the way you walk.

2.2. A real-time window into how your body is aging

Gait, the pattern of how you walk, is increasingly recognized as a fundamental indicator of overall health. Its links to functional mobility and fall risk are well established. But the story goes deeper. Research shows that subtle changes in walking patterns, such as slower speed, increased variability, or longer time spent stabilizing, can appear years before major health events. These changes have been associated with higher risk of hospitalization, loss of independence, and even cognitive decline.

In essence, your walk reflects how well your brain, nervous system, muscles, and joints are working together.

In other words: your walk is a functional vital sign.

2.3. The lab in your pocket

Until recently, measuring gait accurately required a specialized “gold-standard” gait lab — sensor-embedded walkways, complex camera systems, and tightly controlled environments that don’t reflect real life.

OneStep changes that.

With a simple smartphone walk, OneStep captures dozens of clinically meaningful gait parameters, anywhere, anytime, turning everyday movement into objective, actionable insight.

No labs.
No wearables.
Just real walking, in the real world.

2.4. The myth of “normal”: why age and gender matter

For years, gait has been interpreted using single, generic cutoffs. But walking doesn’t age the same way for everyone.

Across large populations, clear patterns emerge:

- Gait speed gradually declines with age
- Double support increases with age (more time with both feet on the ground for stability)
- And these trends differ by gender

This means the *same* walking speed or stability value can represent very different levels of function at different ages.

That’s why OneStep doesn’t rely on one “normal” number.

2.5. Percentiles: putting your walk in context

OneStep uses large-scale population data to create age- and sex-specific gait percentiles across key parameters — including gait speed and double support.

The plots below show how gait evolves across the lifespan:

- Each curve represents a percentile within a specific age and gender group
- Higher percentiles indicate stronger performance for that demographic
- The curves shift with age because what's "excellent" at 80 isn't the same as what's "excellent" at 40

Percentiles answer the question that actually matters:

> *"How am I walking compared to others like me?"*

2.6. The next leap: translating gait into Biological Age

Here's where gait becomes even more powerful.

OneStep doesn't look at a single metric in isolation. We calculate normative percentiles across all key gait parameters, capturing not just how fast you walk, but how stable, symmetric, and efficient your walking pattern is.

When these parameters are combined, they can be translated into a single, intuitive measure.

2.7. Gait Age — your walking-based biological age

Gait Age reflects the age group your walking pattern most closely resembles.

- Walk like the average 70-year-old at age 60? Your Gait Age is older
- Walk like the average 50-year-old at age 65? Your Gait Age is younger

This creates a longevity-style metric — not based on how you feel, but on how you function.

2.8. From insight to action

Your percentile — and your Gait Age — isn't just a score. It's a way to see change early and track it over time.

- Spot risk sooner, before small changes become big limitations
- Personalize care, compared to your true peers, not generic cutoffs
- Quantify progress in rehabilitation, training, and recovery as percentiles rise and Gait Age moves younger

3. Bottom line

Your walk holds the story of your health.

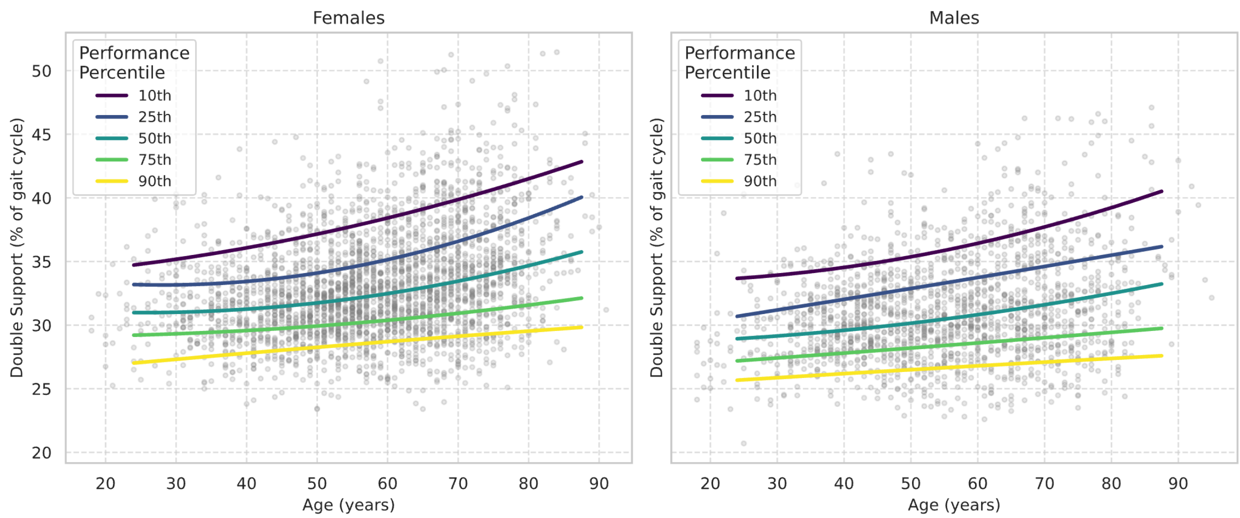
OneStep helps you read that story, and translate it into something everyone understands: biological age so you can track function, intervene earlier, and protect independence, one step at a time.

Figures

The curves shown in the Figures below are based on a population with varying levels of pain interference. Therefore, accuracy for the general population may differ. Future revisions to this report will include updated report data and figures that include additional cohorts.

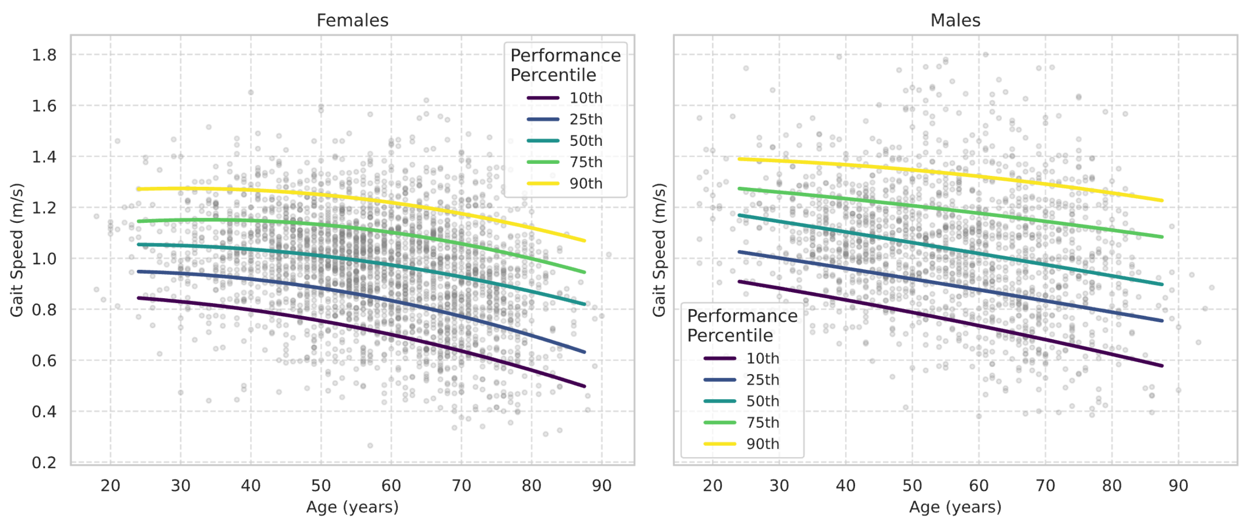
Double Support Percentiles

Lower values are favorable. Percentiles are inverted so a higher curve is always better.



Gait Speed Percentiles

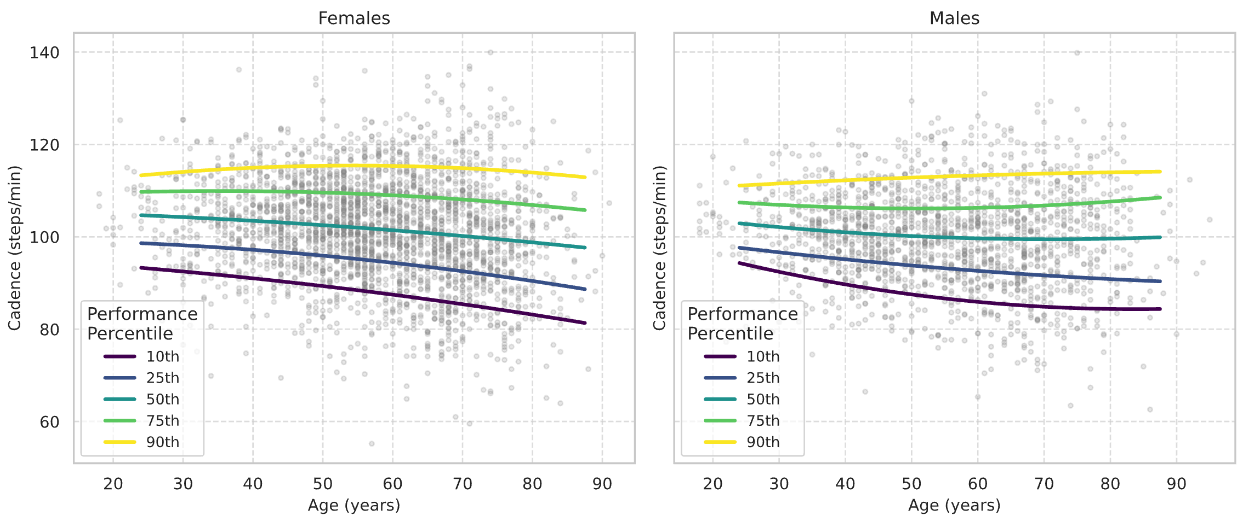
Higher values are favorable. Percentiles correspond directly to raw data.



OneStep

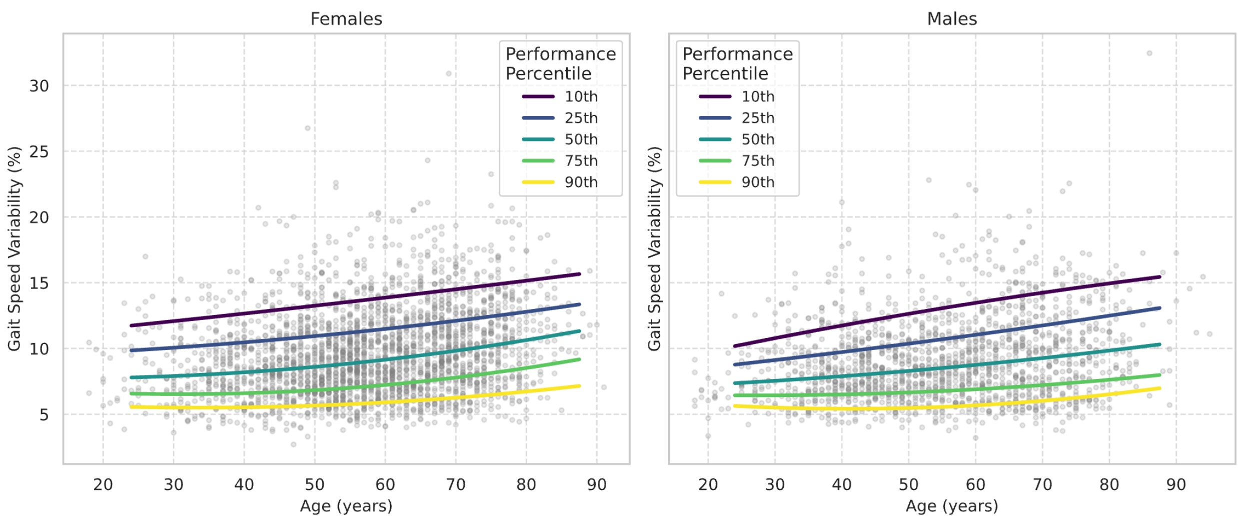
Cadence Percentiles

Higher values are favorable. Percentiles correspond directly to raw data.



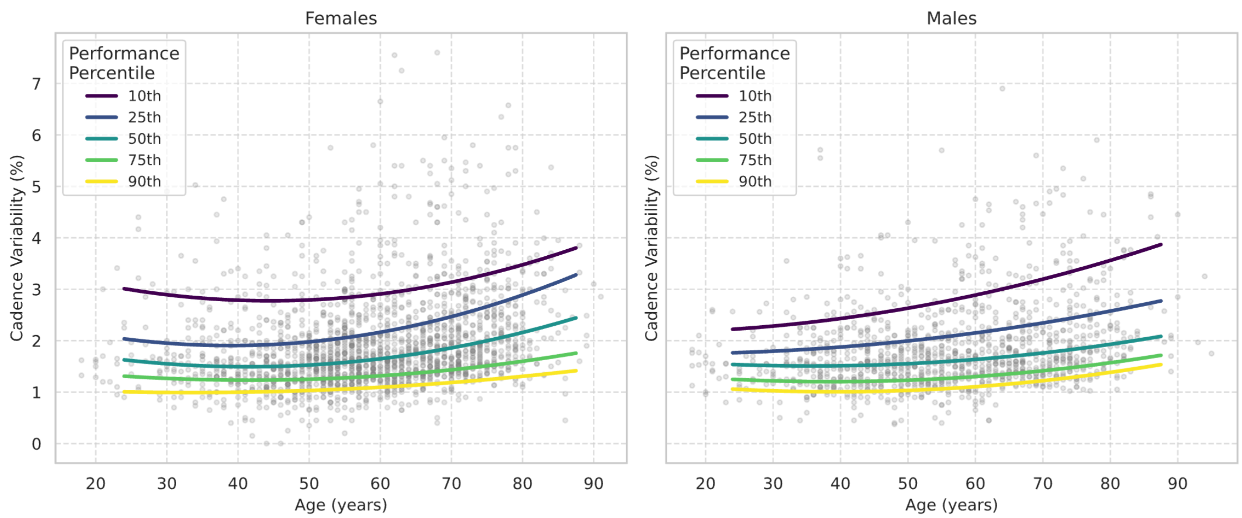
Gait Speed Variability Percentiles

Lower values are favorable. Percentiles are inverted so a higher curve is always better.



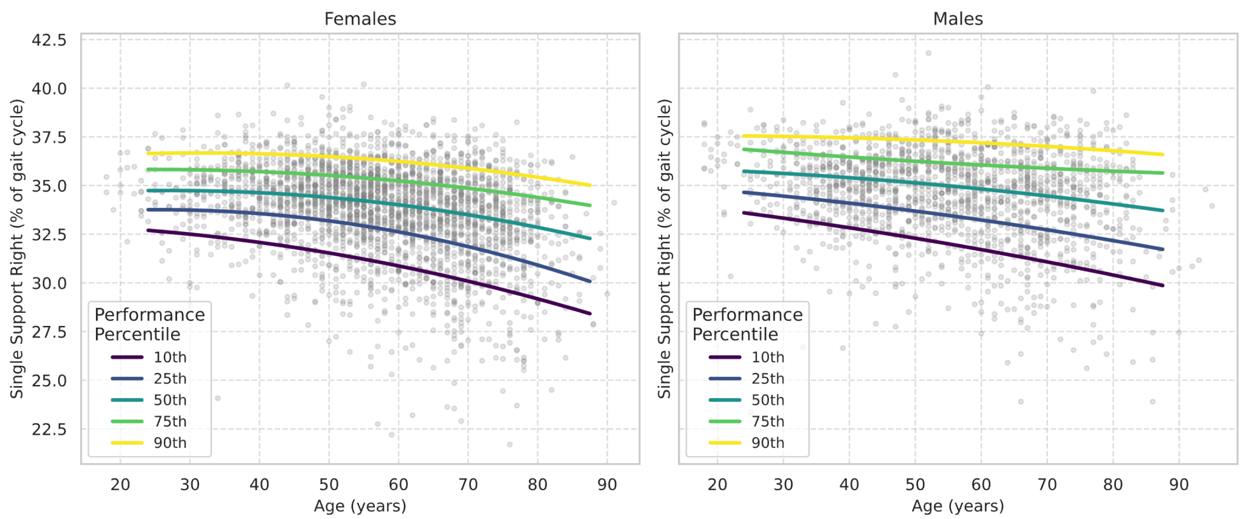
Cadence Variability Percentiles

Lower values are favorable. Percentiles are inverted so a higher curve is always better.



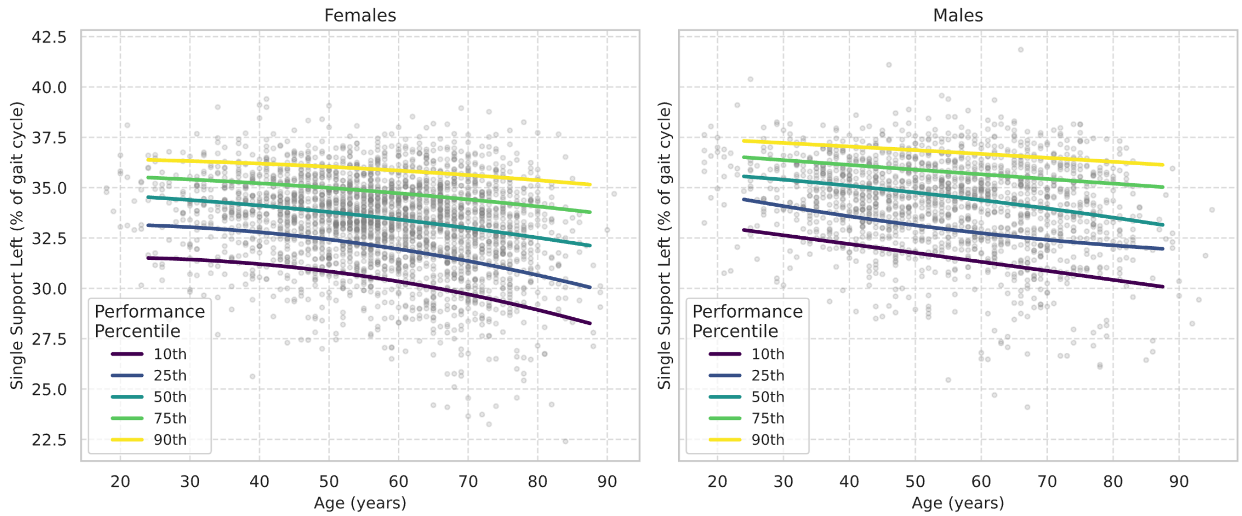
Single Support Right Percentiles

Higher values are favorable. Percentiles correspond directly to raw data.



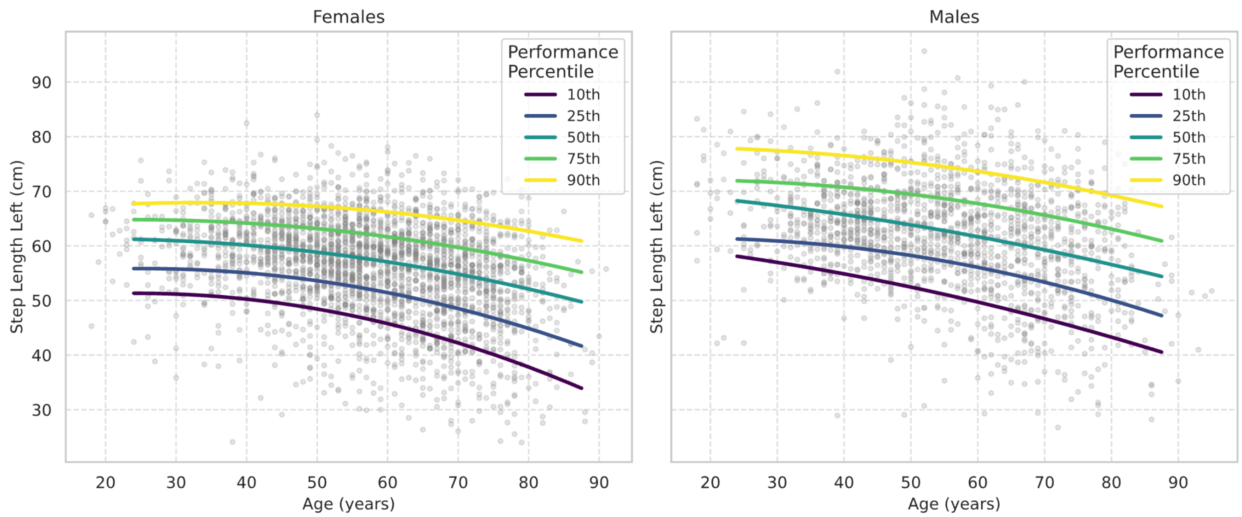
Single Support Left Percentiles

Higher values are favorable. Percentiles correspond directly to raw data.



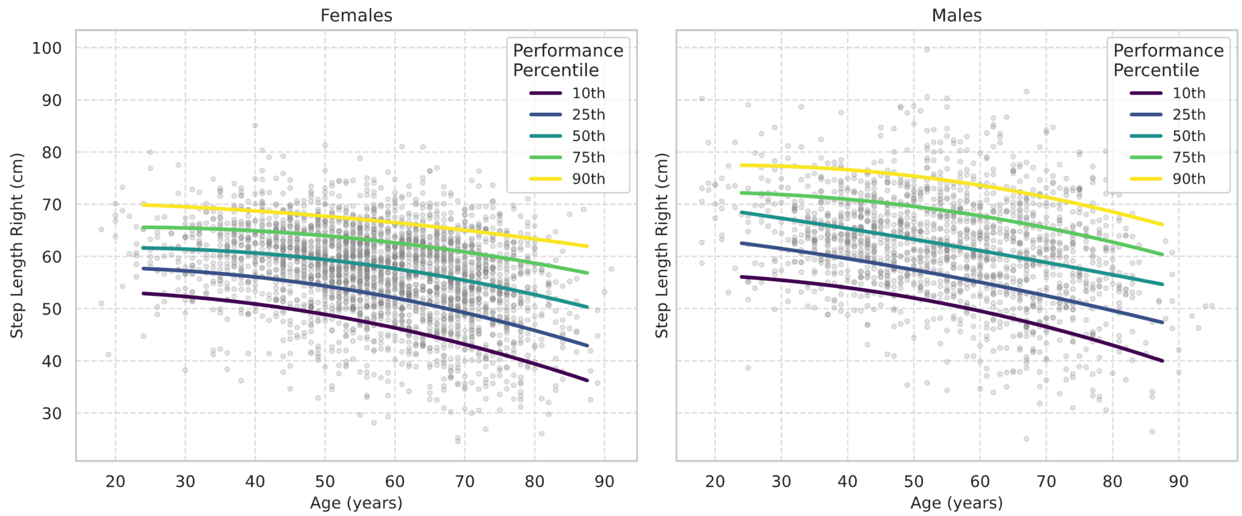
Step Length Left Percentiles

Higher values are favorable. Percentiles correspond directly to raw data.



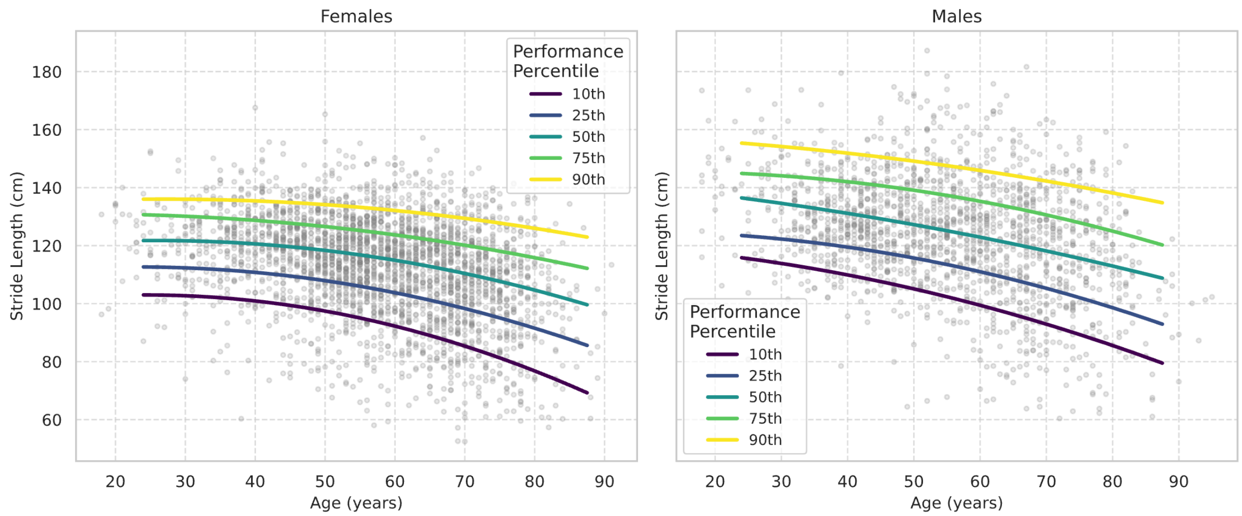
Step Length Right Percentiles

Higher values are favorable. Percentiles correspond directly to raw data.



Stride Length Percentiles

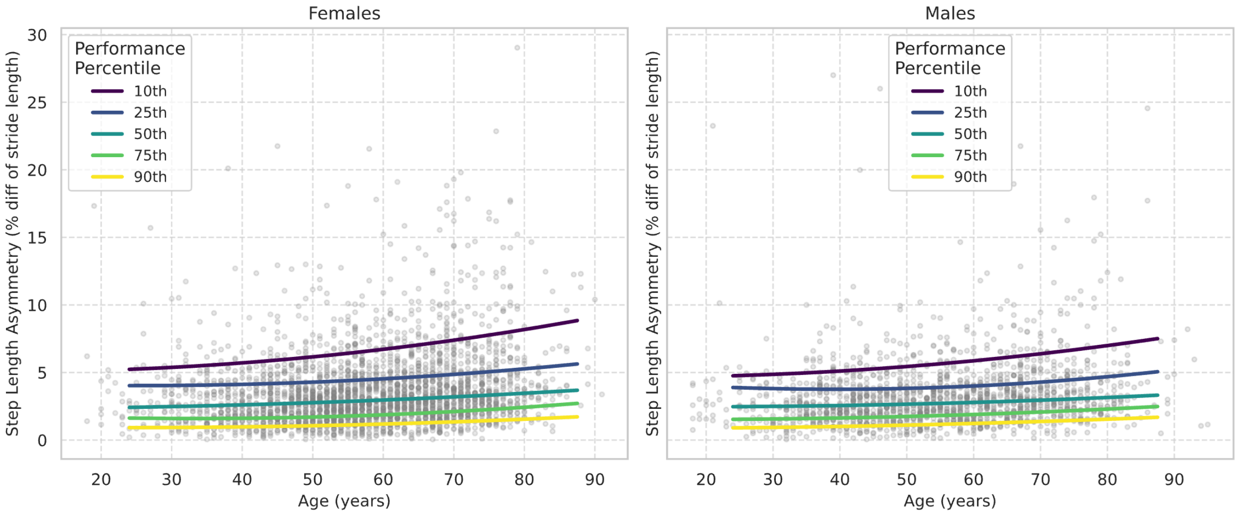
Higher values are favorable. Percentiles correspond directly to raw data.



OneStep

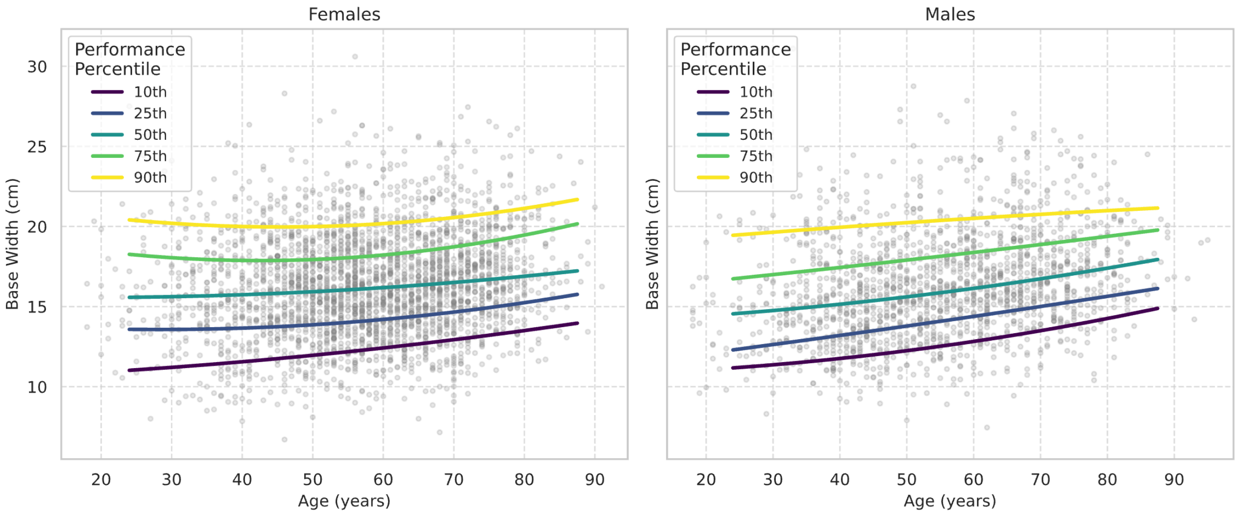
Step Length Asymmetry Percentiles

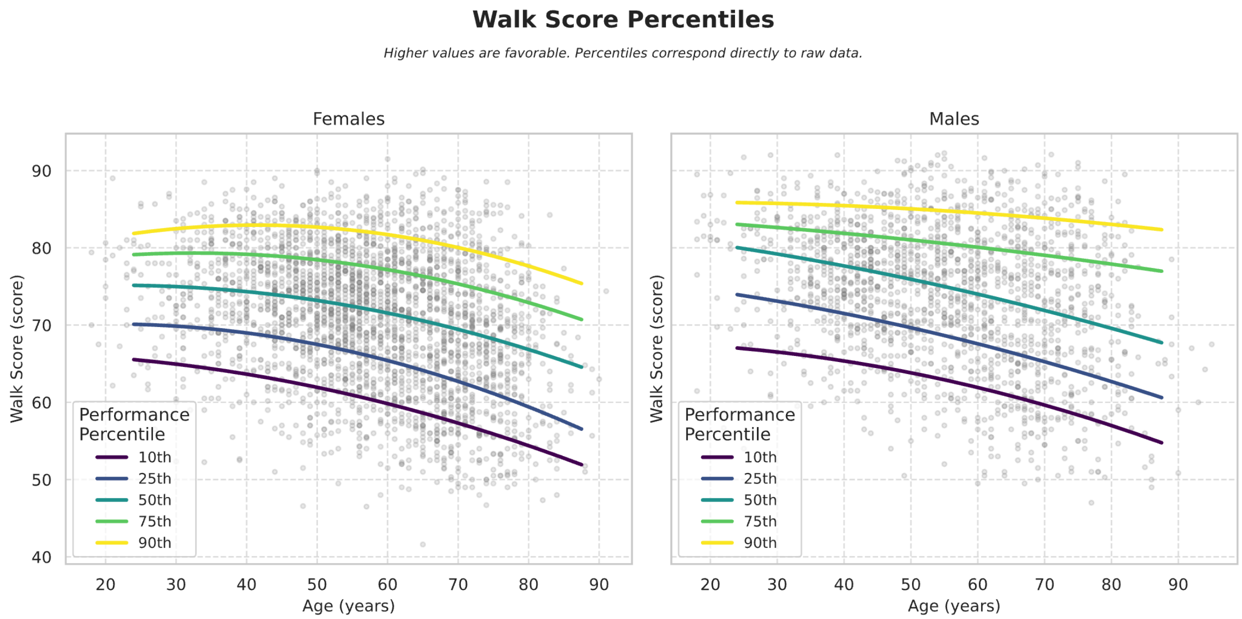
Lower values are favorable. Percentiles are inverted so a higher curve is always better.



Base Width Percentiles

The normative range is 10-20. Percentiles correspond directly to raw data.





References:

1. Nonnekes J, Post E, Imbalzano G, Bloem BR. Gait changes with aging: an early warning sign for underlying pathology. *J Neurol.* 2025 Mar 7;272(4):257. PMID: 40053183; PMCID: PMC11889070.
2. Collyer TA, Murray AM, Woods RL, Storey E, Chong TT, Ryan J, Orchard SG, Brodtmann A, Srikanth VK, Shah RC, Callisaya ML. Association of Dual Decline in Cognition and Gait Speed With Risk of Dementia in Older Adults. *JAMA Netw Open.* 2022 May 2;5(5):e2214647. PMID: 35639376; PMCID: PMC9157262.
3. Mukli P, Detwiler S, Owens CD, Csipo T, Lipecz A, Pinto CB, Tarantini S, Nyul-Toth A, Balasubramanian P, Hoffmeister JR, Csiszar A, Ungvari Z, Kirkpatrick AC, Prodan CI, Yabluchanskiy A. Gait variability predicts cognitive impairment in older adults with subclinical cerebral small vessel disease. *Front Aging Neurosci.* 2022 Nov 18;14:1052451. PMID: 36466602; PMCID: PMC9716182.
4. Christensen JC, Stanley EC, Oro EG, Carlson HB, Naveh YY, Shalita R, Teitz LS. The validity and reliability of the OneStep smartphone application under various gait conditions in healthy adults with feasibility in clinical practice. *J Orthop Surg Res.* 2022 Sep 14;17(1):417. PMID: 36104792; PMCID: PMC9476593.