

Authors

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Introduction & objective

Chronological age is an unreliable indicator of health status or risk for age-related disease. The immune system's integrity is a key determinant of aging and longevity, with immune decline driving vulnerability to chronic illness and reduced resilience. osLifetime represents a critical shift toward functional, immune-based aging metrics that are clinically actionable and personalized. Our results support the integration of immune monitoring into personalized strategies to track the efficacy of lifestyle or therapeutic interventions and to support proactive strategies aimed at preserving healthspan, aligning with the goals of preventative and precision medicine.

Cellular avatar

Your cellular avatar reflects your immune profile—blending immune age, protection score, and inflammaging risk. Higher scores make your avatar more vibrant and balanced, while lower ones reveal movement, shape, and gap changes that highlight areas to improve.

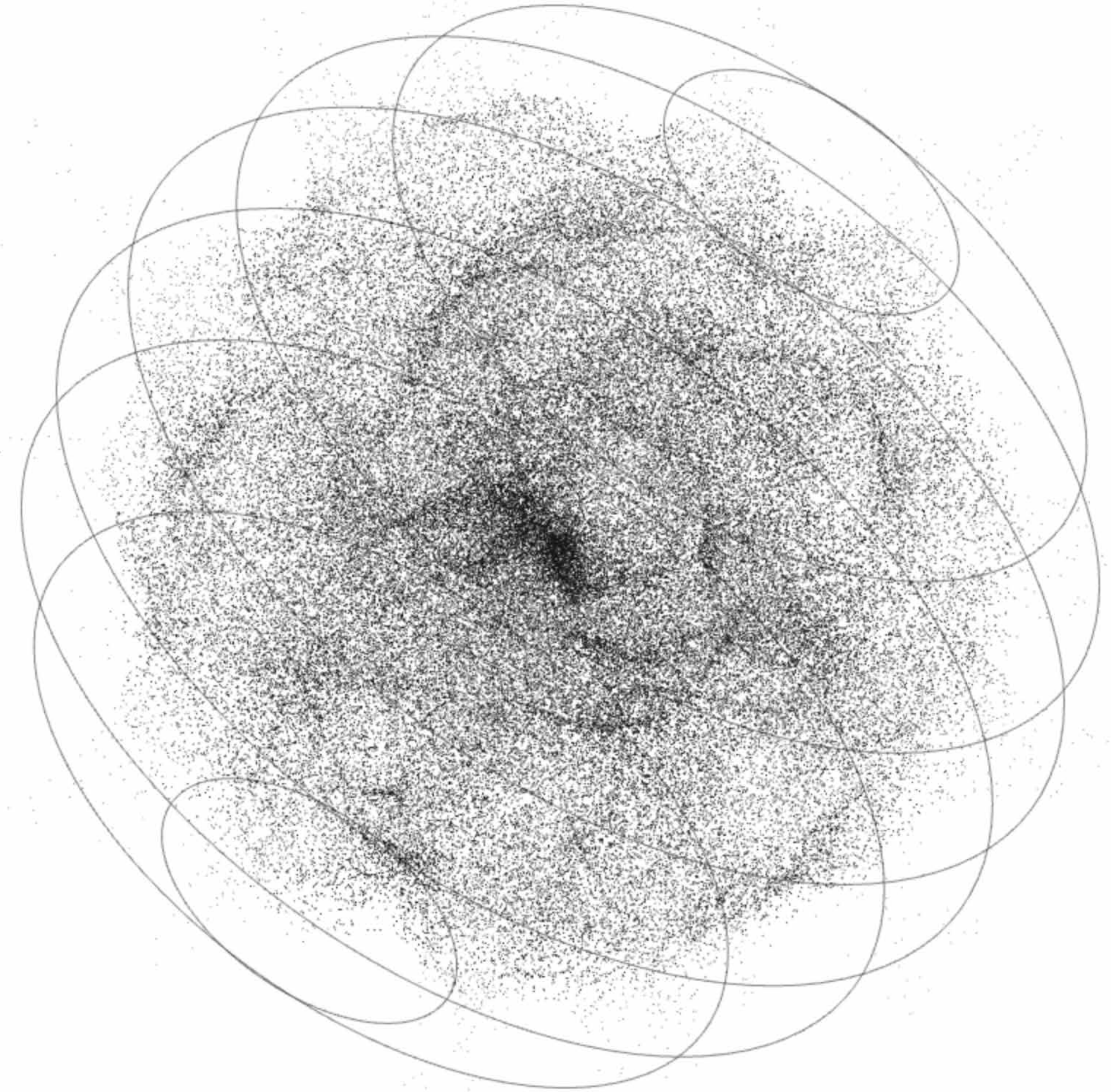
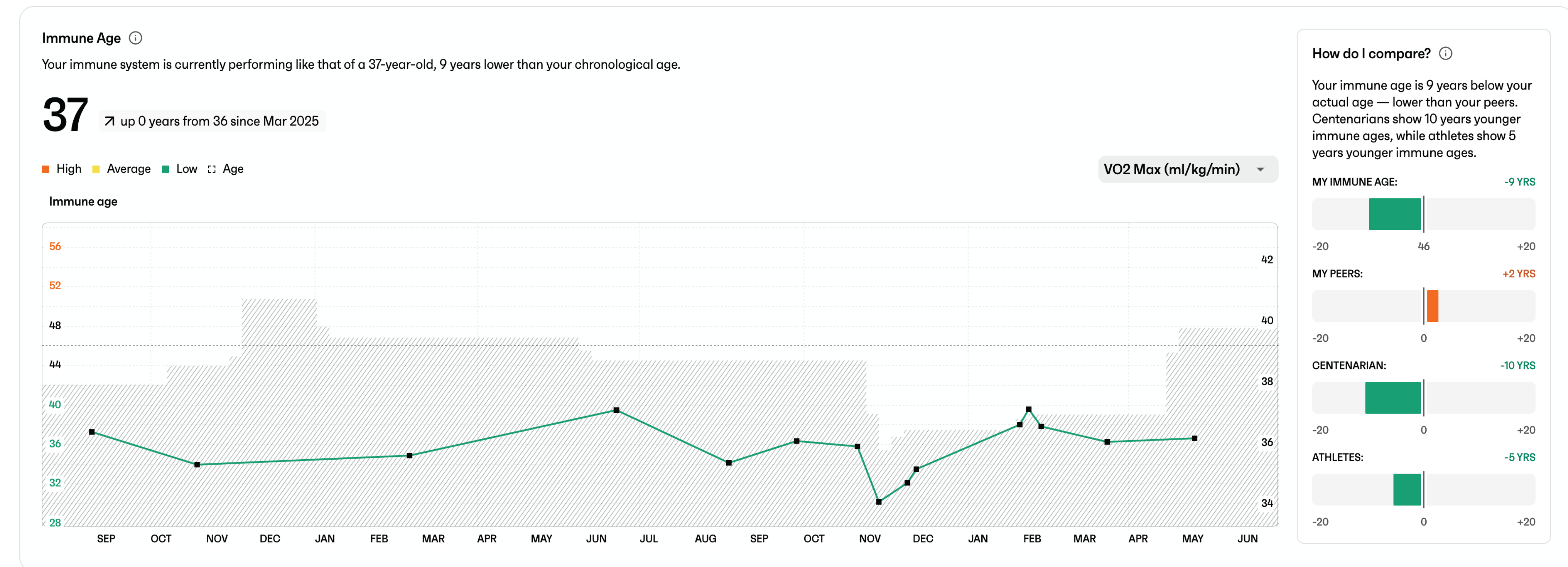


Figure 1. Cellular avatar

Immune age

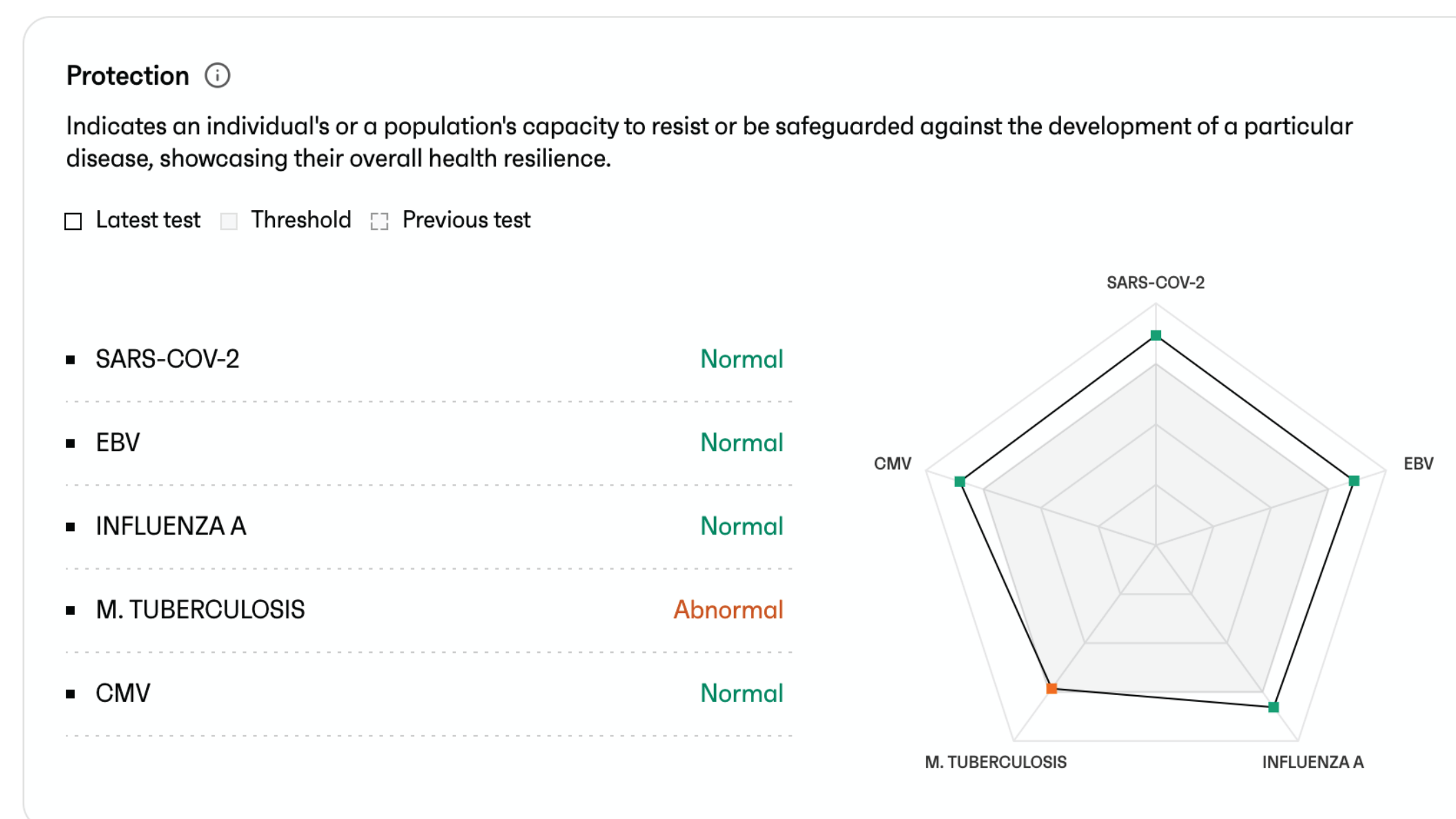
Functional biological age of the immune system, offering dynamic insight into its capacity and resilience. A machine learning model leveraging **deep T cell receptor (TCR) sequencing (osTCR)** to integrate T cell activity and capture signs of **immune cell aging**. Clinically, Immune Age assesses immune fitness beyond chronological age, aiding in **risk stratification** for infections,

autoimmune conditions, and age-related decline. Its **dynamic nature** allows it to track progress over time, effectively guiding and monitoring the efficacy of personalized interventions, including lifestyle changes, stress management, or immunomodulatory therapies.



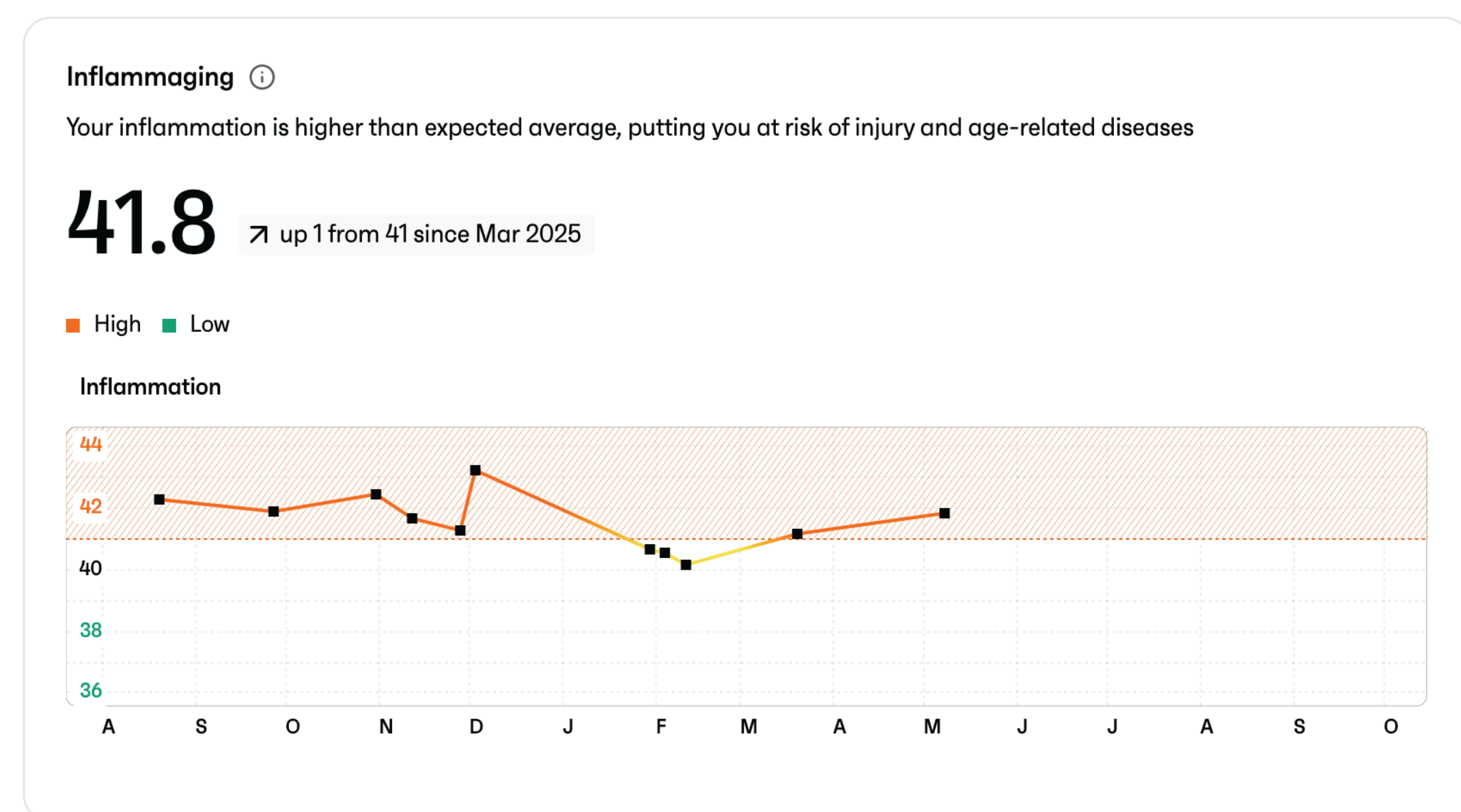
Protection score

Informs on biological resilience and immune system readiness to defend against specific threats, providing real-time snapshot of immune preparedness. The score, ranging from 0 to 100, integrates T cell diversity, naive compartment integrity, and central memory populations to assess both the **activity and precision** of T cell recognition. A score **above threshold** suggests a robust and well-prepared adaptive immune system, indicating strong readiness to recognize and fight off relevant pathogens. Clinically, it identifies gaps in immune protection to **stratify risk**, supporting proactive decisions such as targeted **vaccinations** or immune-enhancing strategies, and allowing for tracking of changes over time to evaluate intervention efficacy.



Inflammaging

Measure of systemic immunological stress, reflecting the chronic, low-grade inflammatory state, a key contributor to biological aging and disease risk. Derived from gene expression data of single cells, it captures specific **pro-inflammatory states**, indicating persistent immune activation independent of acute illness. A **higher score** suggests accelerated biological aging and elevated risk for age-related conditions (e.g., cardiovascular disease, cognitive decline, etc). Clinically, this metric helps **identify chronic inflammation** as an early, modifiable driver of aging, guiding targeted interventions (e.g., lifestyle, pharmacological strategies) to reduce inflammaging, preserve function, and **track progress** over time.



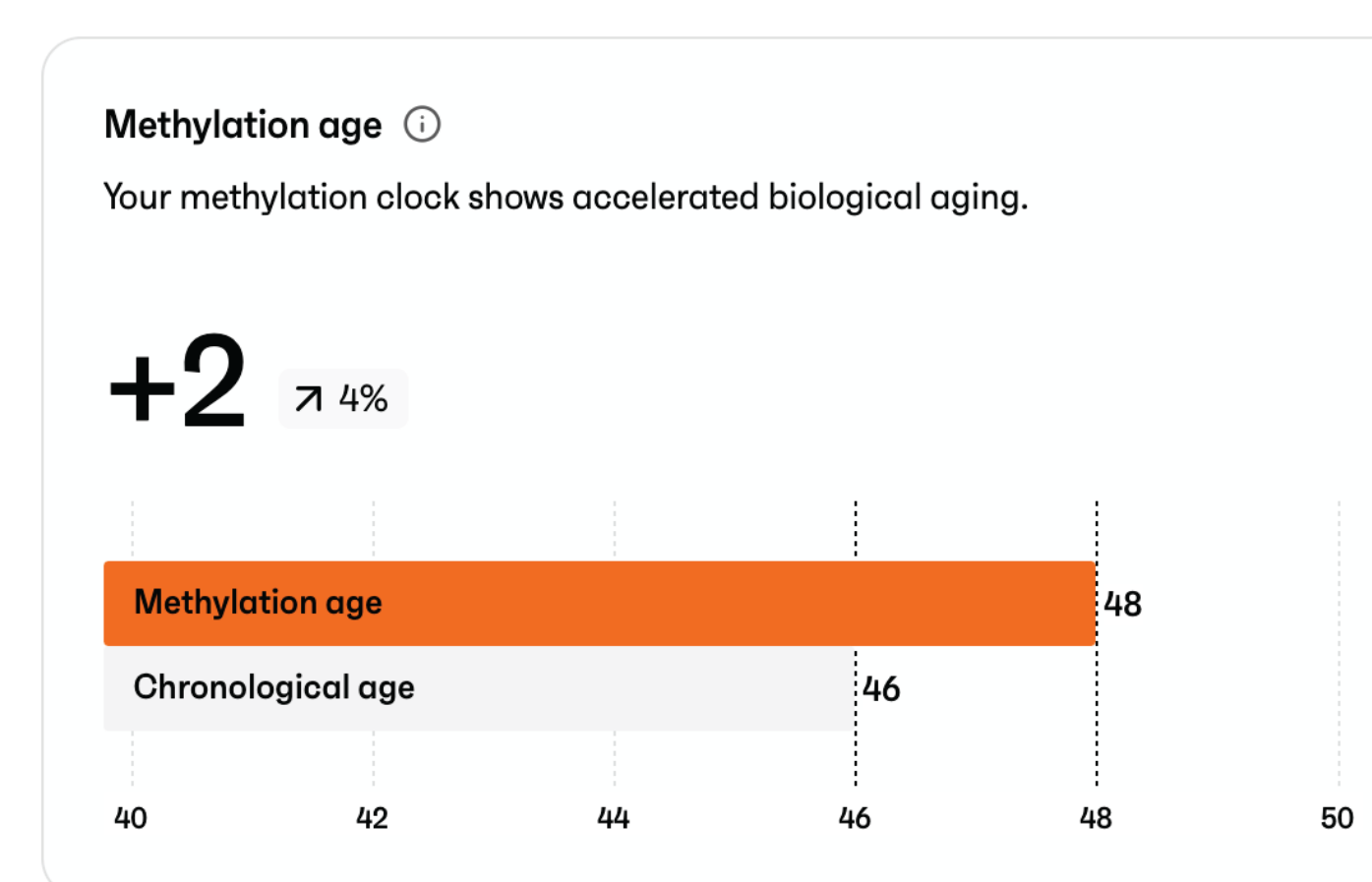
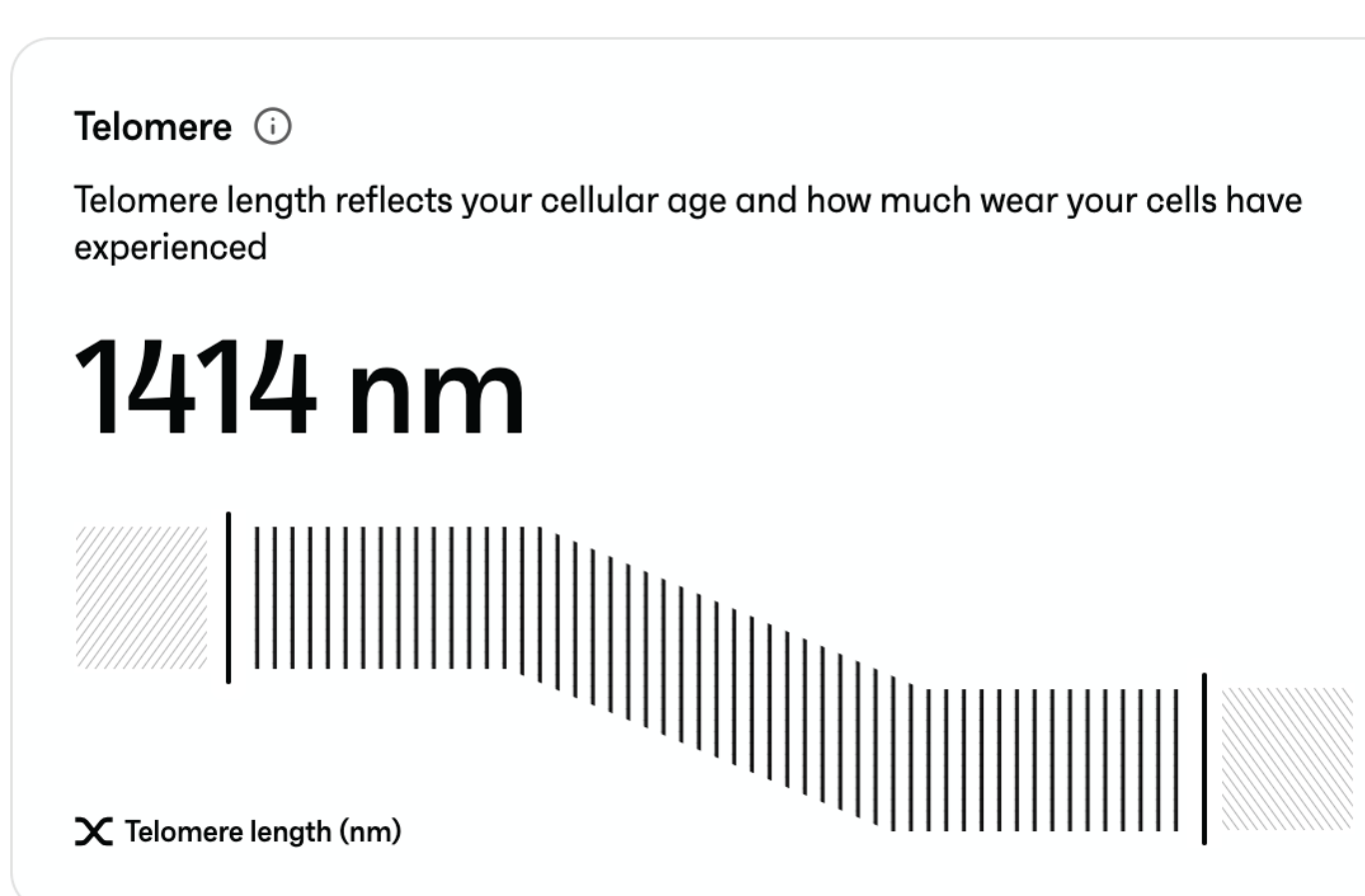
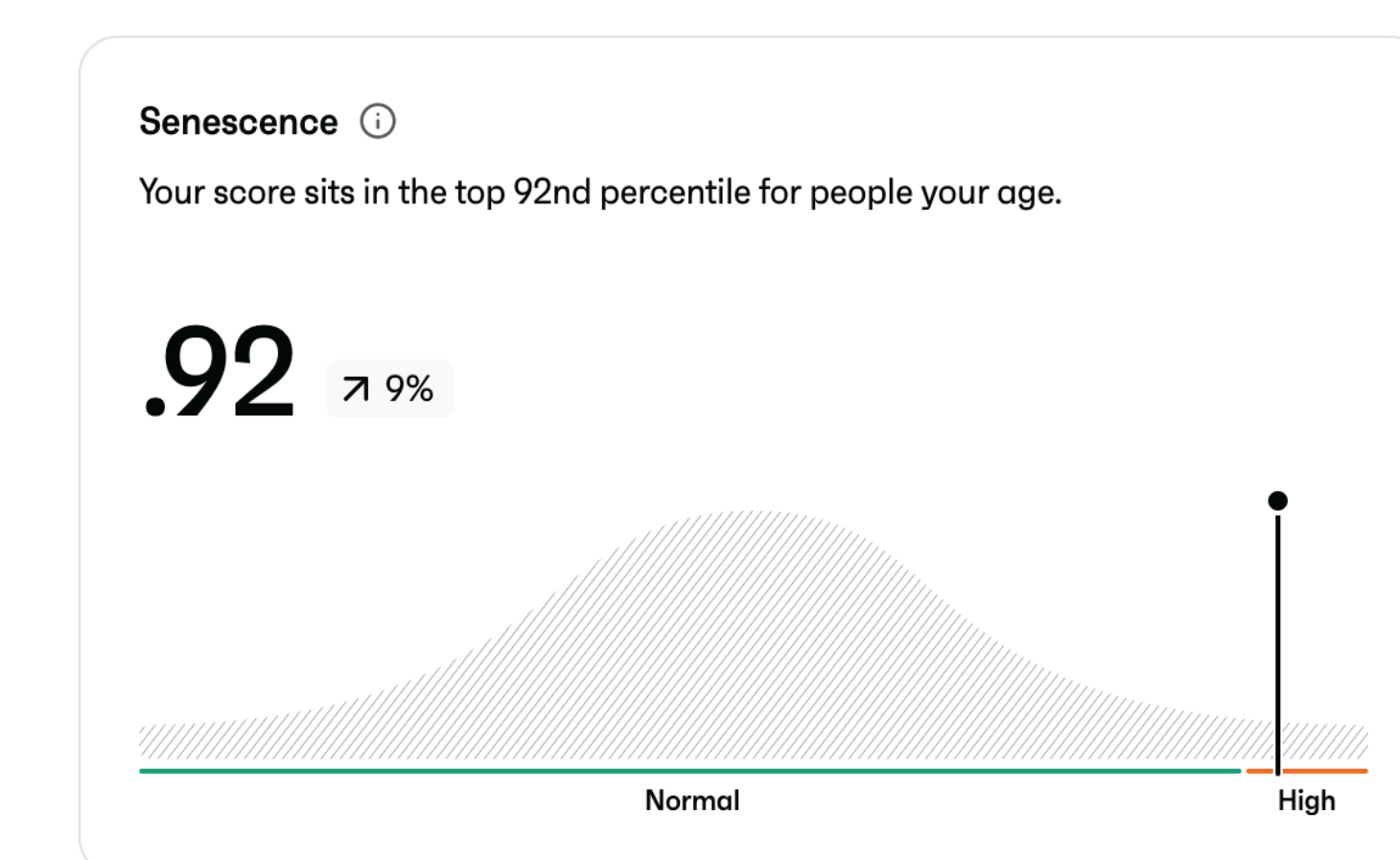
Supporting metrics

Methylation clocks: Epigenetic clock benchmark to compare to the dynamic Immune Age model.

Senescence: Loss of immune cell function related to systemic inflammation events.

Telomere length: Biomarker of cellular aging and replicative potential.

Biological signals: Integration of physiological and environmental data streams (e.g., activity, sleep, GPS) to contextualize immune-derived metrics.



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