

## **HIMAGES - Vitality capacity and immunometabolism: a common path to healthy ageing**

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### **ABSTRACT**

**INTRODUCTION:** The distinction between healthy and pathological ageing has given rise to the vitality capacity concept. Underlying the physiological aspect of ageing, vitality capacity is reflected in the neuromuscular function, metabolism, and immune and stress response. While these domains are generally known to decline with age, lifelong physical activity may prevent this loss. Mechanistically, immune cells are known to be stimulated by physical activity and may play a central role. Indeed, murine studies show immune cell-specific genetic modifications can influence ageing by affecting metabolism, immunity, and neuromuscular function. This study examined the relationships among lifelong physical activity, vitality capacity, and immune profiles in older adults.

**METHOD:** We explored how sustained physical activity relates to vitality capacity and immune characteristics in 40 adults over 55. Participants with contrasting lifelong activity patterns underwent multidimensional vitality capacity assessments: neuromuscular function (handgrip, knee strength, spirometry), immune/stress response (inflammation biomarker, autonomic function, oxygen saturation, perceived immunity), energy/metabolism (metabolic biomarker, nutrition, body composition, perceived fatigue, muscle endurance). Peripheral immune cells from 16 participants underwent single-cell RNA sequencing to profile immune composition and transcriptional states.

**RESULTS:** Lifelong active individuals displayed a consistently higher overall vitality capacity profile. Main differences were found in metabolic and immune-related dimensions. Surprisingly, the neuromuscular function of lifelong participants was not significantly higher than inactive group, even if a trend was observed. Single cell analyses revealed distinct transcriptional signatures between groups, the strongest being found in adaptive immune cells. Genes differently expressed in T cells were mainly associated with metabolic pathways.

**DISCUSSION:** We are now investigating how different immune cell metabolic programs may connect long-term physical activity habits to vitality capacity trajectories.