Human performance at old age

Force plates are a straightforward tool to assess human acceleration as an indicator of human performance. Understanding of the physical principle, and also of the test instruction is required to arrive at meaningful results and interpretations. Notably, performance and physiology levels can differ. A series of studies in healthy people has yielded that peak jumping power is a robust, ecological measure of performance and physiology. It shows a very pronounced decline with age. Moreover, these studies reveal that sports is beneficial for muscles and bones. Some benefits by sports diminish with age (bone, muscle), but fracture reduction by sports extends into 10th decade of life.
Human Performance at Old Age

Jörn Rittweger

Institut für Luft- und Raumfahrtmedizin
Deutsches Zentrum für Luft- und Raumfahrt
Köln
Power = \frac{Work}{Time} = \frac{Force \times Displacement}{Time} = Force \times Velocity
Countermovement jump

The body’s centre of mass: Line of action
Why people jump the way they do

What do we do in sub-maximal jumps?

Countermovement Depth vs. Effort

What do peak ground reaction forces really tell us?

**Countermovement Depth vs. Effort II**


**Peak jump power**

\[ \text{Peak jump power} \approx \frac{\text{jump height}}{\text{countermovement depth}} \]
No Training / Learning effects for Jumping Power

Jumping power & Age

Master Athletes – Some Facts

<table>
<thead>
<tr>
<th></th>
<th>100 m</th>
<th>Pole Vault</th>
</tr>
</thead>
<tbody>
<tr>
<td>M60</td>
<td>11.70 s</td>
<td>4.00 m</td>
</tr>
<tr>
<td>M70</td>
<td>12.77 s</td>
<td>3.31 m</td>
</tr>
<tr>
<td>M80</td>
<td>14.35 s</td>
<td>2.60 m</td>
</tr>
</tbody>
</table>

WMA Records

Leo Sterckx

Guido Müller (12.74 s)

Manuel de la Cruz
How do Master Athletes train?

Rittweger, Aktuel Ernährungsmed 40(Suppl 1): S11-S13
Risk of injuries independent of age

Ganse et al, J Musculoskelet Neuron Interact (2014)
Jump Power in Master Athletes

World record performance:

Age-related decline is greater for marathon than for sprint

*Speed (absolute)*

*Speed (Relative)*

Metabolic power in world record running:

Age-related decline is similar for marathon than for sprint

\[ ER = 3.8 \cdot v + 0.01 \cdot v^3 + 2 \cdot \frac{v^3}{D} \]

Master Sprinters Have Strong Leg Bones

Wilks et al., Bone 45:91-97 (2009)
Bone strength declines with age

Regular Sports at Old Age Reduces Hip Fractures

Summary

- Force plates are cool (and so are accelerometers)
- Performance and physiology levels can differ
- Peak jumping power is a robust, ecological measure of performance and physiology
- Peak jumping power shows a very pronounced decline with age
- Sports is beneficial for muscles and bones
- Some benefits by sports diminish with age (bone, muscle)
- Fracture reduction by sports into 10th decade of life