High-intensity intermittent running performance in relation to age and maturation in highly-trained young soccer players

Martin Buchheit, Ben Simpson and Alberto Mendez-Villanueva,
Physiology Unit, Sport Science Department,
ASPIRE, Academy for Sports Excellence, Doha, Qatar.
High-intensity running during youth soccer games

- LIR: Low-intensity running
- HIR: High-intensity running
- VHIR: Very high-intensity running
- Sprinting

Distance covered (m):
- U13: 7497±196
- U14: 7956±128
- U15: 8026±143
- U16: 8436±156
- U17: 8448±135
- U18: 8254±118

Significant differences:
- a: significant difference vs. U14 (P<0.05)
- b: vs. U15
- c: vs. U16
- d: vs. U17
- e: vs. U18

Buchheit et al. IJSM 2010
Determinants of high-intensity running

Supramaximal intermittent performance (>19-21 km/h): a greater aerobic power (i.e., vVO2max) is responsible for an upward shift of the exercise intensity domain → decreased relative intensity → less fatigue (?)
Determinants of high-intensity running

Supramaximal intermittent performance:

- ↑ Anaerobic capacity / Anaerobic speed reserve (ASR) and the proportion of ASR used
- Inter-efforts recovery capacity
What is already known in youth?

• The younger, the more limited the anaerobic capacity and presumably, the smaller the ASR

• The younger, the better the inter-efforts recovery capacity *(Ratel 2006)*

• Q: How does this translate into supramaximal intermittent performance in highly trained young soccer players?

1. Smaller ASR in the younger $\rightarrow$ worse performance than older?

2. Greater ability to recover in the younger $\rightarrow$ better performance than older?
Purpose

• Examine supramaximal intermittent performance capacity in relation to age/maturation in highly-trained young soccer players
• Examine supramaximal intermittent performance capacity in relation to physical capacities, i.e., ASR, $v\text{VO}_2\text{max}$
Methods
Participants

- **27 U14**: 13.0±0.7 y; -3.1 to 0.3 y to/from APHV, 154.7±9.7 cm; 41.5±7.2 kg
- **19 U16**: 14.9±0.5 y; -0.1 to 2.0 y from APHV, 169.2±7.4 cm; 56.8±9.1 kg
- **16 U18**: 16.7±0.8 y; 1.0 to 2.9 y from APHV, 171.2±5.9 cm; 61.1±6.8 kg

14 hr/week in an elite academy
Testing

- Anthropometry / Peak Height Velocity
- 40-m sprint with 10-m split times
  → Maximal sprinting speed (best split)
Testing

2 Incremental track tests:

- Vam-Eval (continuous) $\rightarrow$ Vvam-Eval $\leftrightarrow$ $vV\text{O}_2\text{max}$
- 30-15 Intermittent Fitness test (no COD) $\rightarrow$ $V_{\text{IFT}}$ $\leftrightarrow$ supramax. Int. perf

![Graph showing incremental track tests with markers indicating velocity and time]
30-15 Intermittent Fitness Test
Variables

- MSS – Vvam-Eval = ASR
- $V_{IFT}$ - Vvam-Eval = Surpramaximal intermittent performance *per se* (SupINT)

$\Rightarrow$ The higher SupINT, the better anaerobic capacity and/or recovery

- SupINT / ASR = recovery index?
Results
Vvam-Eval, MSS and ASR

- **MSS**
- **Vvam-Eval**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Running Speed (km·h⁻¹)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>U14</td>
<td>72 ±11%</td>
<td></td>
</tr>
<tr>
<td>U16</td>
<td>81 ±14%</td>
<td>***</td>
</tr>
<tr>
<td>U18</td>
<td>85 ±12%</td>
<td>***††</td>
</tr>
</tbody>
</table>

Significance levels:
- ***: p < 0.001
- ††: p < 0.01
Surpramaximal intermittent performance

\[ V_{\text{FT}} \times V_{\text{Vam-Eval}} \times \% \]
% of ASR used

Running speed (km.h\(^{-1}\))

- **MSS**
- **Vvam-Eval**
- **VIFT**

<table>
<thead>
<tr>
<th></th>
<th>U14</th>
<th>U16</th>
<th>U18</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSS</td>
<td>27 ±7%</td>
<td>24 ±7%</td>
<td>23 ±4%</td>
</tr>
<tr>
<td>Vvam-Eval</td>
<td>27 ±7%</td>
<td>24 ±7%</td>
<td>23 ±4%</td>
</tr>
<tr>
<td>VIFT</td>
<td></td>
<td>24 ±7%</td>
<td></td>
</tr>
</tbody>
</table>

* * *
Correlation coefficient (90% CI)

Relations with physical capacities and maturity

SupINT

Very large
Large
Moderate
Small
Small
Moderate
Large
Very large

*: adjusted for ASR
Conclusions

• The younger players use a greater proportion of their ASR to reach similar supramaximal intermittent performance levels than the older players
• Supramaximal intermittent capacity is therefore poorly affected by age; however, once adjusted for ASR, the less mature tend to perform better than their more mature counterparts
• This is consistent with the greater propensity of young individuals toward high-intensity activities (i.e., better inter-efforts recovery capacities, faster VO₂ kinetics) (Ratel 2006)
• For all players pooled together, Supramaximal intermittent performance is positively related to ASR, and negatively to Vfram-Eval → training load management? → training strategies?
Match running performance and physical capacity in youth football (soccer)

Martin Buchheit, Alberto Mendez-Villanueva, Ben Simpson and Pitre Bourdon

Sport Science Department, Physiology Unit, ASPIRE, Academy for Sports Excellence, Doha, Qatar.
martin.buchheit@aspire.qa