EFFECTS OF RUNNING VS. SPECIFIC AEROBIC TRAINING IN YOUNG ELITE HANDBALL PLAYERS

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ECSS 2008
Today’s training session…

- Why specific HB training?
- Can specific HB aerobic training be confidently used to improve aerobic fitness and performance?
  - **Acute** cardiorespiratory responses to specific HB training vs. high intensity intermittent running exercises (HIT)
  - **Chronic** effects of specific HB training vs. HIT thorough half a competitive season
- Perspectives
Why specific training?
Why using specific training?

- Maintaining *technical skills is highly primordial* in team-sports
- Activation of muscle groups as they are engaged during match-play → *effective transfer* to the competitive environment
- *Running is not usually the favourite* activity of handball players ;)
- Empirically, *lower painfullness* (+++ motivation)
- Worldwide handball coaches have been using specific training for years
- Small *soccer* games was *as effective as HIT* in enhancing aerobic fitness in junior players (*Impellizzeri et al., 2006*)
Why using specific training?

- However, there was NO data, neither on acute responses, nor on chronic adaptations to specific aerobic handball training
Small handball games (SHBG)

- Organised as 4-a-side, excluding goalkeepers.
- Intensity: as high as possible; coaches encourage the players in order to achieve an intensity high enough (Hoff et al., 2002; Rampinini et al., 2007).
- Simplified handball rules (to avoid game interruption and increase exercise load):
  - dribbling and defence contacts not allowed
  - infringements of minor technical rules (i.e. ‘walking’, ‘double dribble’) not sanctioned
  - throw-on after a goal immediately made by the goalkeepers from their 6-m area
  - all 4 players have to be in the opponent half court for the goal to be validated
  - coach is always available to immediately replace the ball when it is kicked out from the playing area

Buchheit et al., JSMS 2008
Can specific HB aerobic training be used instead of HIT to improve aerobic fitness?

Let’s be logical about this…
**NO!**  
SHBG: no ‘real’ control of intensity  
HIT: intensity can be individualized  

Individualizing HIT intensity using a reference speed:

- $\text{vV}O_2\text{max}$ or MAS (*Billat, Sports Med 2001*)
- $V_{IFT}$ = an intermittently-determined reference speed, reached at the end of the 30-15 Intermittent Fitness Test (shown to be more accurate than $\text{vV}O_2\text{max}$ to schedule HIT (*Buchheit et al., JSCR 2008*)).
SHBG: 0 - HIT: 1
Can specific HB aerobic training be used instead of HIT to improve aerobic fitness?

Acute cardiorespiratory responses to

SHBG vs. HIT
Cardiorespiratory responses to SHBG

9 skilled national level handball players
- 5.1 ± 1.1 hr.wk⁻¹
- 21.0 ± 2.9 yr,
- 181.0 ± 4.6 cm and
- 78.4 ± 8.9 kg,

→ 4 Cosmed K4, etc.

Buchheit et al., JSMS 2008
YES! time-efficient stimulus

8’ SHBG:
2 x 3’45” (interspersed with
30 s rest)

8’ HIT:
16 x 15” @ 90% \( V_{IFT} \) (~120%
\( vVO_{2max} \)) / 15” passive rest

\( \frac{t90VO_{2max}}{SHBG} \):
\[ 73 \pm 12 \%
\]

\( \frac{t90VO_{2max}}{HIT} \):
\[ 48 \pm 10 \%
\]

\( * \)

Buchheit et al., JSMS 2008
SHBG: 1 - HIT: 1
NO! possible ‘ceiling effect’

The fittest players may not benefit from a high intense enough stimuli

Buchheit et al., JSMS 2008

\[ n = 9 \]
\[ r^2 = 0.77 \]
\[ p = 0.002 \]
At present: SHBG: 1 - HIT: 2

.... So, on the long term, HIT should win, no?
Can specific HB training be used to improve aerobic fitness?

Chronic adaptations: SHBG vs. HIT thorough half a season
Participants / training intervention

- 32 highly-trained elite adolescent players (15.5 ± 0.9 y, 16 girls, 16 boys, Tanner Stages from III to V)
  - HIT (n = 17; girls = 8)
  - SHBG (n = 15; girls = 8)
- 10-week program
- 2 x 8 to 10’ HIT or SHBG sessions a week, in addition to usual training contents
  - HB (~7.5h.wk⁻¹)
  - Strength, power and agility (~2h.wk⁻¹)
- SHBG and HIT matched for total duration
  - HIT = 2 x [14 x 15"(92%V_{IFT})-15"passive] = total 7’
  - SHBG = 2 x [2x3’15"] (r=30") = total 7’
Training intervention

SHBG: similar duration than HIT

HIT: 15”@92%V_{IFT}/15”passive rest
Athletic performance assessment

- 30-15IFT → $V_{IFT}$ (km.h$^{-1}$)$^1$
- 3 Times to exhaustion performing 15”/15” @ 100, 95 and 90% of $V_{IFT}$ – passive rest
- Intermittent endurance index (iEI)$^2$

$^1$ Buchheit, JSCR 2008; $^2$ Buchheit et al., IJSM 2008;
Intermittent Endurance Index (iEI)

Adapted from Peronnet & Thibault EI model (JAP, 1989)
Buchheit et al., IJSM 2008

iEI = slope
0.95 < r < 1

Fig 1. Relationship between percentage of $V_{IFT}$ at which intermittent runs were performed (100, 95 and 90%) and associated times-to-exhaustion expressed logarithmically; Ln(ET).
Athletic performance assessment

- 30-15IFT $\rightarrow V_{IFT} \text{ (km.h}^{-1})$
- 3 Times to exhaustion performing 15”/15” @ 100, 95 and 90% of $V_{IFT}$ – passive rest
- Intermittent endurance index (iEI)
- Counter movement jump (CMJ)
- 10 m sprint time (10m)
- Throwing velocity (Shoot)
- best ($RSA_{best}$) and mean ($RSA_{mean}$) times on a shuttle-repeated sprint ability test - 6 x (2 x 15m), $r = 14”$.

$^1$ Buchheit, JSCR 2008; $^2$ Buchheit et al., IJSM 2008; $^3$ Buchheit et al., MSSE 2008
Results
### Overall athletic performance

**Fig 2 & 3.** Training-induced change for girls in physical performance, 10-m sprint time (10 m), best time during the repeated-sprint ability test (RSA$_b$), mean sprint time during the RSA test (RSA$_m$), countermovement jump (CMJ), throwing velocity (Shoot) and velocity reached at the end of the 30–15IFT ($V_{IFT}$). *: large effect size (ES > 0.8). †: significant difference in relative changes between training groups ($P < 0.05$). §: significant difference between pre- and post-training revealed with the 2-factors ANOVA ($P < 0.05$).
Fig 4. Changes in times-to-exhaustion at 100, 95 and 90% of \( V_{\text{IFT}} \) (expressed logarithmically; Ln(ET)) and associated intermittent endurance index (iEI) before and after high-intensity run training (HIT, triangles) or handball specific training using small-handball games (SHBG, circles) with girls and boys pooled.

No change in iEI & no difference between groups
SHBG: 4 (or more ?)- HIT: 3

Even more for SHBG?
future will tell us...
Discussion

- **Aerobic-related indices: SHBG ~ HIT**
  - Training near ‘the high intensity zone’ (≥90% \( \text{VO}_2\text{max} \)) might be enough
  - Additional aerobic solicitations (HB 7.5 hrs a week) might be of higher importance than SHBG or HIT
  - Motivation (SHBG) might overcome training precision (HIT)
  - Circumpupertal players might display very (too?) good responsiveness to ‘any’ kind of aerobic stimuli

- **Repeated sprint ability: SHBG > HIT**
  - Need to sprint repeatedly during SHBG but not HIT
  - Recovery intensity during HIT was passive
Conclusions

- Both small-sided handball games and high intensity running exercises are effective training modes for adolescent handball players.

- However, specific handball training should be considered as the preferred training method due to its specificity and higher impact on repeated sprint ability.
Perspectives

- What about elite adult players?
- In progress: reliability of cardiorespiratory and RPE measures
  - HR: typical error = 4 bpm
  - RPE: typical error = 0.3
- Evaluating the effect of SHBG players number on exercise load - as shown in soccer (Rampinini et al., JSS 2007)
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<table>
<thead>
<tr>
<th></th>
<th>SHBG</th>
<th>HIT</th>
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<tbody>
<tr>
<td><strong>Pre tests</strong></td>
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<tr>
<td>Week -2</td>
<td>30-15&lt;sub&gt;IFT&lt;/sub&gt; / CMJ / 10m / RSA and throwing velocity tests</td>
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<tr>
<td>Week -1</td>
<td>iEL determination (3 intermittent runs to exhaustion)</td>
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<tr>
<td><strong>Training period</strong></td>
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<tr>
<td>Week 1</td>
<td>2 x [2x2’30&quot;] 2 x [2x3’15&quot;] 2 x [5’30” 15”(90%)-15”p] 2 x [7’ 15”(92%)-15”p]</td>
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<tr>
<td>Week 2</td>
<td>2 x [2x2’45&quot;] 2 x [2x3’45&quot;] 2 x [6’ 15”(90%)-15”p] 2 x [8’ 15”(92%)-15”p]</td>
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<tr>
<td>Week 3</td>
<td>2 x [3x2’40&quot;] 2 x [3x3’] 2 x [9’ 15”(90%)-15”p] 2 x [10’ 15”(92%)-15”p]</td>
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<tr>
<td>Week 4</td>
<td>2 x [2x3’15”] 2 x [2x4’15&quot;] 2 x [7’ 15”(90%)-15”p] 2 x [9’ 15”(92%)-15”p]</td>
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<td>Week 5</td>
<td>2 x [3x3’20&quot;] 2 x [3x3’40&quot;] 2 x [11’ 15”(90%)-15”p] 2 x [12’ 15”(92%)-15”p]</td>
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<td>Week 6</td>
<td>Regeneration*</td>
<td></td>
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<tr>
<td>Week 7</td>
<td>2 x [2x3’15”] 2 x [2x3’30”] 2 x [7’ 15”(92%)-15”p] 2 x [7’30’ 15”(93%)-15”p]</td>
<td></td>
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<tr>
<td>Week 8</td>
<td>2 x [3x2’40&quot;] 2 x [2x4’15&quot;] 2 x [9’ 15”(92%)-15”p] 2 x [9’ 15”(93%)-15”p]</td>
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<td>Week 9</td>
<td>2 x [3x2’40&quot;] 2 x [2x4’15&quot;] 2 x [9’ 15”(92%)-15”p] 2 x [9’ 15”(93%)-15”p]</td>
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<td>Week 10</td>
<td>1 x [2x2’30’] 1 x [2x2’45”] 1 x [5’30” 15”(95%)-15”p] 1 x [6’ 15”(100%)-15”p]</td>
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<tr>
<td><strong>Pre tests</strong></td>
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<tr>
<td>Week 11</td>
<td>30-15&lt;sub&gt;IFT&lt;/sub&gt; / CMJ / 10m / RSA and throwing velocity tests</td>
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<tr>
<td>Week 12</td>
<td>iEL determination (3 intermittent runs to exhaustion)</td>
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## SHBG vs. HIT

<table>
<thead>
<tr>
<th></th>
<th>Mean VO$_2$ (ml.min$^{-1}$.kg$^{-1}$)</th>
<th>Mean HR (bpm)</th>
<th>[La]$_b$ (mmol.l$^{-1}$)</th>
<th>RPE</th>
<th>Distance covered (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHBG</td>
<td>53.3 ± 3.3</td>
<td>175.4 ± 8.7</td>
<td>8.9 ± 3.5</td>
<td>6.3 ± 0.5</td>
<td>1234.3 ± 112.3</td>
</tr>
<tr>
<td>HIT</td>
<td>50.1 ± 7.1</td>
<td>178.6 ± 7.8*</td>
<td>11.6 ± 2.07*</td>
<td>6.6 ± 0.5</td>
<td>1182.5 ± 52.2</td>
</tr>
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*Buchheit et al., JSAMS 2008*
Can SHBG be used to improve aerobic fitness?

- **Acute cardiorespiratory responses**
  - Training at or near VO$_2$max (90% or 95% of VO$_2$max at least three minutes) \cite{Laursen2002, Midgley2006, Midgley2006}.

- **Chronic adaptations (i.e., > several weeks)**
  - Maximal aerobic power
  - Aerobic ‘endurance’
Cardiorespiratory responses to SHBG

8' SHBG:
2 x 3'45" (interspersed with 30 s rest)

8' HIT:
16 x 15" @ 90% $V_{IFT}$ (~120% $vVO_2\text{max}$) / 15" passive rest

$V_{IFT}$ = speed reached at the end of the 30-15 Intermittent Fitness Test (30-15$_{IFT}$) (Buchheit JSCR 2008) – more accurate to schedule HIT than $vVO_2\text{max}$

*Buchheit et al., JSMS 2008*
YES: SHBG = a time-efficient stimulus

\[ t_{90 \text{VO}_2 \text{max}}: \]

**SHBG:**
73 ± 12 %

**HIT:**
48 ± 10 %

* Buchheit et al., JSMS 2008