Exposure Variation Analysis (EVA) method to monitor ability to optimally regulate exercise intensity of professional cyclists during time-trial competitions

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INTRODUCTION

Determinants of Individual Time-Trial performance

Physiological determinants

Heterogenous subjects
From sedentary to highly trained cyclists

Peak Power Output
Hawley and Noakes, 1992...

PO at lactic/ventilatory threshold
Amann et al., 2006...

ITT Mean PO

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INTRODUCTION

Individual Time-Trial performance during World-Tour races

Elite cyclists

Mean PO

Well trained and talented

Fig. 2  RPP according to the cyclist’s skills and exercise intensity zones.

a significant difference between climbers and flat specialists (p<0.05),
b significant difference between sprinters and flat specialists (p<0.05),
c significant difference with sprinters (p<0.05).

No significant differences of mean maximal PO amongst elite cyclists

Pinot and Grappe, 2011

High ITT mean PO

Optimal use

Good performance in World-Tour ITT

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INTRODUCTION

Pacing strategies and Individual Time-Trial performance

Abbiss and Laursen, 2008

Constant pacing strategy

Central control mechanisms to maintain high constant PO

Best ITT performances

Reduce fatigue

Reduce mechanical losses due to speed variations

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Control of exercise intensity during Individual Time-Trial

Noakes, 2011; Tucker, 2009; Marcora, 2008

Exhaustion occurring at the finishing line

Self-paced Individual Time-Trials involves a lot of intensity fluctuations that influence perceived exertion and performance

Tucker et al., 2006; Landers et al., 2009

Estimated time remaining

Perceived exertion
INTRODUCTION

Exposure Variation Analysis to study exercise intensity regulation during ITT

Abbiss et al., 2010; Mathiassen and Winkel, 1991

EVA method

EVA matrix

Intensity zones

Acute time zones

< 10 s  > 10 s

105% of mean PO

95% of mean PO

Intensity regulation indices

Accurate PO (APO)

Inaccurate PO (IPO)

Short time regulations (REG)

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INTRODUCTION
Exposure Variation Analysis to study exercise intensity regulation during ITT

Ouvrard et al., under review

<table>
<thead>
<tr>
<th>APO</th>
<th>Each seconds spent at a constant mean PO, optimal for performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPO</td>
<td>Each prolonged effort at a too low or too high PO regarding optimal pacing strategy</td>
</tr>
<tr>
<td>REG</td>
<td>Short-time regulations to avoid prolonged efforts at too low or too high PO</td>
</tr>
</tbody>
</table>

Parameters the more significantly related to performance during national ITT championship

APO

IPO

Better effort regulation

Greater use of the cyclist’s physical capacity during the race

Better performance

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INTRODUCTION

Study aims and hypothesis

<table>
<thead>
<tr>
<th>Date</th>
<th>Race</th>
<th>Ranking</th>
<th>Mean PO</th>
<th>EVA analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>17/02</td>
<td>Andalucia-3</td>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>w</td>
<td></td>
</tr>
<tr>
<td>14/03</td>
<td>Tirreno-Adriatico-7</td>
<td>17&lt;sup&gt;th&lt;/sup&gt;</td>
<td>w</td>
<td></td>
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<tr>
<td>16/05</td>
<td>Giro d’Italia-10</td>
<td>19&lt;sup&gt;th&lt;/sup&gt;</td>
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<td></td>
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<tr>
<td>28/05</td>
<td>Giro d’Italia-21</td>
<td>28&lt;sup&gt;th&lt;/sup&gt;</td>
<td>w</td>
<td></td>
</tr>
</tbody>
</table>

EVA analysis never performed for several ITT of the same riders

Are changes in IPO and APO related to performance changes?

Ouvrard, Pinot, Groslambert & Grappe

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EVA method to monitor ability to optimally regulate exercise intensity of professional cyclists during time-trial competitions

METHODS

Data collecting

6 World-Tour riders = 1 GC leader, 2 TT specialists, 2 climbers and 2 domestics

2 World-Tour official ITTs performed on the same course for 2 consecutive years

PO recorded thanks to SRM power meters
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**METHODS**

Data analysis

### PERFORMANCE CHANGES

- Mean speed TT1
- Mean speed TT2

### PHYSICAL PERFORMANCE VARIATIONS

- Mean PO TT1
- Mean PO TT2

### EFFORT REGULATION DIFFERENCES

<table>
<thead>
<tr>
<th>EVA Analysis TT1</th>
<th>APO</th>
<th>IPO</th>
<th>REG</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVA Analysis TT2</td>
<td>APO</td>
<td>IPO</td>
<td>REG</td>
</tr>
</tbody>
</table>

- Pearson correlation coefficients to analyse relationship between performance changes, mean PO variations and EVA analysis differences ($p < 0.05$)
**RESULTS**

**Performance and mean PO variations**

<table>
<thead>
<tr>
<th>Differences of</th>
<th>Subject 1</th>
<th>Subject 2</th>
<th>Subject 3</th>
<th>Subject 4</th>
<th>Subject 5</th>
<th>Subject 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranking</td>
<td>14</td>
<td>11</td>
<td>(+2)</td>
<td>(+2)</td>
<td>7</td>
<td>58</td>
</tr>
<tr>
<td>Mean speed</td>
<td>0,2 kph</td>
<td>0,8 kph</td>
<td>1,0 kph</td>
<td>1,2 kph</td>
<td>1,6 kph</td>
<td>3,5 kph</td>
</tr>
<tr>
<td>Mean PO</td>
<td>20 w</td>
<td>(+11w)</td>
<td>(+6w)</td>
<td>(+5w)</td>
<td>(+7w)</td>
<td>(+9w)</td>
</tr>
</tbody>
</table>

No relationship between performance changes and differences of mean PO \((r = 0.28)\)
RESULTS

Performance evolutions and EVA parameters changes

APO

IPO

Better effort regulation

Improved ITT performance

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DISCUSSION

Physical capacity and performances changes in World-Tour cyclists

Physical capacity remains mostly stable during professional cycling seasons despite variations of performances

Lucia et al., 2000
Sassi et al., 2008

Pinot et Grappe, 2015

Physical capacity monitoring is insufficient to predict performance variations

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DISCUSSION

Central determinants of ITT performance
Noakes, 2011; Tucker, 2009; Marcora, 2008

Physical capacity

Greater use of the physical capacity during races

Different ITT performances

Pacing strategies and regulation mechanisms

Different mental and psychological parameters
CONCLUSION

How to improve ITT performance of World-Tour cyclists?

Improving effort regulation mechanisms

World-Tour athletes

Well-trained talented athletes

Physical capacity and mean PO

SEVA method to monitor ability to optimally regulate exercise intensity of professional cyclists during time-trial competitions

Improved ITT performance
REFERENCES


Ouvrard, Pinot, Grosclamvert & Grappe

EVA method to monitor ability to optimally regulate exercise intensity of professional cyclists during time-trial competitions