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Training distribution, physiological profile and performance for a male international 1500m runner.

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Running Head: Elite middle distance training methods
Abstract

This case study observed the training delivered by a 1500m runner and the physiological and performance change during a two year period.

A male international 1500m runner (personal best 3:38.9 min:s, age 26 yrs, height 1.86m, body mass 76kg) completed 6 laboratory tests and 14 monitored training sessions, during two training years. Training distribution and volume was ascertained from training diary and spot-check monitoring of heart rate, accelerometry measurements. Testing training information were feedback and discussed with coach and athlete from which training changes were made.

In the first training year, low intensity training was found to be performed above the prescribed level, which was adjusted with training and coach support in year two (Training zone <80% of v\(\dot{VO}_2\)max, year 1 = 20%; year 2 = 55%). ‘Tempo’ training was also performed at an excessively high intensity (\(\Delta[\text{blood lactate}]\) between 5 to 25 mins of tempo run, year 1 = \(\Delta6.7\) mM, year 2 = \(\Delta2.5\) mM). From year 1 to 2, there was a concomitant increase in the proportion of training in the high intensity zone of 100 to 130% v\(\dot{VO}_2\)max from 7 to 10%. \(\dot{VO}_2\)max increased from 72 to 79 ml.kg\(^{-1}\).min\(^{-1}\), economy improved from 210 to 206 ml.kg\(^{-1}\).km\(^{-1}\) and 1500m performance time improved from 3:38.9 to 3:32.4 min:s from the beginning of year 1 to the end of year 2.

Case shows a modification in training methodology that was coincident with a greater improvement in physiological capability and furtherance in performance improvement.

Keywords: Elite athlete, middle distance running, training intensity distribution
Introduction

This case study reports training, physiological status and performances over a 2 year period for a male international 1500m runner. Competitive runners routinely undertake laboratory and field based physiological profiling from which derived physiological variables are well associated with performance in the middle distance events \(^1\). Moreover, training monitoring research shows a poor association between actual and prescribed training intensity \(^2\). Elite athlete training is commonly structured such that large volumes of low intensity, small volumes of medium intensity and moderate amounts of high intensity training are performed \(^3\). In the current case, we present actual versus prescribed training, training volume and distribution and physiological and performance changes for a male international 1500m runner.

Methods

A male international (and therefore subjected to WADA and UKAD out-of-competition and in-competition testing) 1500m runner (initial personal best, 3:38.94 min:s, age 26 yrs, height 1.86m, body mass 76kg) was the focus of this report. For physiological support, the coach requested laboratory based physiological profiling and follow-up integration through field based support, targeting ‘tempo’ training.

Following standardized prior 24 hours of training, diet and control of exercising clothing and shoes, a discontinuous 7 x 3 min incremental treadmill (HP Cosmos Saturn, Traunstein, Germany) test to exhaustion (as described in \(^1\)) determined vLT, RE, \(\dot{VO}_2\) max (highest 30s), v \(\dot{VO}_2\) max.

The athlete recorded daily training distance, time and heart rate (s625x, Polar, Electro Oy, Finland). Training sessions were categorized according to the respective speed and
expressed as a percentage of $\dot{V}O_2\text{max}$ to form the training distribution. Further prescribed training information was taken from coach training schedules and converted to an equivalent measure of speed and distance. These data were compared to the actual training performances of the athlete. Selected ‘tempo’ sessions of 5 x 1609m, designed to simulate MLSS, were monitored for the change in [blood lactate] (Biosen, EKF, Germany) between repetitions 2 and 5.

Further training such as strength training, drills and stability training was performed twice each week, but was not recorded and used in this comparison. Feedback and discussions were held with the coach and athlete on a monthly basis. Performances recorded when personal bests were achieved. Data were analysed using a two-sample t-test compared data for each year ($\alpha=5\%$).

**Results**

The difference between the prescribed and actual training intensity was 18% in year 1 and 2.8% in year 2 ($P<0.001$) for low intensity training. High intensity training was performed close to the prescribed intensity with no differences noted between years (1.2 vs 1.3%, $P=0.85$).

Training designed to elicit MLSS was performed at an intensity greater than MLSS criteria in both years but greater in year 1 than year 2 ($\Delta [\text{blood lactate}], 6.7$ vs 2.5 mM; $P<0.001$).

Training distribution showed a shift toward more low intensity training, less medium intensity training and more high intensity training from year 1 to 2 (figure 1). Change in physiological abilities are shown in table 1.
Improvements in performance (figure 2) were 0.9% for year 1 and 1.4% for year 2, compared with 0.5% mean progression during the two years prior to support.

**Discussion**

This case presents positive outcomes, concomitant to monitoring athlete training execution, regular feedback, discussion and negotiation with the coach and athlete, based upon objective training and physiological data. There was a notable increase in the change in physiological capability observed in year 2 compared to year 1. Further a step-change in performance improvement was observed for each year of physiological support above that experienced prior to scientific support.

Feedback was provided to the coach and athlete about training performed, highlighting the discrepancy between actual and prescribed exercise intensity. The resulting modification of training behavior in year 2, firstly, reconciled an inaccuracy in training delivery, resulting in more low intensity, less medium intensity and a subtle increase in the amount of high intensity training performed. The pattern of intensity distribution in year 2 had become more divergent (different intensity taxonomy used in the current case), moving toward a model of polarized training recognized by Seiler and colleagues, of elite athletes training observed with rowing, swimming, cross-country skiing and 5000m to marathon distance running\(^3\), \(^5\), but not yet been documented for 1500m running. Perhaps due to the large emphasis upon eccentric loading in running, particularly at high speeds, it is plausible that training volume is not only limited by metabolic (overtraining type) but also mechanical (injury type) integrity and thus there is a tendency to make training units (such as a low intensity run) more intense.

The current case saw a small increase in high intensity training volume. This was not prescribed as such, but appeared to result from the athlete being able to undertake high
intensity training at a faster speed following reports from the athlete that they felt able to execute high intensity training more effectively. It is possible that by reducing the intensity ‘low’ and ‘moderate’ intensity running, the glycolytic contribution to and therefore the drain upon glycogen reserves and the immune response would be reduced whilst training volume remained unchanged\(^6\), perhaps allowing for improved high intensity execution.

**Practical applications**

Further this case report presents alteration in training methodology with a shift toward low intensity training, a reduction in medium intensity and allowance for greater high intensity training delivery being coincident with greater improvements in physiological capability which further supported a step-change in performance improvement. This case study suggests that coaches and support physiologists should attend to the actual delivered of training intensity compared to the prescribed programme.
REFERENCES


Table 1. Physiological data collected during incremental exercise to exhaustion during 2 year period of monitoring. T0 = baseline.

<table>
<thead>
<tr>
<th>Physiological measure</th>
<th>Sept T0</th>
<th>Nov Yr 1</th>
<th>Mar Yr 1</th>
<th>Sept Yr 1</th>
<th>Dec Yr 2</th>
<th>Mar Yr 2</th>
<th>Sept Yr 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\dot{V}O_2_{max}$ ( (L \text{ min}^{-1}) )</td>
<td>4.80</td>
<td>4.98</td>
<td>5.16</td>
<td>4.90</td>
<td>5.48</td>
<td>5.60</td>
<td>5.45</td>
</tr>
<tr>
<td>$\dot{V}O_2_{max}$ ( (mL \text{ kg}^{-1} \text{ min}^{-1}) )</td>
<td>70.5</td>
<td>72.4</td>
<td>73.8</td>
<td>70.5</td>
<td>78.6</td>
<td>79.6</td>
<td>78.5</td>
</tr>
<tr>
<td>vLT ( (\text{km hr}^{-1}) )</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>17.0</td>
<td>17.0</td>
<td>17.0</td>
<td>18.0</td>
</tr>
<tr>
<td>$\dot{V}VO_2_{max}$ ( (\text{km hr}^{-1}) )</td>
<td>20.4</td>
<td>20.3</td>
<td>20.4</td>
<td>20.1</td>
<td>22.6</td>
<td>23.2</td>
<td>23.1</td>
</tr>
<tr>
<td>RE ( (mL \text{ kg}^{-1} \text{ km}) )</td>
<td>208</td>
<td>214</td>
<td>217</td>
<td>210</td>
<td>209</td>
<td>206</td>
<td>204</td>
</tr>
</tbody>
</table>
Figure 1. The distribution of training volume for year 1 and year 2 against training intensity as a percentage of velocity at maximum oxygen uptake.
Figure 2. The change in 1500m performance speed during competitive races prior to physiological support and during year 1 and 2.