Training Distribution, Physiological Profile, and Performance for a Male International 1500-m Runner

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This case study observed the training delivered by a 1500-m runner and the physiological and performance change during a 2-y period. A male international 1500-m runner (personal best 3:38.9 min:s, age 26 y, height 1.86 m, body mass 76 kg) completed 6 laboratory tests and 14 monitored training sessions, during 2 training years. Training distribution and volume was ascertained from training diary and spot-check monitoring of heart rate and accelerometry measurements. Testing and training information were 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 y 2 (training zone < 80% of vVO2max, y 1 = 20%; y 2 = 55%). “Tempo” training was also performed at an excessively high intensity (Δ [blood lactate] 5–25 min of tempo run, y 1 = Δ6.7 mM, y 2 = Δ2.5 mM). From y 1 to 2, there was a concomitant increase in the proportion of training in the high-intensity zone of 100 to 130% vVO2max from 7 to 10%. Values for VO2max increased from 72 to 79 mL ∙ kg–1 ∙ min, economy improved from 210 to 206 mL ∙ kg–1 ∙ min, and 1500-m performance time improved from 3:38.9 to 3:32.4 min:s from the beginning of y 1 to the end of y 2. This 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

This case study reports training, physiological status, and performances over a 2-year period for a male international 1500-m 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. Moreover, training monitoring research shows a poor association between actual and prescribed training intensity. Elite athlete training is commonly structured such that large volumes of low-intensity, small volumes of medium-intensity, and moderate volumes of high-intensity training are performed. In the current case, we present actual versus prescribed training, training volume and distribution, and physiological and performance changes for a male international 1500-m runner.

Methods

A male international (and therefore subjected to WADA and UKAD out-of-competition and in-competition testing) 1500-m runner (initial personal best, 3:38.94 min:s, age 26 y, height 1.86 m, body mass 76 kg) 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 a standardized prior 24 hours of training, diet, and control of exercising clothing and shoes, a discontinuous 7 × 3-minute incremental treadmill (HP Cosmos Saturn, Traunstein, Germany) test to exhaustion (as described in Ingham et al) determined vLT, RE, VO2max (highest 30 s), and vVO2max.

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 vVO2max 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 × 1609 m, designed to simulate maximum lactate steady state (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 were recorded when personal bests were achieved. Data were analyzed using a 2-sample t test compared data for each year (α = 5%).
Results

The difference between the prescribed and actual training intensity was 18% in year 1 and 2.8% in year 2 ($P < .001$) 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%, $P = .85$).

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 ($\Delta$ [blood lactate], 6.7 vs 2.5 mM; $P < .001$).

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). Changes 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 2 y prior to support.

Discussion

This case presents positive outcomes, concomitant with 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 the 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 5000-m to marathon distance running, but had not yet been documented for 1500-m 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

![Figure 1](image)

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.

### Table 1 Physiological Data Collected During Incremental Exercise to Exhaustion During 2-Year Period ($T_0$ was baseline) of Monitoring

<table>
<thead>
<tr>
<th>Physiological Measure</th>
<th>Sept $T_0$</th>
<th>Nov Y 1</th>
<th>Mar Y 1</th>
<th>Sept Y 1</th>
<th>Dec Y 2</th>
<th>Mar Y 2</th>
<th>Sept Y 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$VO_{2\max}$ (L/min)</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>$VO_{2\max}$ (mL kg$^{-1}$ 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>$vLT$ (km/h)</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>$vVO_{2\max}$ (km/h)</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 kg$^{-1}$ 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>
metabolic (overtraining type) but also by 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 of “low” and “moderate” intensity running, the glycolytic contribution to and therefore the drain upon glycogen reserves and the immune response would be reduced whereas training volume remained unchanged, perhaps allowing for improved high-intensity execution.

Practical Applications

This case report presents an alteration in training methodology with a shift toward low-intensity training, a reduction in medium-intensity training, and an allowance for greater high-intensity training 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 degree of training intensity compared to the prescribed program.

References