Title

Lower volume throughout the taper and higher intensity in the last interval session prior to a 1,500 m time trial improves performance

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Abstract

Eight highly-trained middle-distance runners (1,500 m personal best 4:01.4 ± 0:09.2 min) completed two 7-day tapers, separated by at least 3 weeks of regular training: (*i*) prescribed using prediction models from elite middle-distance runners, where continuous running volume was reduced by 30% and interval intensity was equal to 1,500 m race pace (RP); and (*ii*) continuous running volume was reduced by 60% and intensity of the final interval session was completed at 110% of 1,500 m race pace (HI). Performance was assessed using 1,500 m time trials on an indoor 200 m track one day before, and one day after each taper. Performance time was improved after HI by 5.2 ± 3.7 s (mean ± 90% confidence limits, $p = 0.03$) and by 3.2 ± 3.8 s after RP ($p = 0.15$). The first and second 300-m segments of the 1,500 m time trial were faster post-taper in RP ($p = 0.012$ and $p = 0.017$, respectively) and HI (both $p = 0.012$). Running faster than race pace late in a low-volume taper results in a larger improvement in 1,500 m track performance than a higher volume taper, where the final interval session is completed at race pace.

Novel Findings

- When combined with a large reduction in continuous running volume (-60%), an increase in intensity of the final interval session (to 110% of 1,500 m race pace) during a taper improves 1,500 m track performance by 2.0%
- Athletes adopt a negative pacing strategy before tapering and a positive-pacing strategy after tapering
- A positive pacing strategy after tapering can result in a worsening in performance if not judged correctly

Key Words: tapering, training load, interval training, training volume, athlete, pacing

Introduction

Tapering has been defined as "a progressive nonlinear reduction of the training load during a variable period of time, in an attempt to reduce the physiological and psychological stress of daily training and optimise sports performance" (Mujika and Padilla 2000). There are a variety of methods that can be adopted to achieve this outcome, but all are characterised by manipulating the training variables of volume, frequency and intensity over a given duration (Houmard 1991); with intensity often expressed relative to individual maximal aerobic capacity, heart rate or race pace (Jones 2006).

The general consensus from swimming, running and cycling data recommends that a taper should consist of a reduction in training volume of 41-60% lasting approximately two weeks, with maintenance of training frequency and intensity (Bosquet et al. 2007). The inclusion of intense training during the taper is key to enhancing performance (Shepley et al. 1992; McConnell et al. 1993; Houmard et al. 1994; Bosquet et al. 2007; Mujika 2010) and consequently requires a reduction in volume to overcome fatigue. Furthermore, training might be completed at increased intensities late in the taper, if the athlete is more fully recovered from previous overload (Mujika et al. 2004). The physiological responses to this strategy might include; increased buffering capacity (Houmard et al. 1994), increases in oxidative enzyme activity, red blood cell volume and muscle glycogen concentration (Shepley et al. 1992), which potentially contribute to an improvement in subsequent performance. It was evident in world class middle-distance runners (Tjelta 2019; Kenneally et al. 2020) and in elite skiers and biathletes (Tønnessen et al. 2014) that the distribution of training intensity shifts toward a more polarised model prior to competition, with more time spent at the opposite extremes of intensity rather than at moderate intensities (e.g. between the first and second lactate thresholds). It was also reported that the elite skiers and biathletes typically complete a high intensity session within 48 hours of competition (Tønnessen et al. 2014). This was supported by training data from the world's most successful female cross-country skier, whereby a progressive increase in the proportion of high intensity training was reported during the three weeks before major competition, with three high intensity sessions completed in the final seven days (Solli et al. 2017). However, there is a need to establish best practice recommendations for high intensity training and optimal recovery during the final days of the taper. Our group have previously explored tapering strategies in elite British endurance runners and prediction models were developed that can prescribe an individual taper from the prior training load (Spilsbury et al. 2015). It was observed that long-distance runners train at intensities above average race pace within the final days of the taper period before competition, whereas middle-distance runners complete the final sessions at race pace (Spilsbury et al. 2015). In a subsequent study, we investigated the influence of an increase in intensity (to 115% of race speed) in the final interval session of a middle-distance taper derived from the prediction models on 1,500 m treadmill time trial performance (Spilsbury et al. 2019). This strategy was *possibly beneficial* to performance (1.4% faster). However, the strategy that was prescribed from the prediction models alone, improved performance time by 3.4%. Since the average reduction in training volume calculated from the prediction models (Spilsbury et al. 2015) in that study was ~30%, whereas the recommendations from the literature suggest 41-60%, (Bosquet et al. 2007), it is possible that the performance improvement in the high intensity taper could have been greater if the volume reduction had been greater. This was compounded by the fact that the total volume of the final high intensity session was greater than the 1,500 m race distance itself.

Whilst the taper is crucial to ensure athletes are ready to produce an optimal performance, they must also be able to regulate their work rate during a race. The distribution of work or energy expenditure over a particular distance is also referred to as 'pacing' or a 'pacing strategy' (Abiss and Laursen, 2008) and enables the athlete to cover the race distance in the shortest possible time, without catastrophic failure in any physiological system (St Clair

Gibson et al. 2006). However, it is unknown whether athletes' pace selection might be influenced by the effects of tapering. For example, athletes might train with overload prior to the taper in an attempt to maximise adaptation (Aubry et al. 2014) and therefore could become accustomed to performing with accumulated fatigue (Halson and Jeukendrup 2004). If this is the case, then decision making in the selection of pace may be inappropriate.

To our knowledge, no study has investigated how tapering influences 1,500 m track running performance, with both our own and that of Shepley et al. (1992) having been based on laboratory treadmill performance. The aims of the current study are therefore: 1) investigate the effectiveness of a tapering strategy derived from prediction models (Spilsbury et al. 2015) on 1,500 m time trial track performance; 2) establish whether an increase in the intensity of the final interval session (to 115% of race pace) and a greater overall reduction in continuous volume (-60%) can enhance 1,500 time trial track performance compared to the model-derived tapering strategy; 3) explore the influence of the taper on self-selected pacing strategy for 1,500 m performance. It was hypothesised that both tapering strategies would improve 1,500 m performance, and that the lower volume taper with a higher intensity final interval session would have the largest effect on running performance.

Methods

Participants

Eight highly-trained male middle distance runners; (mean ± SD) age 21.4 ± 4.2 years, height 182.8 ± 7.2 cm, body mass 67.4 ± 8.0 kg, volunteered to take part in this study. Participants were competitive middle-distance runners (800 m & 1,500 m) with a training history of at least two years and had trained consistently (including low intensity continuous training and high intensity interval training) without interruption for the previous two months. Personal best 1,500 m time was (mean ± SD) 4:01.4 ± 0:09.2 min (range; 3:47.6 min – 4:11.7 min). Participants provided written consent to take part in the present study, which was approved by the Loughborough University ethics committee and carried out in accordance with the Declaration of Helsinki.

Experimental design

The study employed a counterbalanced cross over design (figure 1). Each of the two conditions involved a 7-day period of tapering, with a 1,500 m time trial performance assessment on the day before (pre-taper) and the day after (post-taper). Conditions were separated by at least three weeks of regular training, where participants repeated their baseline training programme. Participants were not informed about the precise differences between the two conditions, but could not be blinded to the manipulation of training load.

{Insert Figure 1. here}

The investigation began in the 16th week of the winter training season. Participants trained under the supervision of their personal coaches and followed their own individual training programmes, which were not manipulated prior to the experimental conditions. Training in the four weeks prior to the first condition was recorded objectively from the participant’s own global positioning system (GPS) device. Training was categorised into continuous (excluding warm up and warm down) or interval running (Smith and Jones 2001) and quantified for mean weekly volume (km) and duration (min), frequency and intensity (% personal best 1,500 m race speed). During the taper period in the race-pace condition (RP), participants completed individualized training relative to the mean of the four weeks preceding the experimental conditions, which was prescribed using predictive equations based on the practices of elite middle-distance runners (Spilsbury et al. 2015). An example of this is shown in table 1. In RP, the speed of the final interval training session was equivalent to the average speed of personal best 1,500 m time.

{Insert Table 1. here}

In the high intensity condition (HI), training was prescribed as above, with the exception of continuous running volume, which was reduced by 60% for all participants and the intensity of the final interval session of the taper was prescribed at 115% of the speed in RP. This intensity was selected based on the practices of elite British (Spilsbury et al. 2015) and Kenyan (unpublished data) long distance and marathon runners. After modifying the load, the general structure of the training program and specific interval sessions were replicated as closely as possible during the taper period for each participant. Participants were instructed to carry out the same warm up and warm down for interval sessions as in the control period. Participants were allocated in a latin square design to receive either the RP condition followed by the HI condition or the HI condition followed by the RP condition. Training load was confirmed throughout both conditions using GPS data.

Final interval session within taper period

In each condition, a standardised interval running session was completed on day five, three days prior to the final performance assessment. Both were carried out on an outdoor 400 m track, at the same time of day. Participants were instructed to perform the same warm up procedure before each session, consisting of a 10-min self-paced jog, 10 min of mobility drills and five to six progressive 80 m stride outs. Interval volume during the taper was distributed so that the final interval session in each condition involved five 300 m repetitions with 90 s recovery. Intensity of each repetition was instructed to be equivalent to personal best 1,500 m race speed in the RP condition (6.2 ± 0.2 m·s^{-1}) and 115% of personal best 1,500 m race speed in the HI condition (7.2 ± 0.2 m·s^{-1}). A warm down of 15 min self-paced jogging was performed after completion of the session.

Performance assessments

Participants completed two 1,500 m time trial runs in each condition, before (pre-taper) and after (post-taper) the 7-day tapering period. All performance assessments were carried out on an indoor 200 m track at the same time of day. Participants were asked to repeat dietary intake in the 24 hr before each performance assessment and caffeine consumption was prohibited during this period. To avoid tactical competition among athletes with similar personal best times, participants were allocated to one of three separate heats based on performance level (e.g. three fastest participants ran in different heats and three slowest ran in different heats). This ensured that participants were able to run on the inner lane of the track. Participants were instructed to run the time trial as an all-out effort and to avoid drafting strategies or tactics. Overall performance time and split times at 100-m intervals were recorded using a radio frequency identification timing system (ULTRA 4, RFID Race Timing Systems, West Midlands, UK), whereby participants were required to wear a small transponder on their left ankle. No feedback was provided on split times or overall performance times until both experimental conditions had been completed. Mean running speed was calculated for each 300-m segment of the time trials using the 100-m split times.

Statistical analysis

Data were analyzed using SPSS 21.0 (Statistical Package for Social Sciences Inc., Chicago, IL). These data were initially tested using the Kolmogorov-Smirnov test and subsequently non-parametric tests were used where the data were not normally distributed, specifically training frequency data. All other data were confirmed to be normally distributed. Training frequency data from the pre-experimental period, RP and HI were compared using the Mann-Whitney U test. All other training load data, including 300 m repetition session data were compared using paired samples *t*-tests. Pre-taper time trial performance data were compared using paired samples *t*-tests, to confirm no difference in baseline performance in RP and HI conditions. Time trial data from the performance assessments were analyzed via a two-way repeated measures ANOVA, with taper (no taper versus taper) and condition (RP versus HI) as within-subject factors and Bonferroni *post hoc* analysis. The smallest meaningful change (SMC) in 1,500 m performance was assumed to be a reduction or increase in running time of 1% (Hopkins 2005). Changes in performance time were calculated as multiples of the SMC and the magnitude was considered either small (1x), moderate (3x), large (6x) or very large (10x) (Buchheit 2016). Mean running speed was compared in the corresponding 300-m segment of pre- and post-taper time trials for both RP and HI conditions using the Wilcoxon Signed Rank test. Effect size (ES) was calculated and was considered either trivial (0–0.19), small (0.20–0.49), medium (0.50–0.79) or large (≥ 0.80) (Cohen 1992). Data are presented as mean ± SD or ± 90% confidence interval (CI), unless stated otherwise. Statistical significance was accepted at $p \leq 0.05$.

Results

Confirmation of training completed during the baseline period and in both taper conditions was provided from GPS data and is shown in table 2. Mean 300 m repetition time in the final interval session was faster in the HI condition compared to the RP condition (43.8 ± 2.0 s *vs.* 48.0 ± 2.1 s, respectively, $p < 0.01$), but slower in HI than prescribed (43.8 ± 2.0 s *vs.* 41.0 ± 1.5 s, $p < 0.01$). Mean 300 m repetition time was slower than prescribed for all participants (range 1.1 to 4.5 s slower).

{Insert Table 2. here}

1,500 m performance assessment

Pre-taper 1,500 m performance times were not different in RP and HI conditions (258.9 s ± 7.4 s versus 259.0 ± 6.3 s, $p = 1.00$). The change in 1,500 m performance times after tapering compared to pre-taper in RP and HI are shown in figure 2A. The mean improvement in 1,500 m performance time after tapering in the HI condition was twice as large as the SMC (5.2 s, $p = 0.03$, SMC = 2.6 s, CI = 1.5 to 8.9 s), compared to 1.3 times the SMC in the RP condition (3.2 s, $p = 0.15$, SMC = 2.6 s, CI = -0.6 to 7 s; table 3). Individual responses to RP and HI tapering conditions are shown in figures 2B and 2C, respectively.

{Insert Figure 2. here}

{Insert Table 3. here}

Pacing

Split times indicated that participants ran faster in the first (0-300 m) and second (300-600 m) segments of the post-taper time trial compared to the pre-taper time trial in both the RP (50.4 ± 1.1 *vs.* 52.3 ± 2.1 s, $p = 0.012$, ES = 1.14 and 50.1 ± 1.7 *vs.* 52.1 ± 0.9 s, $p = 0.017$, ES = 1.56, respectively) and HI conditions (49.5 ± 2.3 *vs.* 51.8 ± 2.3 s, p = 0.012, ES = 0.97 and 49.9 ± 1.5 *vs.* 52.5 ± 1.0 s, p = 0.012, ES = 2.01, respectively, figure 3).

{Insert Figure 3. here}

Individual responses

Six of eight participants improved performance after tapering in the RP condition (range 2.4-8.8 s), but of those, only 5 improved in excess of the SMC. Two participants showed a worsening in performance (4.7 s and 5.8 s, respectively). In the HI condition, seven of eight participants improved performance in excess of the SMC after tapering, (range 3.8-11.7 s) and one participant showed a worsening in performance (7.0 s). This individual showed a decline in performance in both conditions. Mean 300 m segment speeds are shown for this participant in figure 4.

{Insert Figure 3. here}

Discussion

In highly-trained middle-distance runners, 1,500 m track performance improved by 1.2% after a 7-day taper prescribed using predictive equations based on the practices of elite middle-distance runners, where the final interval session intensity was equal to race speed. When a greater reduction in continuous volume (-60% from baseline training) was prescribed, and the final interval session was completed at 110% of race pace, 1,500 m track performance improved by 2.0%. The large 90% confidence interval in both conditions indicated that there was variation in the individual responses to the tapers, with most participants improving performance and two participants experiencing a worsening in performance. After both tapering conditions, participants adopted a positive pacing strategy and completed the first two 300 m segments of the time trial significantly faster than pre-taper.

In a meta-analysis of the available literature on competitive runners, swimmers and cyclists, the mean improvement in performance after tapering was 1.96% (Bosquet et al. 2007). Treadmill data has shown, after a 7-day high intensity-low volume taper in trained endurance runners, 5,000 m performance improved by 3% (Houmard et al. 1994), which is similar to our own earlier data (3.4%) over 1,500 m (Spilsbury et al. 2019). To our knowledge, the current study is the first to investigate the effects of tapering on 1,500 m track running performance. The observed improvement in performance after RP was 1.2% and was in excess of the SMC in performance (1%) for five out of eight participants. The smaller improvement in the track performance versus treadmill performance in the previous study was likely due to two participants experiencing a worsening in performance after the RP taper. Although, a smaller improvement might also be expected due to the higher and more homogenous performance standard of the participants and a more externally valid performance test. Compared to RP, the observed improvement in performance after HI was 2.0% and performance time was improved in seven out of eight individuals in excess of the SMC (1%). The largest individual improvement in performance from baseline was observed after the HI taper (4.5%).

Previously, theoretical models have shown that a moderate increase in training load at the end of a taper may further improve performance as the athlete can capitalise on additional adaptations, after initially overcoming accumulated fatigue from previous training (Thomas et al. 2009). In particular, a greater capacity to respond positively to high intensity training during very low volume tapers has been observed, resulting in increases in buffering capacity, oxidative enzyme activity, red blood cell volume and muscle glycogen concentration (Shepley et al. 1992; Houmard et al. 1994). Our previous work investigated the effect of a single higher intensity interval session completed late in the taper, when the athlete might be more fully recovered from pre-taper training (Spilsbury et al. 2019). However, the effect on 1,500 m treadmill time trial performance was unclear and there was large variability in individual responses. Our interpretation was that this was due to the conservative reduction in training volume prescribed via our predictive equations (~30%), which were derived from athletes who did not implement this higher intensity session (Spilsbury et al. 2015). The data in this study suggests that the greater reduction in training load recommended by Bosquet et al. (2007) from swimming, running and cycling data, was successful in improving performance in HI. This may have allowed greater recovery from pre-taper training, enabling individuals to respond more positively to the increase in intensity during the final interval session of the taper. These data also suggest that it is not necessary to complete all training in the taper period at high intensity which was the strategy adopted by Houmard et al. (1994) and Shepley et al. (1992). The HI strategy is aligned with the current practices of elite endurance athletes, who typically incorporate both high intensity interval training and lower intensity continuous running into their taper, albeit with volume reduction being to a lesser extent (Stellingwerff 2012; Spilsbury et al. 2015).

In the HI condition, participants were instructed to run at a pace equal to 115% of race-speed in the final interval session. However, training data revealed that mean intensity of this session was in fact 110% of race-speed. Although faster than the corresponding session in RP, this was significantly slower than prescribed. In comparison, the final interval session in our previous study (Spilsbury et al. 2019) was carried out on a treadmill and speed was therefore fixed at 115% of race speed for each individual in the HI condition. Since efforts at >100% of race speed in middle-distance events equate to considerably higher absolute speeds than the same percentages of long-distance event race speeds, it is possible that 115% of race speed was too intense for this event group, particularly so close to 'competition'. In comparison, elite marathon runners are able to complete their peak intensity interval session during the taper at ~114% of race speed, but typically this session occurs 10 days from competition (Spilsbury et al. 2015) and is a slower absolute speed than for 1,500 m runners. Considering the practices of marathon runners and the recommendations from the literature that the optimal taper duration is approximately two weeks (Bosquet et al. 2007), it is possible that the one-week taper was not sufficient to overcome fatigue from previous training. Therefore, athletes may have self-selected to run slightly slower than instructed on the track to protect themselves from potentially exacerbated fatigue in HI, whilst still allowing a positive response to the session and enhanced subsequent time trial performance compared to RP. This might explain the more consistent performance improvement in HI observed in the current study, compared to that of Spilsbury et al. (2019), where intensity was fixed at 115% of race speed. From a practical standpoint, it highlights the importance of executing the final session optimally at the individual level. Alternatively, it is possible that adverse weather conditions (e.g. wind) prevented participants from running at the prescribed speed, due to the final session taking place on an outdoor 400 m track. Indeed, the actual speed may have represented a level of effort equivalent to 115% of race speed. It was not feasible for participants to complete the final session on an indoor track, nor for the weather conditions to be measured or controlled. The volume of this session was fixed at a total of 1,500 m (5 x 300 m repetitions with 90 s rest), rather than as a proportion of baseline training, to further prevent exacerbation of fatigue when increasing the intensity.

It was not feasible in the present study to assess the physiological characteristics of the participants. However, this may have facilitated our understanding and interpretation of the individual responses to tapering in both conditions. In middle-distance running in particular, athletes with distinctly different physiological profiles can be capable of achieving similar performance times (Sandford et al. 2019). Evidence is also emerging to suggest that different muscle fibre typology can influence recovery time from repeated bouts of high intensity exercise (Lievens et al. 2020). Potential differences in aerobic and anaerobic capacities, and neuromuscular qualities might therefore influence how athletes respond to, and recover from, a fixed intensity session at 110% of race pace late in the taper.

Participants completed the first two 300 m segments of the time trial quicker after tapering in both RP and HI, followed then by a similar pace in the remaining segments compared to pre-taper. In closed-loop events, such as 1,500 m, the aim in a non-tactical race is to complete a fixed distance in the shortest possible time (St Clair Gibson et al. 2001). Athletes must regulate their rate of work output to optimise overall race performance and prevent catastrophic changes to physiological homeostasis which can result in premature exhaustion (Tucker and Noakes 2009). The faster start in the present study suggests that the participants were able to detect and take into account their improved recovery status after tapering and perhaps draw on their previous experience of racing after tapering. After the faster first two 300 m segments, pace was adjusted and remained similar to pre-taper time trials in the final three segments to potentially avoid premature exhaustion (Noakes et al. 2005; St Clair Gibson et al. 2006). A positive pacing strategy such as this, is typically selected in events lasting <4 minutes, whilst pace becomes more evenly distributed in longer events (Tucker and Noakes, 2009). Performance might be enhanced by adopting a fast-start in 1,500 m running training due to a speeding of VO_2 kinetics (Bailey et al. 2011). However, it may also be harmful to performance if not judged correctly (Hanon et al. 2007) and such interventions may require practice prior to important competition. In support, Mauger et al. (2009) found that cyclists were able to adopt a successful pacing strategy once prior experience of the 4 km time trial distance was gained, even with no distance or time feedback.

Poorly judged pacing could explain the response of two individuals whose performance declined after tapering in the RP condition, one of whom also experienced a decline in performance after tapering in HI. The individual with worsened performance in both conditions executed a negative pacing strategy in the pre-taper time trials, shown by a slower start and an increase in speed in the final 300 m segments. In the post-taper time trials, this individual opted for a positive pacing strategy, but likely started too fast, which resulted in the pace continuing to decline and slower overall times. If athletes are unfamiliar with racing in an optimally tapered state, a reduced perception of effort, coupled with high motivation to run fast in a competitive setting, may result in unrealistic expectations about the level of performance they are actually capable of. In support, the individual athlete in this case was completing the highest training volume of all participants prior to tapering (84 $km \cdot week^{-1}$, excluding warm up and warm down volume) and was therefore prescribed the largest absolute reduction in training volume in both RP and HI. The unfamiliarity of implementing a large reduction such as this, likely led to heightened expectations and therefore poor pace-judgement early in the race, thus hindering overall performance. It has been suggested that the learning implications from experiencing a range of pacing patterns may be beneficial to performance (Foster et al. 1993). This is particularly important for middle-distance athletes, as a range of different race tactics and pacing strategies can be implemented in pursuit of reaching the finish line first (Casado et al. 2020, Sandford and Stellingwerff 2019). Furthermore, recent evidence suggests that middle-distance runners with distinctly different physiological profiles might be suited to contrasting pacing strategies (Bellinger et al. 2020). Athletes with a high velocity at $\dot{V}O_{2peak}$ and superior running economy might be more successful in a fast, even-paced race, whilst a slow tactical race with a fast last lap might favour athletes with a higher maximal accumulated oxygen deficit and a higher gastrocnemius carnosine Z-score (higher estimated percentage of type II muscle fibres) (Bellinger et al. 2020). It is therefore recommended that athletes take the opportunity to practice pacing during less important competition when there has been a taper planned or during periods of reduced volume in their normal training cycle.

Whilst the finding that athletes modify their pacing strategy after tapering is novel, allowing athletes to self-select their pacing strategy in the time trials may have confounded the effects of the taper on performance. Since all participants were experienced in racing the 1,500 m event, it was not anticipated that some individuals would be unable to regulate their rate of work output optimally as a result of tapering and experience a worsening in performance. A treadmill time-to-exhaustion test at 1,500 m pace would have eliminated this issue, however 1,500 m time trials have been shown to more reliable (Laursen et al. 2007) and represent an externally valid performance test when completed on a running track.

Conclusion

A novel 7-day tapering strategy where continuous training volume is reduced by 60% and the final interval session is completed at 110% of race pace, results in a larger improvement in 1,500 m track performance than a 7-day taper based on the practices of elite middle-distance runners. However, due to variation in individual responses, it is recommended that middle-distance athletes trial both tapers in training or for minor races, in order to determine the optimal strategy to improve their performance. After tapering, athletes appear to adopt a positive pacing strategy during a 1,500 m track performance. To avoid an over-fast start when employing this pacing strategy, pacing in a tapered physiological state should be practiced and close attention should be paid to split times early in the race to facilitate an optimal performance.

Acknowledgements

The authors would like to thank the English Institute of Sport, British Athletics and Stuweb Race Timing Solutions for their support.

Conflicts of interest & sources of funding

The authors declare that they have no conflicts of interest and the study did not receive funding from sources external to Loughborough University.

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Tables

Table 1. An example of the taper training load calculated from baseline training load using prediction models developed from elite British endurance athletes*

Training Variables	Example Data
Continuous Volume	
Control (km)	70
Taper[†] (% control)	65
Taper (km)	45
Interval Volume[‡]	
Control (km)	12
Taper[§] (% control)	58
Taper (km)	7
Continuous Frequency	
Control (runs·week^{-1})	7
Taper[ǁ] (% control)	63
Taper (runs·week^{-1})	4
Interval Frequency	
Control (runs·week^{-1})	3
Taper[¶] (runs·week^{-1})	3
Continuous Intensity	
Control (% race speed)	65
Taper[**] (% race speed)	62
Interval Intensity	
Control (% race speed)	96
Taper[††] (% race speed)	100

*prediction models with control training load variables as predictors (Spilsbury et al. 2015).

[†](97.153 + (-0.106*control continuous volume) + (-2.547*control continuous frequency)*0.9), adjusted for standard error of the estimate.

[§]average reported by British middle-distance runners (55% of control interval volume).

[ǁ](130.800 + (0.211*control continuous volume) + (1.059*control interval volume) + (-10.016*control continuous frequency)).

[¶]Control interval frequency maintained. Laboratory interval session was included in this frequency, not additional.

[**](-13.443 + (-0.07*control continuous volume) + (0.946*control continuous frequency) + (1.141*control continuous intensity)).

[††](34.356 + (0.684*control interval intensity)).

[‡]warm up and warm down volume for interval sessions not included.

Table 2. Weekly volume, frequency and intensity of training in the taper conditions and percentage change from baseline. Warm up and warm down data is not shown.

		RP		HI	
Training Variables	**Baseline**	**Taper**	**%Δ**	**Taper**	**%Δ**
Training volume					
Continuous running (km)	54 ± 14	37 ± 8*	-30%	21 ± 5*†	-60%
Interval running (km)	13 ± 4	8 ± 2*	-42%	8 ± 2*	-42%
Total running (km)	66 ± 16	45 ± 10*	-32%	29 ± 7*†	-56%
Training frequency					
Continuous running (runs·week^{-1})	5 ± 1	4 ± 0*	-24%	4 ± 0*	-24%
Interval running (runs·week^{-1})	2 ± 0	2 ± 0	0%	2 ± 0	0%
Total running (runs·week^{-1})	7 ± 1	6 ± 1*	-18%	6 ± 1*	-18%
Training intensity					
Continuous running (% race speed)	65 ± 4	62 ± 5*	-5%	62 ± 4*	-5%
Interval running (% race speed)	95 ± 3	99 ± 2*	5%	100 ± 2*	5%
Final interval session (% race speed)	-	101 ± 1	-	110 ± 3†	-

Data are mean ± SD; *n* = 8; RP, race-pace condition; HI, high-intensity condition; %Δ, mean percentage change from baseline to taper periods. * Different to baseline, † different to RP taper, all $p < 0.05$.

Table 3. Differences in pre- and post-taper 1,500 m time trial performance in the RP and HI conditions.

	Pre-taper Time (s)	**Post-taper Time (s)**	**Mean Improvement (s) and 90% CL**	**Factor of the Smallest Important Effect[a]**
RP	258.9 ± 7.4	255.7 ± 8.7	3.2; ± 3.8	1.3
HI	259.0 ± 6.3	253.8 ± 7.7	5.2; ± 3.7	2.0*

Data are mean ± SD unless stated otherwise; n = 8; [a], with reference to multiples of the smallest meaningful change (SMC) of 1% (2.6 s); The number of asterisks (*) indicate the magnitude of change, with 1 referring to small (1x >SMC), 2 to moderate (3x >SMC), 3 to large (6x >SMC) or 4 to very large (10x >SMC); CL, confidence limits.

Figure Captions

Figure 1. Experimental design illustrated by two experimental conditions, separated by three weeks of regular training. Arrows represent 1,500 m time trial performance assessments the day before and after each taper condition. The final interval session took place on day five of each 7-day taper.

Figure 2. Change in performance time (%) after tapering compared to pre-taper in RP and HI (**A**). *Circles represent individual responses, median response shown as horizontal line within the box. Positive values represent an improvement in performance, negative values represent a worsening in performance. No change in performance (dotted line), smallest meaningful change in 1,500 m treadmill time trial performance measure (1%, dashed line). Individual 1,500 m time trial performance responses (dashed lines) and group mean ± SD (solid line) in RP (**B**) and HI (**C**).*

*Figure 3. Mean running speed for each 300 m segment of the 1,500 m time trial in the RP condition (**A**) and the HI condition (**B**). The pre-taper time trial data is represented by the dashed line/open circles and post-taper time trial data by the solid line/filled circles. * different to corresponding pre-taper 300 m segment ($p < 0.05$).*

*Figure 4. Mean running speed for each 300 m segment of the 1,500 m time trial in the RP condition (**A**) and the HI condition (**B**) for the individual participant with a decline in performance times post-taper. The pre-taper time trial is represented by the dashed line/open circles and post-taper time trial by the solid line/filled circles.*