TITLE: Training for Elite Team Pursuit Track Cyclists – Part I: A Profile of General Training Characteristics

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Abstract

Purpose To profile the training characteristics of an elite team pursuit cycling squad, and assess variations in training intensity and load accumulation across the 36-week period prior to a world record performance at the 2018 Commonwealth Games.

Methods Training data of five male track endurance cyclists (mean [SD]; age 21.9 [3.52] yrs; 4.4 [0.16] $W.kg^{-1}$ at LT_2; 6.2 [0.28] $W.kg^{-1}$ MAP; maximal oxygen uptake 68.7 [2.99] $ml.kg.min^{-1}$) were analysed with weekly total training volume, and heart rate, power output, and torque intensity distributions calculated with reference to their 3:49.804 min:sec.ms performance requirements for a 4-km team pursuit.

Results Athletes completed 543 [37] h^{-1} of training across 436 [16] sessions. On-bike activities accounted for 69.9% of all training sessions, with participants cycling 11,246 [1,139] km^{-1} in the training period of interest, while 12.7% of sessions involved gym/strength training. A pyramidal intensity distribution was evident with over 65% and 70% of training, respectively, performed at low-intensity zone heart rate and power output, while 5.3% and 7.7% of training was performed above anaerobic threshold (LT_2). The athletes accumulated 4.4% of total training volume at, or above, their world record team pursuit lead position torque (55 Nm).

Conclusions These data provide updated and novel insight to the power and torque demands, and load accumulation contributing to world record team pursuit performance. While the observed pyramidal intensity distribution is common in endurance sports, the lack of shift towards a polarised intensity distribution during taper and competition peaking differs from previous research.

Keywords: athletic performance; elite sport; training intensity distribution, track cycling, endurance

1. Introduction

The athlete training process involves the systematic planning and execution of exercises to develop mental, physical, tactical, and technical components of athletic performance. The periodisation of training across successive mesocycles, each with their own emphasis and targeted adaptations, allows for the accumulation of load in a manner that builds upon adaptations gained in prior phases[1–3] for the purpose of optimising performance at a predetermined time.

In track cycling, the team pursuit is completed by four riders in a pace line over a distance of 4000 metres, demanding highly-developed aerobic and anaerobic metabolic capacities[4,5]. The benefit of aerodynamics results in a variable power requirement for riders, from 100% at first wheel (lead position), to ~70% at second wheel, and ~64% at third- and fourth-wheels[6,7]; as riders change order (transition) within the race, they are permitted a brief active recovery period while not leading the pace line (follow positions)[8]. Studies have reported the measured and approximated power output requirements in the team pursuit. Schumacher & Mueller[9] estimated a 670 W lead power output, and 571 W average in the follow positions, would be required for a 4:00.0 min:sec.ms race time based on modelling by Broker and colleagues[6]. More recently, lead and race mean power have been measured as 658 ± 13 and 501 ± 26 W, respectively, in an international calibre performance time of 3:49.9 min:sec.ms[7]. Little has been published on the periodisation strategies used for team pursuit riders. How track cyclists train to enable these power outputs and the resultant performances is of interest to improve our understanding and guide practice.

The only training profile of a track cycling team pursuit squad previously published detailed the training characteristics of the German national team preparation for a world record performance (3:59.710) at the 2000 Sydney Olympics[9]. The general training concept involved aerobic base development through high-volume low-intensity load accumulation (29-35000 $km.yr^{-1}$), along with multiple road stage races, and three short (4-6 day) track cycling blocks performed 6-10 weeks apart, including the final competition preparatory/taper phase. For those athletes, 94% of training was performed below lactate threshold (LT_1; < 2 mmol.L^{-1}). Training goals of their short track cycling blocks were to develop track-specific anaerobic capacities and technical refamiliarisation. In the 22 years since that world record performance, a new best time has been set 17 times, therefore changes in track endurance cyclists' physical capacities and how they train is of great interest.

In other endurance sports of similar event duration, elite athletes' weekly training volume typically ranges from 6-15 hours, with approximately 80% of training performed at intensities < 2 mmol.L^{-1}; the remaining training volume is completed at intensities > 4 mmol.L^{-1} or between the two metabolic thresholds (e.g., 1500-m running[10], rowing[11], speed skating[12]). Track cycling training often involves short, high-intensity bouts that may confound heart rate-based estimation of metabolic load due to heart rate kinetics during and after these bouts. The availability of power output data in cycling allows quantification of external load to accurately measure the work performed, better accounting for the stochastic nature of cycling efforts (e.g., high-intensity interval training, racing). Kenneally and colleagues[13] offered an alternative to traditional training load measures by quantifying intensity distributions relative to competition requirements (i.e., race pace). Race-relative measures could be particularly useful in track cycling, where accumulation and intensity distributions can be calculated for multiple relevant measures (e.g., power output, torque). Still, it is valuable to quantify training intensity distributions using both internal and external load measures within the context of traditional models that typically guide training prescription for differentially targeting specific physiological adaptations.

To the authors' knowledge, only two published studies have documented the training or physiological characteristics of track cyclists for a prolonged period[9,14]. Of those, only Schumacher & Mueller[9] presented data from a world record performance season. The aim of this study was to profile the physical training characteristics of an elite team pursuit squad, assessing variations in training intensity and load accumulation across a 36-week period in preparation for the 2018 Commonwealth Games. Through this profile, we examined the integration of specific and non-specific training modalities, and quantified training intensity distributions relative to metabolic and race pace thresholds. Within this paper we focus primarily on the physical component of performance (i.e., not mental, tactical, technical). These findings will help quantify the training demands enabling world-class performances, which may be useful for coaches, practitioners, and athletes in track cycling to improve training planning.

2. Methods

2.1. Participants

Five male track endurance cyclists (mean [SD] age, 21.9 [3.52] yrs; height, 183.0 [5.24] cm; body mass, 78.6 [3.21] kg) participated in this study. All participants were members of the Australian Cycling Team, and research approval was provided by AusCycling (then Cycling Australia). After being provided information about the study and its requirements, participants provided informed consent, permitting the researchers access to their testing, training, and performance data for the study period of interest. The study was granted ethics approval (ETH19-3866) by the University of Technology Sydney Human Research Ethics Committee and complied with the Declaration of Helsinki. Participant characteristics are presented in Table 1.

2.2. Training Data Analysis

Athlete testing, training, and performance data were collected for every recorded activity in the 36-week study period of interest (1st August 2017 to 5th April 2018). Data were exported from the athletes' online training diaries (TrainingPeaks™, CO, USA), and Australian Cycling Team sport science databases. Training diaries were imported to Excel

2016 (Microsoft, USA), inspected for missing and outlier data, and systematically coded by training session type for analysis.

Individual workout files were uploaded to Golden Cheetah (v3.5 open-source license, UK), cleaned (i.e., heart rate and power data spikes removed), then exported as 1-Hz raw data. Torque (Nm) was derived from power output and cadence, as described by Gardner et al.[15]. Training session duration was determined from training diary and heart rate data to ensure agreement. Power output data were measured using instrumented cranks (SRM, Germany; Quarq, SRAM, USA; Rotor, Spain), and heart rate data collected using chest-worn heart rate monitors (Polar, Finland; Wahoo, USA). Power and heart rate data were available for 87% and 73% of sessions, respectively. Seventy percent of sessions had both variables recorded. In sessions where variables were missing, time in zone data were imputed by hot deck imputation method[16,17] using multiple-parameter inputs (athlete, week, coded session name, duration, distance, and available heart rate or power variables) in VIM[18]. Imputed variables (heart rate, power output, session duration) were plotted and visually inspected for discrepancies (e.g., outliers) between raw and imputed values.

Time in training intensity zones was calculated using zones identified from a lactate threshold step test (5 min, 50 W steps)[19], performed by athletes within the first month of the study period of interest, and subsequently updated following testing on 2 further occasions between September and November. For this study, LT_1 is defined as the power output (and resultant heart rate) preceding the first > 0.4 $mmol.L^{-1}$ increase in blood lactate, and LT_2 identified using the Mod-Dmax method[20].

Athletes were primarily based in Adelaide, SA, Australia, and the majority of track-based training sessions were conducted at the Adelaide SuperDrome – a 250-metre indoor wooden velodrome with maximum bank angle of 43°. The final race event was held at the Anna Meares Velodrome, Brisbane, QLD, Australia – a 250-metre indoor wooden velodrome with 44° maximum bank angle. Each athlete's average lap pace in track training session efforts was calculated to analyse trends in pace evolution, along with the gear used in each effort. Race power outputs for each athlete in lead position (i.e., first wheel) were modelled using race simulation effort data (power, speed, cadence) collected in training sessions prior to the event, corrected for environmental conditions (temperature, humidity, barometric pressure, air density). A fixed proportion of the respective riders' lead position modelled power was used to calculate power output at each follow position (i.e., second, third, and fourth wheel) based on previous research[6]. These data were used to calculate time spent above each threshold (e.g., world record (WR) Lead, WR Follow, WR Average). Performance modelling was required because the athletes' track bike power meters were not in use during the competition.

2.3. Statistical Analysis

Data were analysed and figures plotted using R (version 4.0.2)[21]. All data are presented as mean ± SD.

3. Results

3.1. General Training Characteristics

Participant baseline characteristics at the beginning of the training period are presented in Table 1. Riders were based in a centralised program for the majority of their preparation with regular breaks from the Training Centre where they continued to train in their own home environment (Figure 1). Training was periodised into defined blocks that progressed from riders having an individualised program to target specific aerobic, strength and skill goals, to a team and race-specific focus. In total, there were 2560 individual items stored in the participants' training diaries for the study period of interest. Of these, 2182 (85.2%) were active (e.g., bike, gym) training or passive heat acclimation (e.g., sauna) sessions. Heat acclimation sessions were used both independently and immediately after active training sessions to, respectively, induce or extend physiological stress. The remainder included non-active recovery (e.g., massage, illness, days off), testing (e.g., anthropometry or musculoskeletal screening), travel, and team meetings.

Table 1 Approximate Position

Figure 1 Approximate Position

Participants trained 905.89 ± 55.30 $min^{-1}.wk^{-1}$ (Figure 2-A) and cycled 312.40 ± 28.32 $km^{-1}.wk^{-1}$ across the 36-week study period. Bike-based sessions (track, road, indoor) accounted for 69.9% of all sessions, while 12.7% were gym sessions. Heat acclimation stress was used either independently or as an adjunct stressor to exercise in 2.9% of sessions (for heat acclimation protocol see Tebeck et al.[22]). Riders competed in both track and road races throughout their preparation for the Commonwealth Games. The track events were not limited to team pursuit and a range of events (i.e., omnium, Madison) were contested by the riders.

Figure 2 Approximate Position

3.2. Training Intensity Distribution

A pyramidal intensity distribution was evident in most training weeks for both heart rate (Figure 2-B) and power output (Figure 3-B). Across the 36 weeks, percentage of total time spent below LT_1 was 65.5 ± 11.45% and 70.8 ± 13.28% for HR and power, respectively. Participants performed 5.3 ± 3.08% and 7.7 ± 3.41% of training above LT_2 HR and power intensities, respectively, with the remainder (29.2 ± 11.55% and 21.6 ± 12.18%) between LT_1 and LT_2.

Figure 3 Approximate Position

Figure 4 Approximate Position

3.3. Power & Torque Load Accumulation

When accounting for training intensities relative to their world-record performance power (Figure 3) demands, participants accumulated 5.2 ± 1.58% of their total training load at or above mean team pursuit follow (i.e., wheels 2-4) intensity. Total load accumulated at, or above, lead team pursuit power output was 1.2 ± 0.46% of total duration, while 1.8 ± 0.55% was above the WR-performance average power output. Required torque at the WR-performance steady state cadence (~118 rpm) was 55 Nm for the team pursuit lead position (Figure 4), with 4.4 ± 1.33% of total training volume accumulated at, or above, this intensity. For total race average and follow position torque requirements, 4.7 ± 1.23% and 5.6 ± 1.10% of training, respectively, was performed at equal or greater intensities during the 36-week preparation phase.

Figure 5 Approximate Position

3.4. Race performance

The 2018 Commonwealth Games men's 4000-metre team pursuit final took place at Anna Meares Velodrome (Chandler, QLD, Australia) on 5th April 2018. Air density inside the velodrome was 1.165 kg/m^3. Across the season, there was a gradual improvement in track session average lap pace during training efforts in preparation for the benchmark event. A concomitant increase in gear size was observed in the two primary phases of pace evolution during the study period of interest (Figure 5). A gear size of 116 inches was selected for the race to suit rider technical and physical capabilities within the constraints of event demands. Rider pacing was steady once target velocity was attained, with minor variations in speed observed, resulting in highly consistent 1-km split times (Figure 6). The final race time was 3:49.804 min:sec.ms.

Figure 6 Approximate Position

4. Discussion

This was the first study to characterise team pursuit cyclists' training intensity and load accumulation relative to their own world-record performance power output and torque demands. We have also provided the first update to our understanding of the general training characteristics in elite team pursuit athletes in over 20 years. The team's performance at the 2018 Commonwealth Games was a then-world record 3:49.804 min:sec.ms in the men's 4000-metre team pursuit, beating the previous record (Great Britain, 2016) by 0.461 seconds. This analysis offers important insights to the training demands contributing to elite performance, with some findings in agreement, and others in conflict, with previous findings from multiple endurance sports.

In the 36-week preparation period prior to their world record performance, the team pursuit squad members completed ~540 training hours across multiple training modes, and ~11240 km^{-1} cycled. Annualised volume (787 h^{-1} and 16289 km^{-1}, respectively) differs greatly from that reported by the 2000 team pursuit world record-setters involved in the study of Schumacher & Mueller[9]. The ~13000 km^{-1} difference in total training distance was related to the track-specific training program of the present group that focussed on developing aerobic and anaerobic capacity and fatigue resistance via high-intensity training completed via multiple modalities (i.e., road, ergo, track, treadmill) compared to the low-intensity, high-volume road-based concept of the German program. The German concept was based on the development of aerobic power through volume and road stage races, with transfer to track-specific anaerobic demands using short (4-7 day) track training camps. The program resulted in 94% of athletes' training performed below LT_1, while 2% was above LT_2 compared to 68% and 4%, respectively, in the present study. Different methods were used for identifying metabolic thresholds, which may explain some of the proportional differences due to respective cut-offs[23]. Nonetheless, the training data clearly shows an evolution in approaches to prepare for the team pursuit from the year 2000 to 2018.

A large proportion of training was performed at low intensities, albeit less than the 70-80% typically reported in endurance training[24,25]. Similar to previous training intensity distribution research[13,26,27], a pyramidal training intensity distribution was evident for most of the preparation period. However, an often-observed shift toward a polarised distribution in the late phase was not seen[26,27]. To provide context to this observation, it is important to acknowledge in the quantification of time in heart rate zones is the incidental effect of transitional periods between LIT and HIT (e.g., during high-intensity interval training) on MIT volume. The majority of these athletes' track and ergometer sessions were performed as short duration (< 2 min) efforts. As a result of this training prescription, MIT volume would be inflated (compared to external work performed) due to time spent in the intermediate training zone during the ascending and descending heart rate response. For non-steady state training, as is common in track cycling, it is likely more appropriate to use external load when quantifying intensity distributions as a more accurate reflection of metabolic stress. It is also important to consider the impact of environmental stressors while using heart rate to quantify training load, particularly in elite athletes where heat and hypoxia are often used as additional training stimuli. In the present study, these effects are noted in the slightly higher heart rate relative to power during heat acclimation performed during the season (Figures 2-B and 3-B). The inclusion of heat acclimation was seen as an opportunity to achieve required metabolic stress to maintain aerobic capacity and blood volume with less mechanical stress (i.e., torque). Heat stress applied in various training sessions within these athletes was observed to induce elevations in heart rate >80% HR_{max} and core temperature >38.5 °C (see Tebeck et al.[22]), indicating increased physiological stress and the induction of valuable metabolic responses[22]. This strategy allowed for reduced neuromuscular fatigue allowing for greater training quality in track and gym sessions.

Gym-based training was a major component of the performance program, representing 16% of total training time. Resistance training was prescribed to develop strength, power, and speed, periodised to complement on-bike training throughout the preparation period. A focus of this training was improving athlete robustness and resilience for injury prevention and load tolerance through development of movement competencies and core strength. The inclusion of 2-3 resistance training sessions per week has been shown to improve cycling efficiency and mean maximal power output in elite cyclists[28]. Multi-joint compound exercises – leg press, deadlift, and squat variations – were the principal movements of the program, with plyometric exercises used to further develop rate of force development. Training was not limited to lower-limb exercises, with upper-body movements incorporated along with extensive core training to aid posture and control in the highly demanding, aerodynamic team pursuit position. It is unclear what resistance training, if any, the athletes involved in the Schumacher & Mueller study[9] performed during their Olympic preparation; the large road-based training volume may have precluded the inclusion of resistance training in their program, or it simply may not have been considered necessary to develop requisite characteristics for track endurance or road cycling at that time.

Rapid production of large amounts of force, extensively and repeatedly, underpins team pursuit performance. Given the fixed-gear nature of track cycling, internally-driven (e.g., physiological, biomechanical) improvements in average speed may be achieved through combinations of increased cadence, increased gear size, or fatigue deferral. Increases in cadence result in a reduction of mechanical efficiency[29] and are likely impractical from the already high pedal velocities of this and more recent world-record performances. Conversely, larger gear sizes have the benefit of potential efficiency improvements with the trade-off of increased torque demands[29,30]. The large resistance training component of the athletes' preparation likely contributed to their ability to produce greater torque throughout the performance. These increased torque demands are most pronounced in the standing start where track cyclists must overcome inertial resistance to reach target cadence/velocity. The energetic cost of this phase, which accounts for ~9% of the race duration, may have been proportionally lower due to the development of the athletes' maximal force-production capabilities through their resistance training programs. Furthermore, evidence of a positive relationship between anaerobic work capacity and lower limb mass and maximal force exists[31–33]. In the team pursuit, athletes perform repeated bouts above LT_2 that have a high anaerobic demand. Therefore, increases to the anaerobic work capacity would be beneficial both physically and tactically. The potential improvements in the athletes' work capacity may have enabled a reduced rate of fatigue while producing the power outputs required to enable their world-record performance.

Variations in torque/power occur throughout the team pursuit performance; oscillations that occur as cyclists travel from corners to straights (and vice versa) each lap and the more pronounced changes during rider transitions are unavoidable. While the riders' model-estimated power does fluctuate throughout the race, their pacing profile remains highly consistent with only minor changes in speed (Figure 6), reflecting a stable pedal cadence. A 1.5% pace change resulting from ±2-rpm variations in this world-record performance may seem minor, however the outcome would be a difference of 0.215 seconds per flying lap. Such fluctuations could impair riders' abilities to execute race strategy due to the metabolic consequences of the altered physiological load and recovery dynamics. Minimising excess variation through improved force modulation may be a trainable skill required to optimise race strategy execution. Additionally, some evidence exists to support tactical decisions for optimising the pacing and turn strategies of riders to minimise fluctuation and time loss resulting from fatigue[34].

4.1. Limitations

Several limitations must be acknowledged in this exploratory analysis. The proportion of missing data for power output (13%), heart rate (27%), or both (30%) may have affected quantification of training intensity distributions. These data were missing completely at random (MCAR, i.e., unrelated to another measured variable), typically related to temporary unavailability of the measurement device (e.g., heart rate monitor/power meter not present, battery issues). The use of a hot deck imputation method, where missing values were estimated from similar complete observations and inspected against the raw data for outliers, allowed us to explore a complete and more accurate dataset. The use of modelling methods to quantify power output in the race could have introduced error in the analyses. However, recently published data of a near-identical performance time by an international team pursuit squad provide similar power data [7], which supports the accuracy of the estimated data used in the present study.

Session durations stated in workout summaries, particularly for track sessions, were for the entirety of the session rather than only the active/work duration. As such, these session durations are inflated by the rest time between efforts, which can be >15 mins in some instances. Furthermore, several sessions had recorded durations much longer (>15 min) than the planned duration, possibly due to athletes forgetting to end sessions on bike computers. These sessions were visually inspected and erroneous data corrected to match the active period or session planned duration. Time in respective training zones were then recalculated based on the corrected durations.

Finally, no off-training activities were recorded, which may alter total training volume and load, particularly at low intensities[11,35]. Future studies of this nature should consider the potential influence of activities of daily living and incidental physical activity on quantification of training volume and intensity distribution.

4.2. Practical Applications

Our study reveals that track cyclists can develop the physical characteristics required for world-class team pursuit performance by adopting a track-specific training philosophy that includes phases of individualised attribute development, team-based track focus and strength development, and race pace development. The inclusion of resistance training within athletes' programmes appears to contribute to force development, which is necessary for the use of larger fixed gear sizes that permit improved lap pace. Athletes perform a vast majority of training at low intensities (below LT_1) – with the balance across moderate and high intensities – which aligns with the existing elite endurance athlete training intensity distribution literature. This low-intensity training volume is typically accumulated through road cycling sessions designed to complement the overall objectives of the training phase. Time spent at, or above, race-relevant thresholds (e.g., lead power/torque) may be a relevant measure to prescribe training in order to build capacity for the team pursuit event and may be worth further investigation in future research. Given the large improvements in team pursuit world record (Italy, 3:42.032 min:sec.ms, 2021) since the performances discussed here and in Part II of this study, it would be valuable to conduct further research investigating the interaction between physical characteristics and changes in tactical and technical aspects of these more recent performances. Differences in technology and aerodynamics, as well as race tactics, are important factors to understand for their contribution to improved performance. It may also be worthwhile monitoring additional measures, such as heart rate variability, sleep, and nutrition, to help understand and contextualise the athletes' training stress and recovery throughout the various training phases.

5. Conclusions

These data provide valuable insight to the training performed prior to a world record performance in team pursuit cycling. The study shows that a track-specific training program –

complemented by road-based volume, structured resistance training programming, and well-planned adjunct environmental stress – supports the development of requisite aerobic, anaerobic, and neuromuscular characteristics for world-class track cycling. These findings stand out against the single prior study of team pursuit training in which a road-specific, high-volume philosophy underpinned training leading to that team's own world record performance. In the present study, a performance improvement of 9.904 seconds (4.1%) from the world record in 2000 was achieved with approximately 44% less annualised volume by distance. We acknowledge the contribution of improved aerodynamics and equipment advancements to this improvement; however, it is likely that the training encountered by these athletes was a major factor in developing performance in the face of shifting demands of the event from aerobic focused toward power-endurance. We believe these exploratory studies, while descriptive in nature, are critical in progressing our understanding of the demands of sports so that they may guide practice and athlete development to advance performance.

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Author Contributions: Study design was conceived by AS, JS, and KS, with data collected by JS and TD. AS analysed all data, with KS, JS, and TD reviewing the analyses. AS wrote the first draft, with all authors contributing to the editing of drafts up to the final manuscript. All authors read and approved the final manuscript.

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TABLES & FIGURES

Table 1 Team pursuit squad characteristics at the beginning of the study period of interest

Figure 1 Training and competition overview of the Australian Men's Track Endurance squad in preparation for the 2018 Commonwealth Games

Figure 2 Weekly mean A) training volume performed in each activity type, and B) heart rate training intensity distributions by team pursuit squad athletes in 36-week period prior to world-record event

Figure 3 Mean A) distribution of power outputs by athletes in team pursuit squad during 36-week training period prior to world-record performance with power outputs corresponding to relevant intensity and race-demand thresholds indicated; and, B) percentage time in power output intensity zones per training week

Figure 4 Mean A) distribution of torque produced by team pursuit athletes during 36-week training period prior to world-record performance with lines corresponding to relevant metabolic and race-demand torque thresholds; and, B) percentage time in torque intensity zones per training week

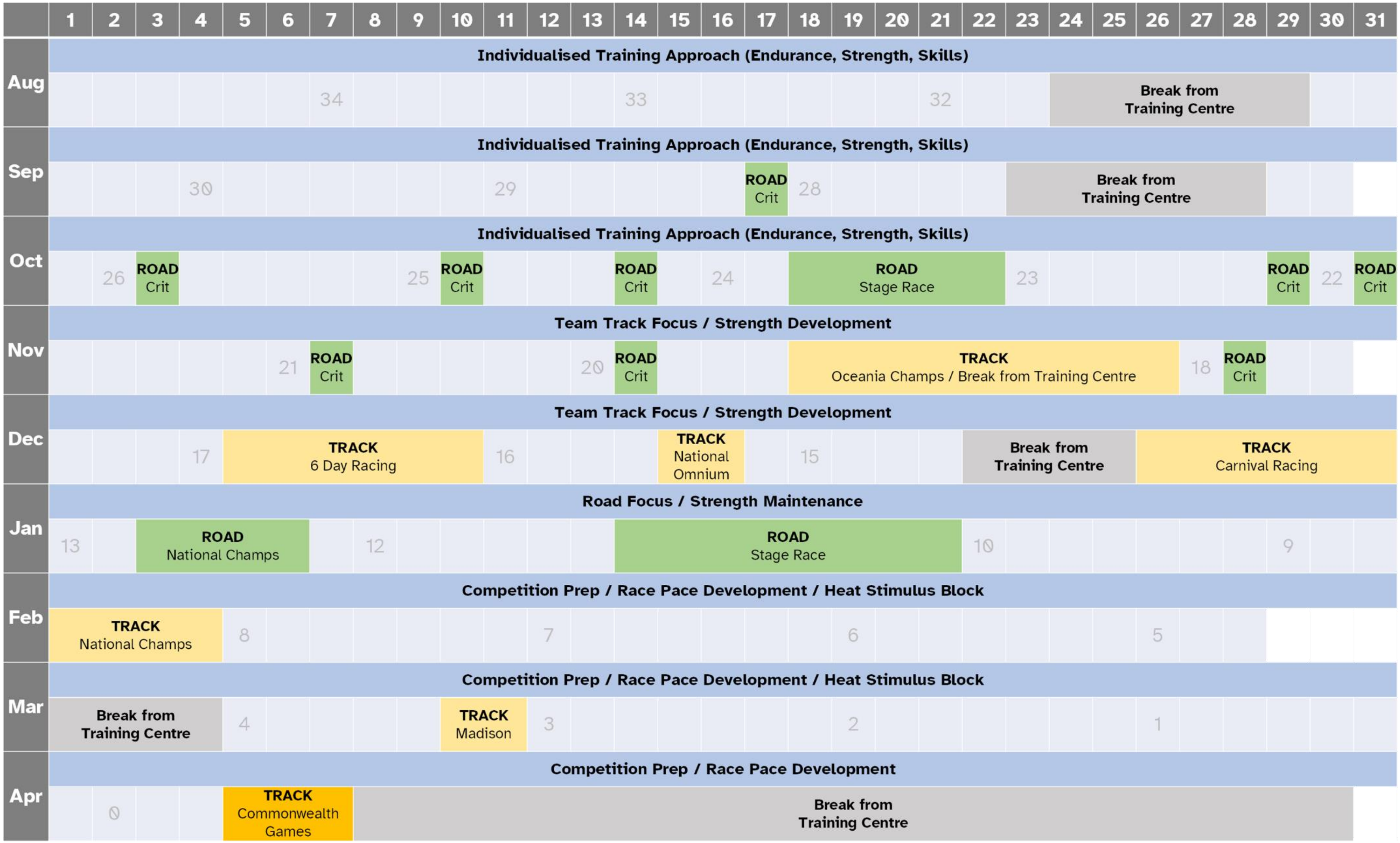
Figure 5 Within-season variation and trends of mean track session gear selection and effort pace (lap time) prior to world-record team pursuit performance

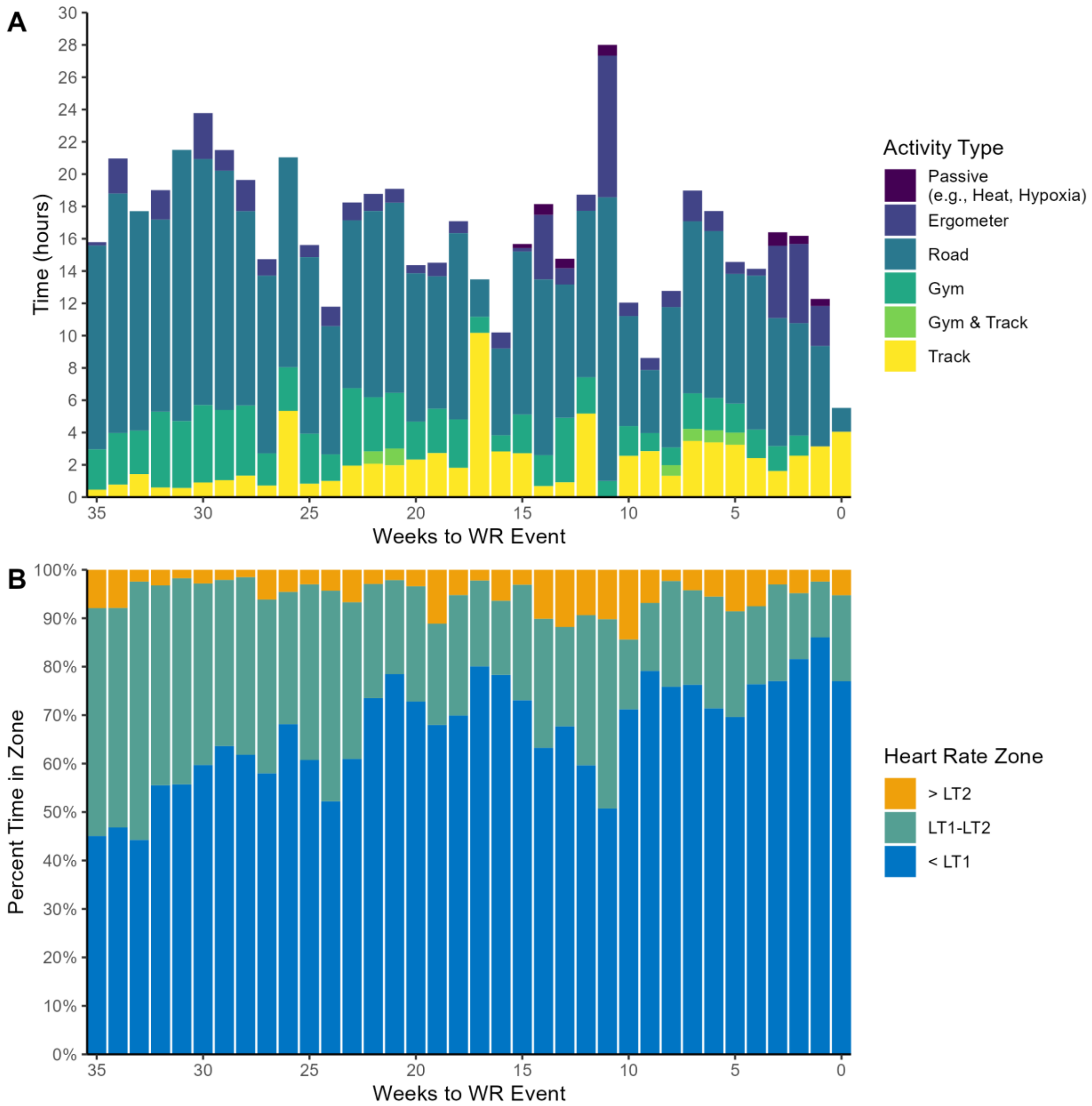
Figure 6 Race analysis of the world-record performance in the 2018 Commonwealth Games 4000m Men's Team Pursuit Final with lead rider speed (closed circles) and model-estimated power (open circles) at each half-lap split

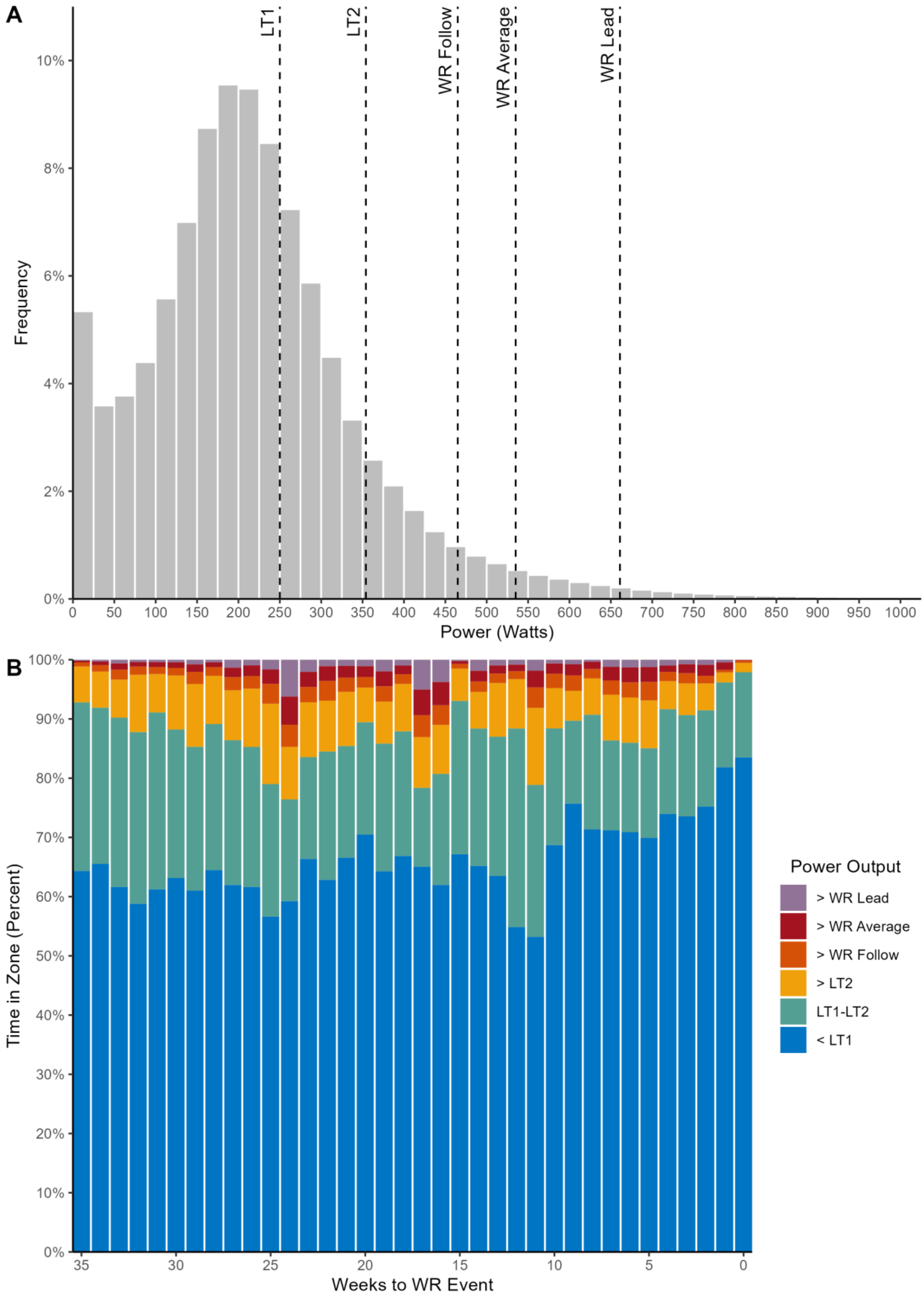
Table 2 Team pursuit squad characteristics at the beginning of the study period of interest

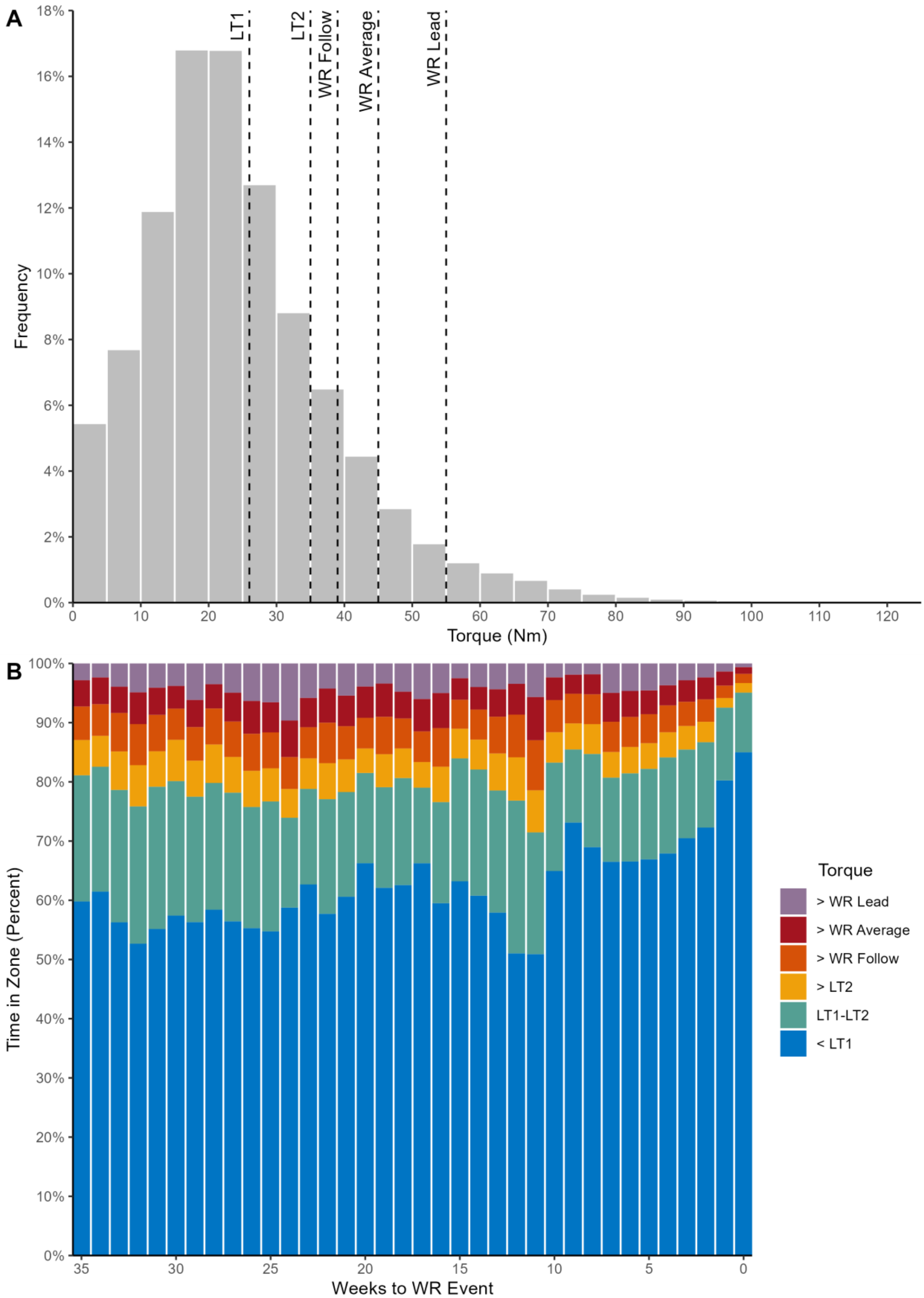
	Mean [SD]	**Range**
Age (years)	21.9 [3.52]	19.2-27.9
Height (cm)	183.0 [5.24]	179.0-192.0
Weight (kg)	78.62 [3.21]	75.3-83.3
W at LT_2	344 [10.95]	331-354
$W.kg^{-1}$ at LT_2	4.4 [0.16]	4.2-4.6
W at VO_{2peak}	486 [24.40]	447-508
$W.kg^{-1}$ at VO_{2peak}	6.2 [0.28]	5.8-6.5
VO_{2peak} ($L.min^{-1}$)	5.40 [0.30]	5.0-5.8
VO_{2peak} ($mL.kg.min^{-1}$)	68.74 [2.99]	65.6-73.2
BLa_{peak} (mmol.L)	16.9 [3.34]	14.2-22.3
HR_{max} (bpm)	196 [9.39]	186-208

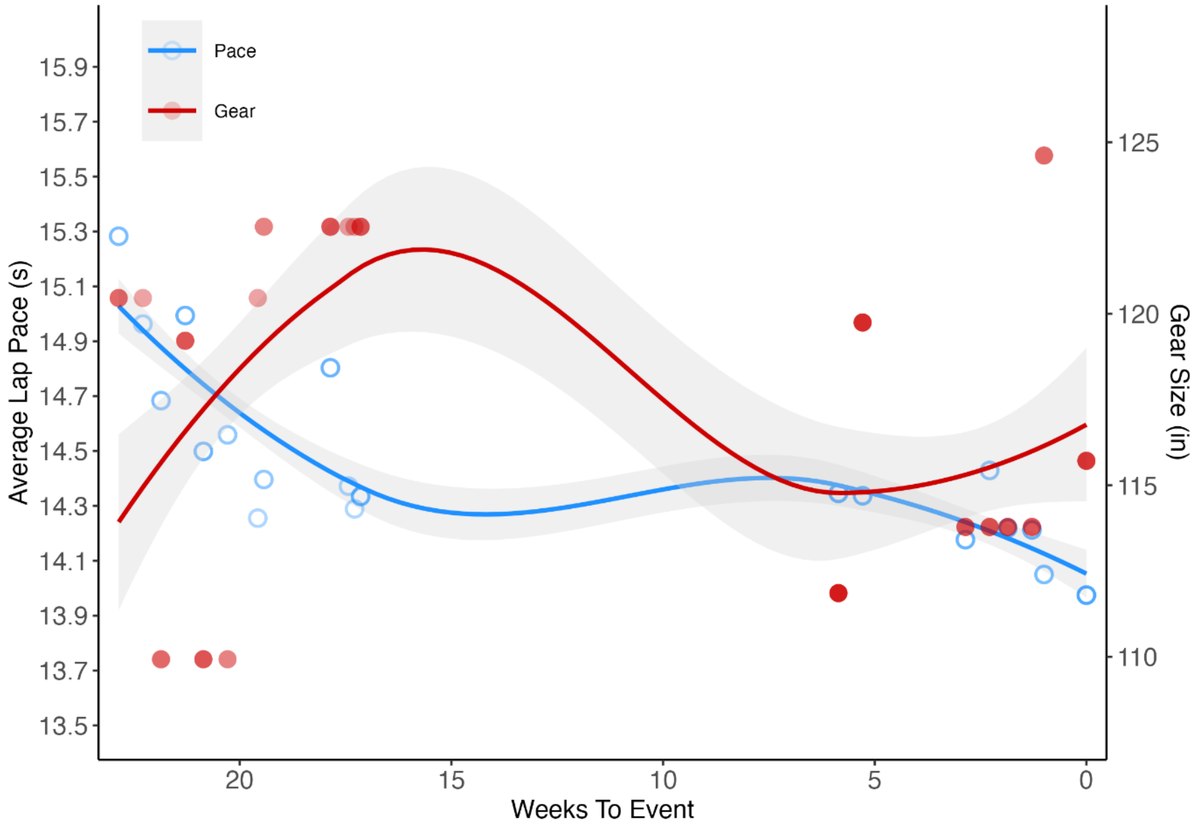
Abbreviations: W, power output, watts; $LT_{2,}$ anaerobic threshold; VO_{2peak}, peak oxygen consumption; Bla_{peak}, peak blood lactate

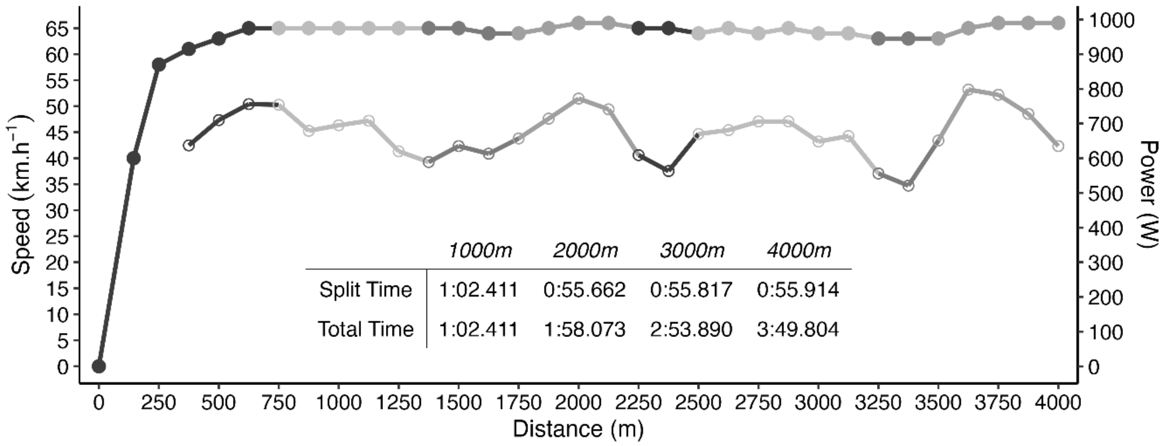

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Aug
Individualised Training Approach (Endurance, Strength, Skills)
34
33
32
Break from Training Centre
Sep
Individualised Training Approach (Endurance, Strength, Skills)
30
29
ROAD Crit
28
Break from Training Centre
Oct
Individualised Training Approach (Endurance, Strength, Skills)
26
ROAD Crit
25
ROAD Crit
ROAD Crit
24
ROAD Stage Race
23
ROAD Crit
22
ROAD Crit
Nov
Team Track Focus / Strength Development
21
ROAD Crit
20
ROAD Crit
TRACK Oceania Champs / Break from Training Centre
18
ROAD Crit
Dec
Team Track Focus / Strength Development
17
TRACK 6 Day Racing
16
TRACK National Omnium
15
Break from Training Centre
TRACK Carnival Racing
Jan
Road Focus / Strength Maintenance
13
ROAD National Champs
12
ROAD Stage Race
10
9
Feb
Competition Prep / Race Pace Development / Heat Stimulus Block
TRACK National Champs
8
7
6
5
Mar
Competition Prep / Race Pace Development / Heat Stimulus Block
Break from Training Centre
4
TRACK Madison
3
2
1
Apr
Competition Prep / Race Pace Development
0
TRACK Commonwealth Games
Break from Training Centre


A
Time (hours)
Weeks to WR Event
Activity Type
Passive
(e.g., Heat, Hypoxia)
Ergometer
Road
Gym
Gym & Track
Track
B
Percent Time in Zone
Weeks to WR Event
Heart Rate Zone
> LT2
LT1-LT2
< LT1


A
LT1
LT2
WR Follow
WR Average
WR Lead
Frequency
10%
8%
6%
4%
2%
0%
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000
Power (Watts)
B
Time in Zone (Percent)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
35 30 25 20 15 10 5 0
Weeks to WR Event
Power Output
> WR Lead
> WR Average
> WR Follow
> LT2
LT1-LT2
< LT1


A
Frequency
Torque (Nm)
LT1
LT2
WR Follow
WR Average
WR Lead
B
Time in Zone (Percent)
Weeks to WR Event
Torque
> WR Lead
> WR Average
> WR Follow
> LT2
LT1-LT2
< LT1


Pace
Gear
Average Lap Pace (s)
15.9
15.7
15.5
15.3
15.1
14.9
14.7
14.5
14.3
14.1
13.9
13.7
13.5
Gear Size (in)
125
120
115
110
20
15
10
5
0
Weeks To Event


Speed (km.h⁻¹)
Power (W)
Distance (m)
1000m 2000m 3000m 4000m
Split Time 1:02.411 0:55.662 0:55.817 0:55.914
Total Time 1:02.411 1:58.073 2:53.890 3:49.804