TITLE: Training for Elite Team Pursuit Track Cyclists – Part II: A Comparison of Preparation Phases in Consecutive World Record-Breaking Seasons

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Abstract

Purpose To compare the training characteristics of an elite team pursuit cycling squad in the 3-month preparation phases prior to two successive world record performances.

Methods Training data of five male track endurance cyclists (mean [SD]; age 23.4 [3.46] yrs; body mass 80.2 [2.74] kg; 4.5 [0.17] W.kg^{-1} at LT_2; 6.2 [0.27] W.kg^{-1} MAP; maximal oxygen uptake 65.9 [2.89] ml.kg.min^{-1}) were analysed with weekly total training volume by training type, and heart rate, power output, and torque intensity distributions calculated with reference to the respective world records' performance requirements.

Results Athletes completed 805 [82.81] and 725 [68.40] min.wk^{-1} of training, respectively, in each season. In the second season there was a 32% increase in total track volume, though track sessions were shorter (i.e., greater frequency), in the second season. A pyramidal intensity distribution was consistent across both seasons with 81% of training on average performed below LT_1 power output each week, while 6% of training was performed above LT_2. Athletes accumulated greater volume above world record team pursuit lead power (2.4% vs 0.9%) and torque (6.2 vs 3.2%) in 2019. In one athlete, mean single-leg press peak rate of force development was 71 and 46% higher at mid- and late-phases, respectively, during the preparation period.

Conclusions These findings provide novel insights of the common and contrasting methods contributing to successive world record team pursuit performances. Greater accumulation of volume above race-specific power and torque (e.g., team pursuit lead), as well as improved neuromuscular force generating capacities may be worthy of investigation for implementation in training programs.

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

1. Introduction

The 4000-metre team pursuit is a track cycling event in which four riders, each rotating periodically through positions in a paceline, attempt to catch the opposing team or ride the distance in the fastest time. Since the year 2000, the average annual rate of improvement of the men's team pursuit world record has been 0.748 seconds, increasing to 1.674 seconds since 2016. The frequency and magnitude of improvement of record performances raises intrigue about how the additional speed is achieved. While technological advancements have certainly contributed[1], our attention is drawn to the trainable components of athlete performance (i.e., physical, mental, tactical, and technical abilities). Reductions in event duration decrease the relative contribution of the aerobic energy system to the overall performance[2]. The shift from aerobic focused toward increased power endurance means the event demands not only highly-developed aerobic and anaerobic metabolic capacities[3,4] but also enhanced neuromuscular qualities to produce and tolerate large amounts of lower-body force[5]. Applying the appropriate training stress at the appropriate time – especially when the desired adaptations may be physiologically opposite – is the challenge in developing peak team pursuit performance.

Coaches and their performance support teams spend countless hours devising training programmes they believe will allow their athletes to arrive at the start line in the best possible condition to perform. Achieving peak performance capacity also requires athletes to execute their planned training at a consistently high level. The periodisation of training across various modes and intensities is intended to promote overload without excess fatigue and elicit desired adaptations for improving performance[6–8]. Training design and organisation across the season can be critical to performance optimisation, especially in the specific/competition preparation and tapering phases[9]. When and how coaches and practitioners increase – and, subsequently, reduce – training load to attain a state of over-reaching prior to taper has been described in several sports[10–15]. Commonalities in these preparation phases are a peak in training volume/load 2-4 weeks prior to competition. This peak is followed by 40-60% reductions in load in the taper toward competition while maintaining session intensity and priming technical, tactical, and mental readiness[6,9]. A comparison of preparations within the same cohort is valuable to understand how similarities and differences in approach may contribute to elite performance. Several studies have presented data on athlete preparations over multiple seasons[11,13,16–18], reporting similar reductions in load but with some variation in the taper duration and intensity distributions between seasons. However, none of these studies involved track cyclists.

The aim of this study was to compare the 3-month preparation phase training characteristics of an elite team pursuit squad across two successive seasons, both of which culminated in world record performances. The training philosophies and objectives of each season were distinct, with both enabling the athletes to develop the necessary attributes to improve their team pursuit performances. It is, therefore, valuable to understand what components of their training programming differed, and how that might have contributed to their eventual performances. In this exploratory analysis, we focused primarily on the training of physical components of performance, assessing similarities and differences in week-to-week training intensity and load accumulation in preparation for the respective seasons' benchmark events – the 2018 Commonwealth Games and 2019 Union Cycliste Internationale (UCI) Track World Championships. These findings can help to inform training planning and aid development of physical qualities contributing to elite team pursuit performance.

2. Methods

2.1. Participants

Five male track endurance cyclists from the Australian Cycling Team participated in this study. All participants were members of the men's track endurance squad during the 2018 and 2019 seasons. Research approval was provided by AusCycling (then Cycling Australia). After being given 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. The study was preregistered on Open Science Framework, with registration and protocol information available online at osf.io/fdg2n. Participant characteristics are presented in Table 1.

2.2. Training Data Analysis

The two study periods of interest were from 6th January 2018 to 5th April 2018 and 1st December 2018 to 28th February 2019 (both 89 days / 13 weeks). Athlete testing, training, and performance data were collected for every recorded activity in the 13-week study period of interest. 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.[19]. Training session duration was determined from training diary and heart rate data to ensure agreement. Power output data were measured using SRM cranks (Schoberer Rad

Messtechnik, Germany), and heart rate data collected using chest-worn heart rate monitors (Garmin, KS, USA). In 93% and 91% of on-bike sessions in 2018 and 2019, respectively, power and/or heart rate data were recorded with 77.5% and 66.9% of sessions having both. In sessions where variables were missing, time in zone data were imputed by hot deck imputation method[20,21] using multiple-parameter inputs (athlete, week, coded session name, duration, distance, and available heart rate or power variables) in VIM[22]. 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 performed by athletes immediately prior to the study period of interest. Athletes started cycling at 150 W with load increased by 50 W every 5 minutes until blood lactate reached 4.0 $mmol.L^{-1}$, after which a short recovery was performed before a 4-minute best-paced maximal effort[23]. 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[24]. Training intensity distributions were calculated for heart rate, power output, and torque. A pyramidal intensity distribution is identified by a majority of training performed at low intensities $<LT_1$, with the remainder primarily performed below LT_2 (i.e., Z1 > Z2 > Z3), whereas a polarised intensity distribution is identified when time above LT_2 exceeds time between LT_1-LT_2 (i.e., Z1 > Z3 > Z2). The 13-week training period incorporated three main training phases – Early Preparation (5 weeks), Mid Preparation (5 weeks), and Late Preparation/Peaking Phase (3 weeks).

For the 2018 event, race power outputs for each athlete in lead position (i.e., first wheel) were acquired by performance modelling using race pace-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[25]. For the 2019 event, data were measured directly on each athletes' power meter. These data were used to calculate time spent above each threshold (i.e., Lead, Follow, Average).

The 2019 UCI Track Cycling World Championships men's 4000-metre team pursuit final took place at Arena Pruszków (Pruszków, Poland) on 28th February 2019 – 329 days after the team pursuit squad set their previous world record at the 2018 Commonwealth Games (Chandler, QLD, Australia). Air density inside the velodrome was 1.159 kg/m^3.

2.3. Statistical Analysis

Data were analysed and figures plotted using R (version 4.0.2)[26]. All data are presented as mean ± SD.

3. Results

3.1. Training Characteristics

Participant characteristics from the 2019 season are presented in Table 1 along with percentage changes from the 2018 season. During the 3-month preparation phases, athletes completed on average 805 ± 82.81 and 725 ± 68.40 min^{-1}.wk^{-1} of training in the 2018 and 2019 seasons, respectively (Figure 1). Total distance cycled across track, road, and ergometer sessions 63 ± 232 km^{-1}.wk^{-1} lower in the 2019 season (3665 ± 560 km vs 2728 ± 558 km). Training sessions involved both specific and non-specific training, and active and environmental stress. 'Ergometer' sessions included those completed on indoor trainers or cycling on a treadmill. 'Gym & Track' sessions involved either gym-based exercises as part of a warmup routine, or alternation between resistance training- and track-based efforts. Compared to 2018, there was a 32 ± 33% increase in total track volume, however average track session duration decreased by 7 ± 14%. Track training duration in each season is inflated by the inclusion of recovery periods between sets. There was a 10 ± 21% reduction in total road cycling duration in the second season.

Table 1 Approximate Position

In 2018, the team frequently performed standing and flying start team pursuit efforts over distances of 2-4 km, with extended rest periods (15-50 mins) between. While these training efforts were maintained in 2019, a greater number of 'broken' team pursuit efforts were performed wherein athletes performed sets of several 1-2 km efforts (often standing start followed by flying starts) separated by short (5-8 lap) active recovery periods.

3.2. Training Intensity Distribution

A pyramidal intensity distribution was observed for power (Figure 2-A) and heart rate (Figure 2-B) each week of both seasons. An average of 72 ± 8% and 79 ± 10% of total time was spent below LT_1 heart rate each week in the first and second seasons, respectively, while these proportions were 81 ± 6% and 81 ± 4% for power output. Similar average weekly distributions were observed between seasons for moderate (LT_1-LT_2) and high (>LT_2) intensities for heart rate (21 ± 6% vs 16 ± 6% and 7 ± 4% vs 6 ± 5%, respectively) and power output (13 ± 5% vs 12 ± 3% and 6 ± 3% vs 6 ± 3%, respectively).

Figure 1 Approximate Position

Figure 2 Approximate Position

3.3. Power & Torque Load Accumulation

Despite the faster race time, required mean power output and torque demands were lower in the second world record performance. Race power outputs were 581 ± 52, 507 ± 22, and 414 ± 30 W for team pursuit lead (wheel 1), race average, and follow positions (wheels 2-4) respectively, in the 2019 performance. These were 80, 28, and 51 W lower, respectively, than those modelled in the prior world record. These differences were 8 (55 vs 47), 4 (41 vs 45), and 5 (34 vs 39) Nm, respectively, for lead, average, and follow torque demands between performances. Athletes accumulated a greater proportion of training above the respective WR race-relevant power (Figure 3) and torque (Figure 4) demands in the second season; 2.4 ± 1.35% (vs 0.9 ± 0.45%) and 6.2 ± 2.26% (vs 3.2 ± 1.51%) of bike-based sessions were spent above WR lead power and torque, respectively.

Figure 3 Approximate Position

Figure 4 Approximate Position

3.4. Gym-based training

The strength & conditioning programme in both seasons aimed to develop athletes' strength, power, and speed through structured resistance training to complement bike-specific development and overall training objectives. At matched timepoints of both preparation phases, single-leg press mean power was 2.2% and 2.6% higher in 2019, respectively, at 5-7 weeks (mid-phase) and 1-3 weeks (late phase) prior to world record performance. Mean peak power was 5.3% higher in the mid phase and 8.3% lower in the late phase compared to the 2018 season. Mid-season peak force and rate of force development were 31.6% and 32.3% higher, respectively, in the second season, with between-season differences for each measure increasing to 71.1% and 46.3% in the 2019 taper period. These changes in power and force production were achieved with load 24.8% and 111.7% greater leg press loads, respectively, at each timepoint.

Figure 5 Approximate Position

3.5. Race performance

Compared to the 2018 season, greater variation in pace was observed during track session training efforts in 2019, ranging from above 15.0 to below 13.9 seconds per lap – race target pace – in the final weeks of preparation. A more linear approach was observed in the final six weeks of the 2018 preparation. Riders used a gear size of 118.5 (n = 2) or 120.4 inches (n = 2) for the race, which was an increase from 116 inches in the previous record, to match the riders' improved physical and technical capabilities. The final race time was 3:48.014 min:sec.ms.

Figure 6 Approximate Position

4. Discussion

This was the first study to compare team pursuit cyclists' preparations prior to successive world record performances. Differences in training programming, intensity distribution, and load accumulation relative to each season's respective world-record performance power output and torque demands were analysed. In each 13-week period prior to respective world record performances, the team pursuit squad members completed 186 and 167 training hours in 2018 and 2019, respectively, across multiple modes, including a 26% reduction in cycling (track, road, ergometer) volume by distance. With the reduced volume of training, the athletes performed a greater proportion of training at intensities above the competition-specific demands in the second season, including a 60% increase in total load accumulated above WR team pursuit lead position torque. The team's performance at the 2019 UCI Track Cycling World Championships was a then-world record 3:48.012 min:sec.ms in the men's 4000-metre team pursuit, beating their own world record (2018 Commonwealth Games, 3:49.804 min:sec.ms) by 1.792 seconds. This analysis offers important insights to the training demands contributing to repeated elite performances, including the variations in training programming that may contribute to continued performance development.

The training intensity distributions observed among these athletes were similar across both seasons, and to those previously reported in elite endurance training[27,28]. Most bike-specific training (81%) was performed at low intensities – below LT_1 – with 6% of training performed above LT_2 (high intensity). This pyramidal intensity distribution is common in other endurance sports of similar event duration[29–31]. While intensity distributions were similar, the lower overall training volume by time and distance would have allowed greater recovery time between sessions. What was evident in the intensity distributions were the discrepancies between the more stable power output data and the highly variable heart rate measured within each week (Figure 2). These variations likely reflect the stochastic nature of cycling and, particularly, track events where training efforts are often short, high-intensity bouts. Due to the transitional periods between low- and high-intensity exercise (e.g., during repeated sprint training), there is an inflationary effect on moderate-intensity training volume while heart rate passes through this training zone to 'catch up' to the metabolic demand of the external load (e.g., power output). This inflationary effect occurs during both the ascending and descending arm of the heart rate response. Caution should be advised when using heart rate-based intensity distributions to inform training decisions in sports where athletes frequently perform activities in which a metabolic steady state is not reached. Indeed, it has been shown that heart rate does not accurately predict metabolic stress during exercise with high variation of intensity[32]. The majority of these athletes' track and ergometer sessions were performed as short duration (< 2 min) efforts. As a result of these training prescriptions, heart rate may not be a suitable means for quantifying intensity distribution or load accumulation.

Notable increases in single-leg press performance measures were observed at matched timepoints from the 2018 and 2019 seasons. These improvements reflect the objective of developing maximal strength, power, and speed, having previously focused on movement competency and robustness for injury prevention. Differences in leg press loads, especially in the pre-competition taper period, reflect a change in training philosophy within the performance support staff – a new strength & conditioning coach joined the team prior to the 2019 season. Peak force and rate of force development were 32% higher at mid-phase compared to the 2018 season, with differences increasing to more than 46% in the taper period despite substantial increases in resistance load. These increases in rapid and repeatable force production indicate improved neuromuscular capacities[33,34], which may have translated to on-track performance. Given the greater resistance training loads nearer to peak performance in the second season, the athletes may have maintained neuromuscular qualities allowing them to tolerate higher loads. This would be most relevant in the standing start where torque and power output are greatest. The increased gear size from the previous record performance would result in a greater torque requirement to overcome the inertial resistance and attain target velocity[35]. How these torque demands affect performance later in the race, when neuromuscular fatigue and damage might begin to impair contractile function and force production, may be worthy of further investigation.

Despite the larger gear selected for the second world record performance, average torque demands at target pace in each position were lower than was modelled in the 2018 season. While the need to use modelled rather than measured power output data in the first world record was unfortunate, we stand by the accuracy of the estimates and recently published data from an international calibre team pursuit squad for a similar performance time are nearly identical[36]. The difference in torque demands likely reflects technical (e.g., athlete position) and technological (i.e., equipment) improvements in aerodynamics. The average CdA achieved by the riders in the 2019 performance supports this theory. Reduced torque demand decreases neuromuscular strain, potentially improving athletes' abilities to maintain consistent force in the late stages of the race, minimising any fatigue-induced time losses.

Between seasons, differences were evident in the type of training performed and taper strategies. The team shifted from primarily using repeated individual standing and flying team pursuit efforts in 2018 with longer rest periods (15-50 min) between, to an increased number of 'broken' team pursuit efforts involving sets of shorter efforts separated by 5-8 lap active recoveries. These broken team pursuit efforts worked as high-intensity interval training and permitted accumulation of race-distance volume at higher average intensities than the longer, traditional training efforts. The work and recovery durations, along with gear sizes and pacing, could be manipulated more easily to target various metabolic adaptations within these race-specific efforts. In both seasons, the total volume reduction during the taper was >65% from the late-phase peak (Figure 1). However, a shorter 2-week taper was performed in 2018 with 24 and 55% reductions in training volume per week, compared to a 3-week taper in 2019 with volume reductions ranging from 25-41%. These values are not dissimilar to those performed in other sports[6,9]. The more gradual taper in the second season was planned to allow adequate time for adaptation from the high-intensity track training completed at six and three weeks prior to competition. In this period, there was greater sustained effort volume at or above WR requirements compared to the previous season.

4.1. Limitations

Several limitations must be acknowledged in this exploratory analysis, including that its comparisons are limited to differences in physical characteristics, with limited ability to delineate changes in performance resulting from improvements in mental, tactical, or technical aspects of their preparation and performance. While it would be highly valuable to explore changes in those other performance components, those aspects were not as well documented or measurable to enable analyses. Still, the differences reported within this study provide important insights to how an elite track cycling team can modify and evolve their physical preparations to enable repeated success.

The proportion of missing data in each season for power output (2.8-3.4%), heart rate (12-21%), or both (7.4-9.5%) 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[20,21], allowed us to explore a complete and more accurate dataset.

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[37,38]. 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

This study demonstrates that the training contributing to successive world record team pursuit performances exhibits several common and contrasting themes. Notably, a pyramidal training intensity distribution was consistent in the preparation phases prior to both performances and in alignment with prior elite endurance athlete intensity distribution literature. However, an increase in accumulated volume for race-specific power and torque was observed in the second season, possibly contributing to the new world record.

The inclusion of resistance training within track endurance cyclists' training programmes may contribute to force development and neuromuscular load tolerance, permitting use of greater gear sizes and, therefore, higher speeds at a specific cadence. Furthermore, the use of larger resistance loads in the weeks prior to race day may not be detrimental to performance. A focus on race pace development through increased gear size and broken team pursuit training efforts may be beneficial for improving average speed. These findings should be investigated further to determine any causal effects so that training interventions can be developed to more effectively exploit the mechanisms underpinning performance improvement.

Since the performances investigated in the present study, the team pursuit world record has been broken on several occasions with the most recent record performance in 2021 being almost 6 seconds faster than that set by Australia in their 2019 race (Italy, 3:42.032 min:sec.ms). This represents a major improvement, and notable changes in both tactical (e.g., rider turn length) and technical (e.g., gear ratio, body position, equipment, aerodynamics) factors are evident. The interaction of these factors with physical and mental characteristics are not as evident, but highly worthy of investigation. Based on the world record progression since 2000, accounting for its increased rate of change since 2016, it is possible that we will witness a new men's team pursuit world record below 3:41.000 min:sec.ms in 2024 (unpublished analysis). Understanding the factors contributing to such a performance would be of great interest to many within the sport.

5. Conclusions

These findings provide valuable insight to the training characteristics of elite team pursuit cyclists in successive world record-breaking seasons. Specifically, it highlights some commonalities and differences in training approaches during the 3-month competition preparation and taper phases. In the second season, athletes on-bike training volume by distance was lower, while there was an increase in total load accumulated above WR team pursuit lead position torque demands. The physical taper in 2019 was performed over an additional week, with more gradual and consistent reductions in training volume. In both seasons, a track-specific training programme with well-structured road-based volume and resistance training provides the requisite training load and stress to develop the physical components of performance necessary for elite team pursuit performance. A likely role of improved aerodynamics through technical and technological improvements must be acknowledged for its contribution to the improved performance time. The training planned for and executed by the athletes in the second season likely would not have been possible without the already strong foundation developed in the prior season; the physical, tactical, technical, and mental capabilities that had been established could be recalled by the athletes and allow them to push the limits of performance further. These observations speak to the need for a long-term athlete and performance development plan to reach performance potential.

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Author Contributions: Study design was conceived by AS, JS, and KS. AS analysed all data, with KS and JS reviewing the analyses, and JS and TD providing contextual insight to support the findings. 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 in 2019 season and change from 2018 season

Figure 1 Athletes' weekly mean training volume (hours) performed, by session type, in the preparation phase prior to each world record event

Figure 2 Changes in team pursuits squad's weekly average training intensity distributions for A) power output, and B) heart rate from the 2018 season (open circles) to 2019 season (closed circle)

Figure 3 Athletes' A) power output distributions and, B) mean percentage time in team pursuit-relevant power intensity zones for each week prior to world-record performances

Figure 4 Athletes' A) torque distributions and, B) mean percentage time in team pursuit-relevant torque intensity zones for each week prior to world-record performances

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

Figure 6 Changes in single-leg press measures (clockwise, from top left: peak power, mean power, peak force, peak rate of force development) across two training periods (mid [5-7 weeks] and late [1-3 weeks]) for a team pursuit cyclist (n = 1) prior to world record performances.

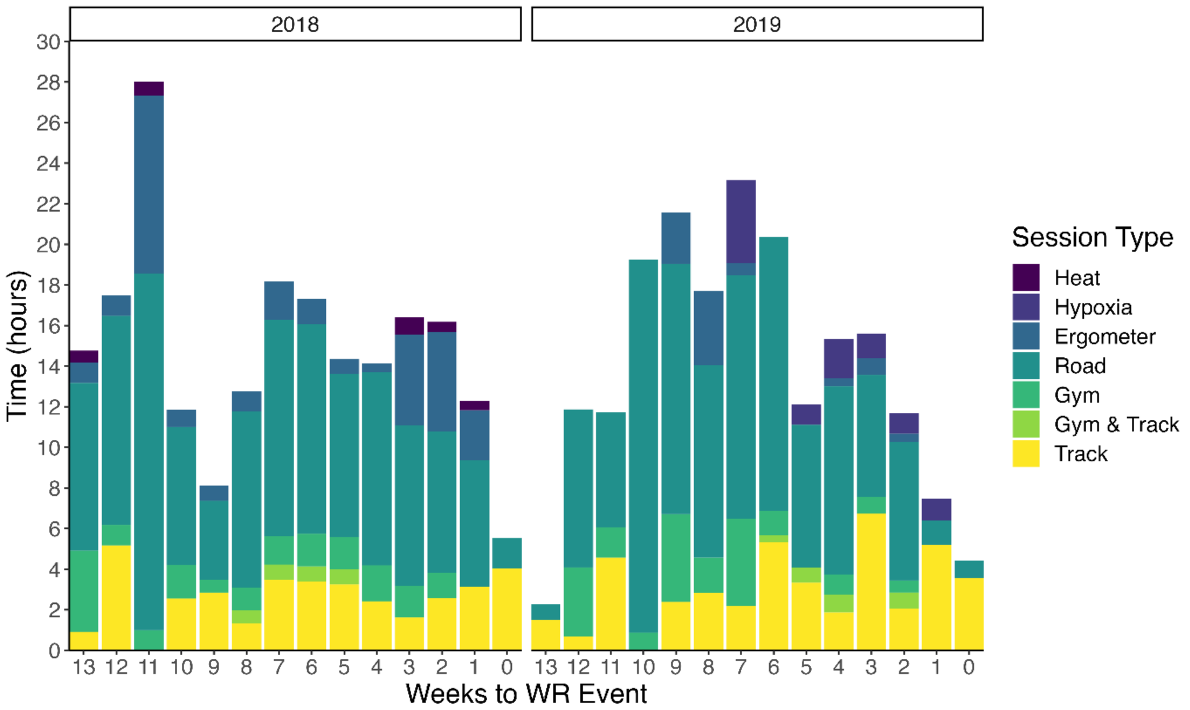
Table 1 Team pursuit squad characteristics in 2019 season and change from 2018 season

	Mean [SD]	**Range**	**Change [%]**
Age (years)	23.4 [3.46]	20.8-29.4	1.5 [6.8%]
Height (cm)	183.0 [5.24]	179.0-192.0	0.0 [0.0%]
Weight (kg)	80.2 [2.74]	78.0-84.3	1.6 [2.0%]
W at LT_2	362 [15.47]	343-384	18 [5.2%]
$W.kg^{-1}$ at LT_2	4.5 [0.17]	4.3-4.7	0.1 [2.3%]
W at VO_{2peak}	502 [23.74]	483-541	16 [3.3%]
$W.kg^{-1}$ at VO_{2peak}	6.2 [0.27]	5.9-6.7	0.0 [0.0%]
VO_{2peak} ($L.min^{-1}$)	5.2 [0.29]	4.9-5.5	-0.2 [-3.7%]
VO_{2peak} ($mL.kg.min^{-1}$)	65.9 [2.89]	63.0-69.0	-2.8 [-4.1%]
BLa_{peak} (mmol.L)	19.1 [2.21]	17.0-22.8	2.2 [13.0%]
HR_{max} (bpm)	191 [10.96]	182-210	-5 [-2.6%]

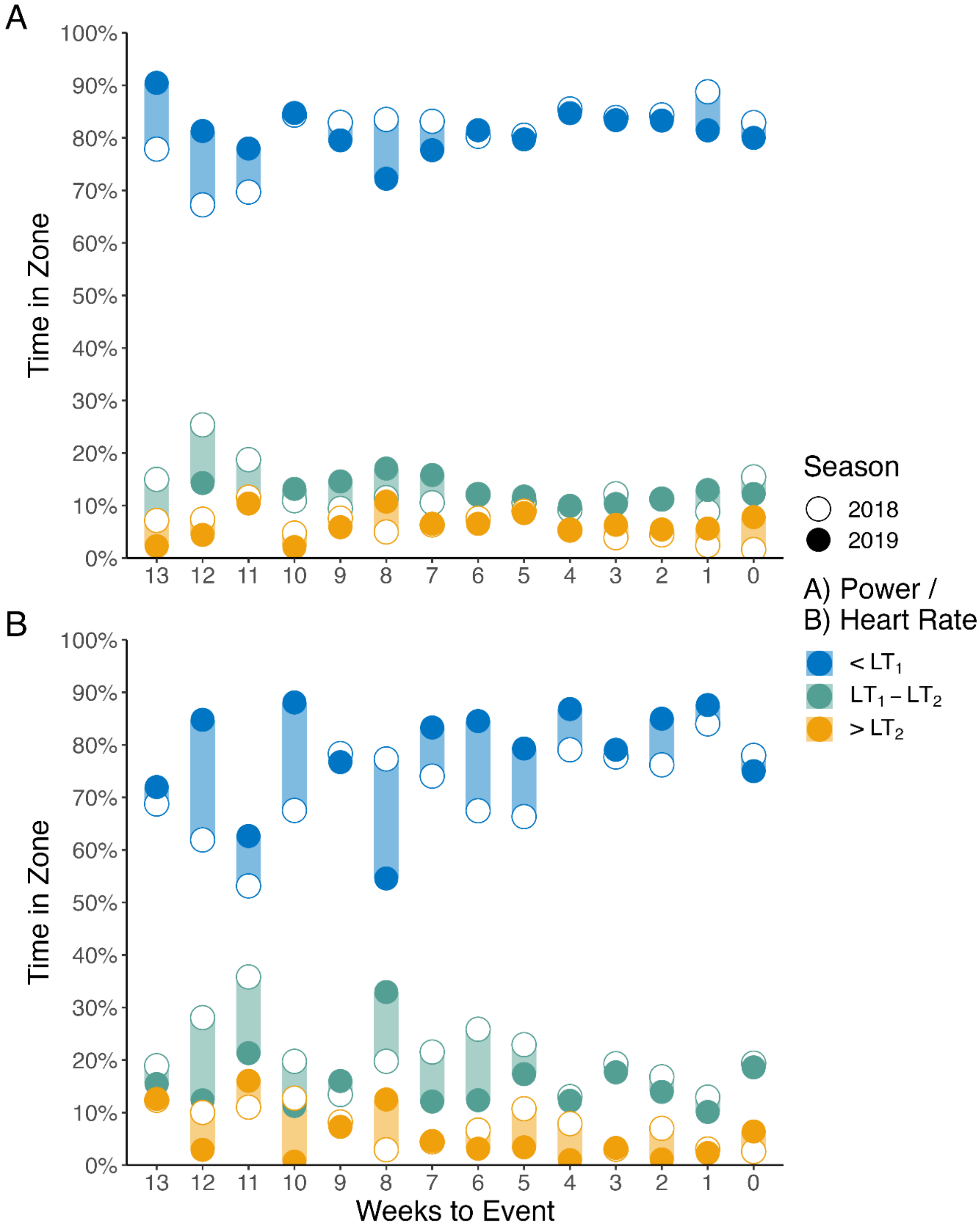
Abbreviations: W, power output, watts; $LT_{2,}$ lactate threshold; VO_{2peak}, peak oxygen consumption; Bla_{peak}, peak blood lactate

Table 2 Comparison of training sessions completed by team pursuit squad in two weeks prior to world record performances

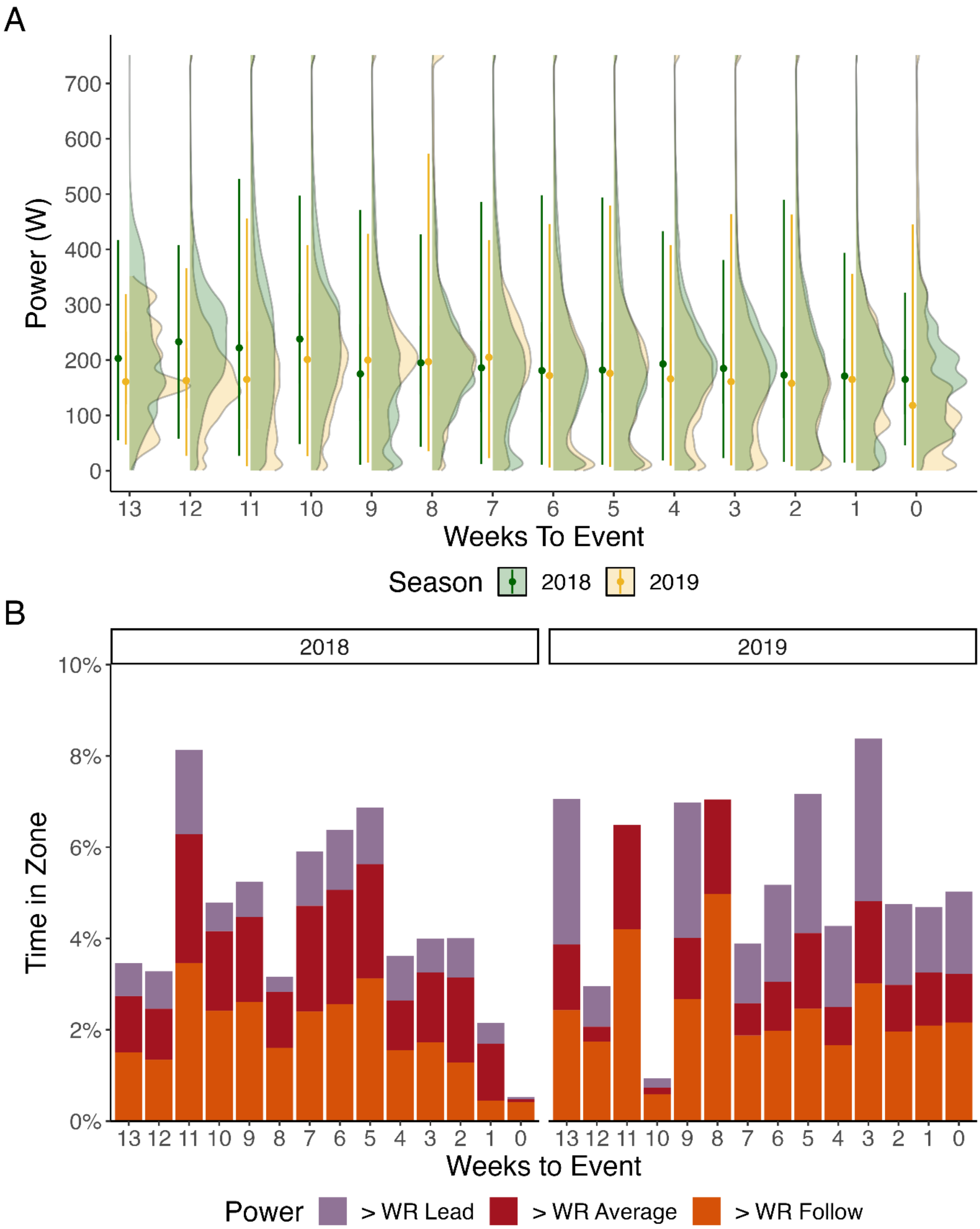
Days to Event		**2018 Commonwealth Games**	**2019 UCI Track World Championships**
14	*AM*	Road – Recovery	Road – Aerobic
	PM		
13	*AM*	Track: Technical, Team Pursuit Swings	Track: Team Pursuit
	PM	Gym & Track: Preload Team Pursuit	Gym & Track: Preload Team Pursuit
12	*AM*	Road: Aerobic; Heat: Ergometer	Road: Aerobic
	PM		Track: Technical, Madison Changes
11	*AM*	Road: Aerobic; Heat: Passive	Road: Recovery
	PM		
10	*AM*	Ergometer: TP Simulation, Heat: Steady State	Track: Team Pursuit
	PM		
9	*AM*	Track: Team Pursuit	Hypoxia: Ergometer
	PM		Travel: International
8	*AM*	Heat: Ergometer	
	PM		Massage / Mobility
7	*AM*	Track: Team Pursuit & Bunch	Track: Team Pursuit
	PM	Heat: Passive	
6	*AM*	Road: Aerobic	Ergometer: Rollers
	PM	Travel: Domestic	
5	*AM*	Ergometer: Rollers	Track: Team Pursuit
	PM		
4	*AM*	Road: Pre-start ride	Track: Team Pursuit
	PM	Track: Team Pursuit	
3	*AM*	Road: Pre-start ride	Road: Pre-start ride
	PM	Track: Team Pursuit	Massage
2	*AM*	Ergometer: Rollers	Ergometer: Rollers
	PM		
1	*AM*		
	PM	Track: Team Pursuit	Track: Team Pursuit *Race, Qualifying & Round 1*


2018
2019
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
13 12 11 10 9 8 7 6 5 4 3 2 1 0
13 12 11 10 9 8 7 6 5 4 3 2 1 0
Weeks to WR Event
Session Type
Heat
Hypoxia
Ergometer
Road
Gym
Gym & Track
Track

532

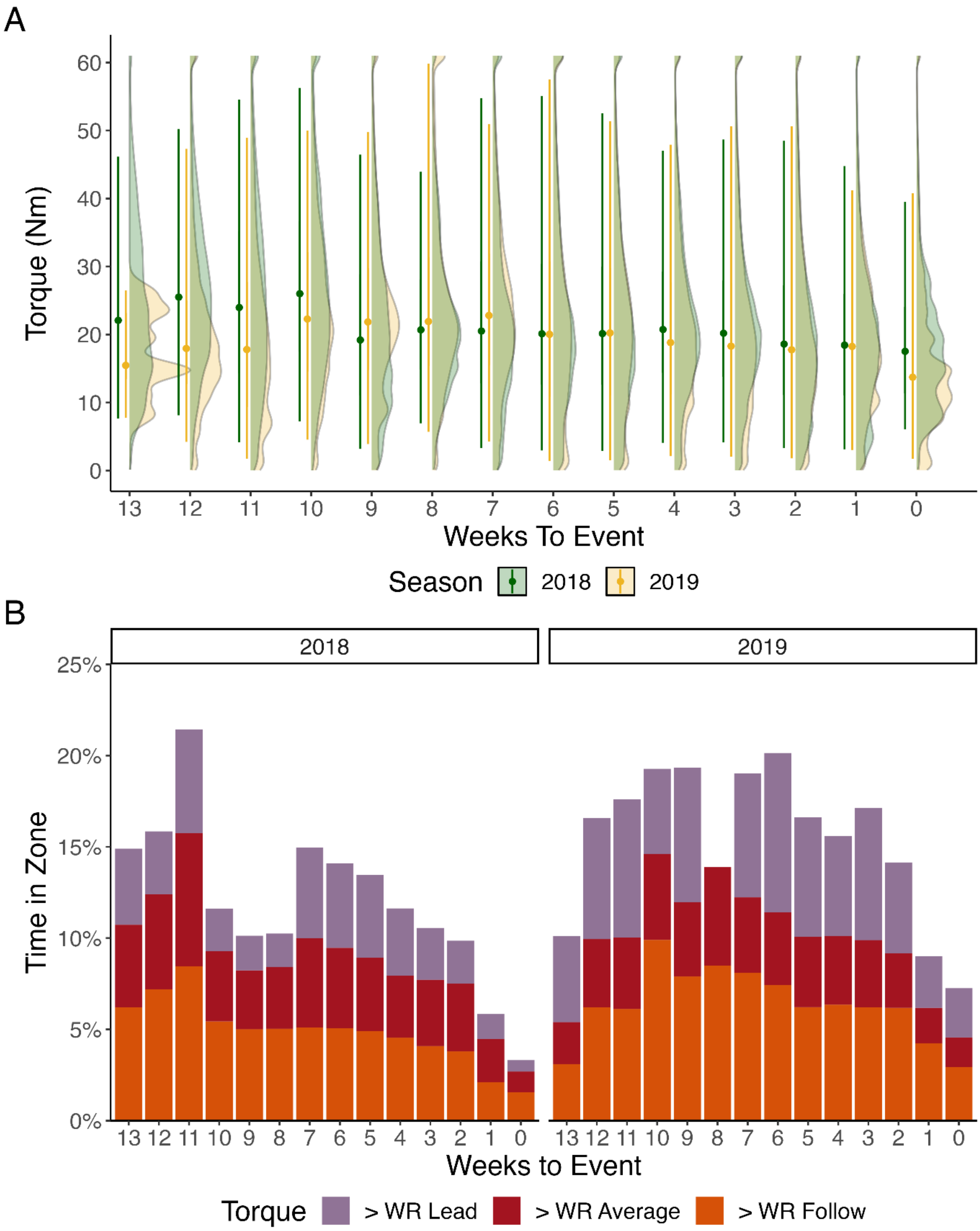

A
B
Time in Zone
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
13 12 11 10 9 8 7 6 5 4 3 2 1 0
Weeks to Event
Season
2018
2019
A) Power /
B) Heart Rate
< LT_1
$LT_1 - LT_2$
> LT_2

534

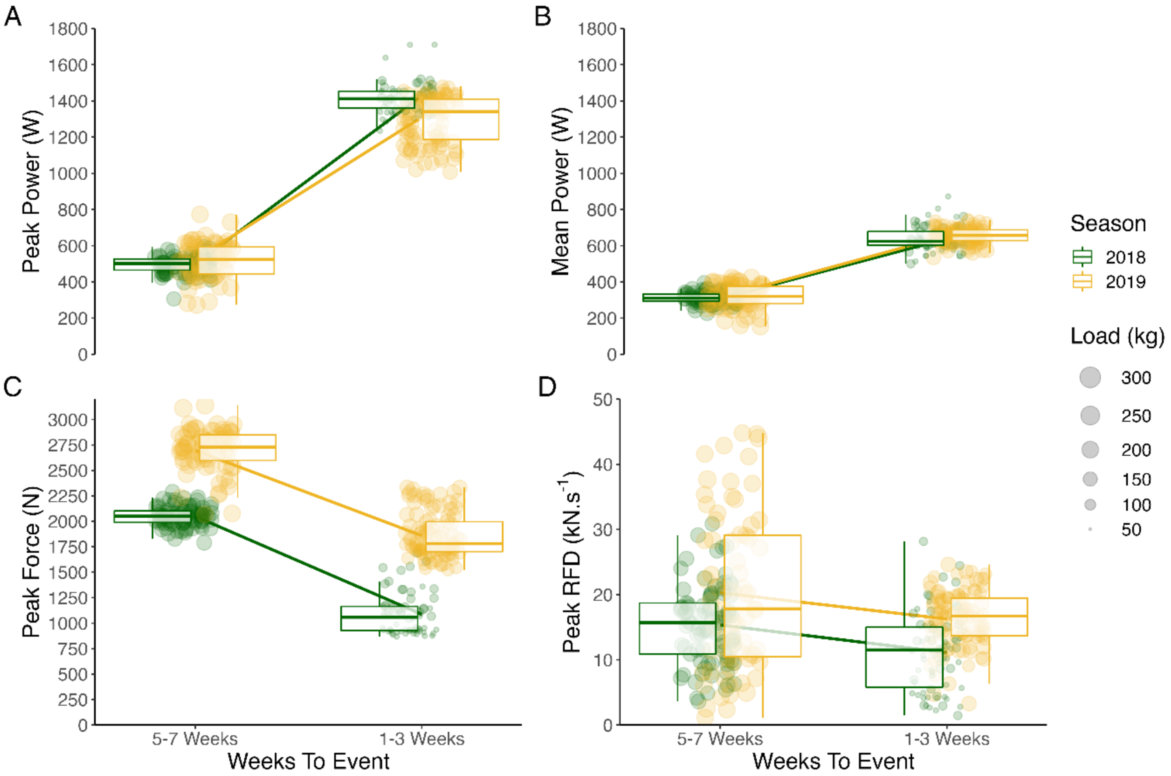


A
Power (W)
700
600
500
400
300
200
100
0
13 12 11 10 9 8 7 6 5 4 3 2 1 0
Weeks To Event
Season 2018 2019
B
2018
2019
Time in Zone
10%
8%
6%
4%
2%
0%
13 12 11 10 9 8 7 6 5 4 3 2 1 0
Weeks to Event
Power > WR Lead > WR Average > WR Follow

535

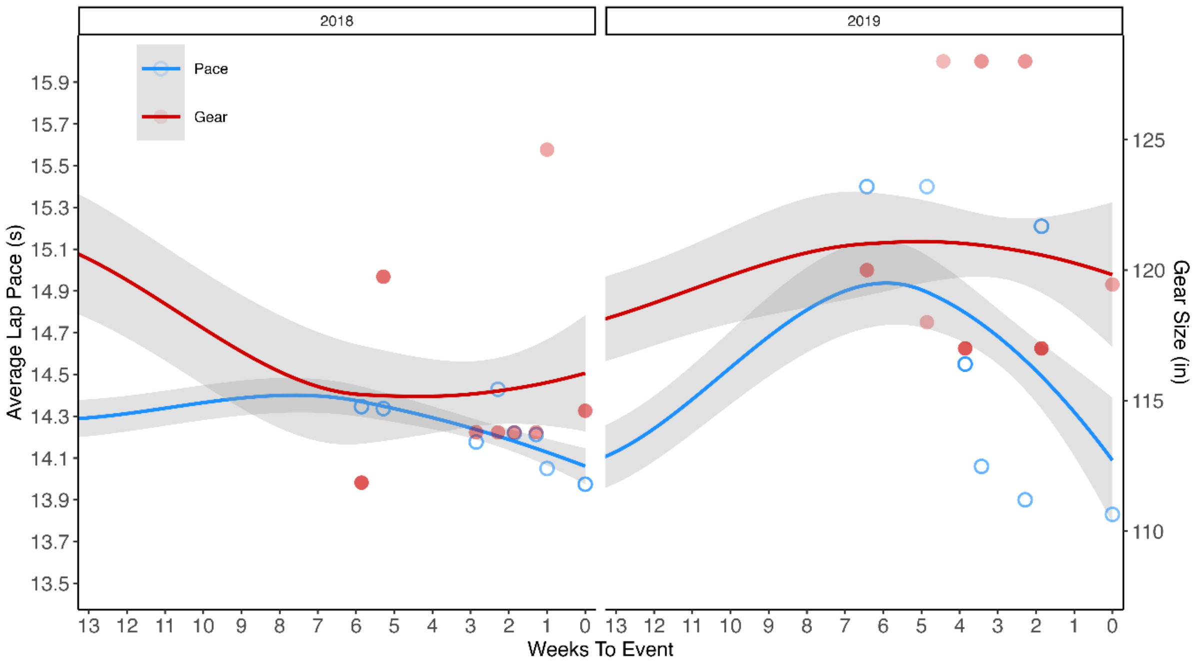


A
Torque (Nm)
60
50
40
30
20
10
0
13 12 11 10 9 8 7 6 5 4 3 2 1 0
Weeks To Event
Season 2018 2019
B
2018
2019
Time in Zone
25%
20%
15%
10%
5%
0%
13 12 11 10 9 8 7 6 5 4 3 2 1 0
13 12 11 10 9 8 7 6 5 4 3 2 1 0
Weeks to Event
Torque > WR Lead > WR Average > WR Follow



A
Peak Power (W)
B
Mean Power (W)
C
Peak Force (N)
D
Peak RFD (kN.s-1)
5-7 Weeks
1-3 Weeks
Weeks To Event
Season
2018
2019
Load (kg)
300
250
200
150
100
50

536


2018
2019
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
13 12 11 10 9 8 7 6 5 4 3 2 1 0
Weeks To Event