Title: The travel demands of an elite rugby sevens team: Effects on objective and subjective sleep parameters.

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The travel demands of an elite rugby sevens team: Effects on objective and subjective sleep parameters.

Abstract:

Purpose: To explore the effects of travel related to international rugby sevens competition on sleep patterns.

Methods: Seventeen international male rugby sevens players participated in this study. Sleep assessments were performed daily during two separate Sevens World Series competition legs (Oceania and America). The duration of each competition leg was subdivided into key periods (pre-tour, pre-competition, tournament 1 and 2, relocation and post-tour) lasting 2 to 7 nights. Linear mixed models in combination with magnitude-based decision were used to assess 1) the difference between pre-season and key periods and 2) the effect of travel direction (eastward or westward).

Results: Shorter total sleep time (hh:mn) was observed during tournament 2 (mean ± SD, 06:16 ± 01:08), relocation (06:09 ± 01:09) and pre-tour week (06:34 ± 01:24) compared with pre-season (06:52 ± 01:00). Worse sleep quality (A.U) was observed during tournament 1 (6.1 ± 2.0) and 2 (5.7 ± 1.2) as well as during the relocation week (6.3 ± 1.5) than during pre-season (6.5 ± 1.8). When traveling eastward compared with westward, earlier fall asleep time was observed during tournament 1 (ES -0.57, 90%CI [-1.12 to -0.01]), relocation week (-0.70 [-1.11 to -0.28]), and post-tour (-0.57 [-0.95 to -0.18]). However, *possibly* trivial and unclear differences were observed during pre-competition week (0.15 [-0.15 to 0.45]) and tournament 2 (0.81 [-0.29 to 1.91]).

Conclusion: Sleep patterns of elite rugby sevens players are robust to the effects of long-haul travel and jet lag. However, staff should consider promoting sleep during the tournament and relocation week.

Keywords: Travel, jet lag, training load, recovery, team sport.

Introduction

Rugby sevens is one of the most physically demanding team sports due to both the intensity of match play, and the short recovery times afforded between matches.[1,2] At the elite level, this physical challenge is exacerbated by fatigue from travel.[3] The male HSBC World Series consists of five competition legs consisting of two tournaments interspersed by one week, each in a different geographic location. Each leg is played on a different continent, separated by just four weeks. A tournament itself is composed of five to six games over the course of two to three days. Having so many fixtures, in so many places is a challenge for staff who have to prepare their athletes to perform and recover over the whole competition.[2]

To aid recovery and performance, sleep would be expected to play an important role. However, it is likely that sleep is highly disturbed due to training, game play and travel demands. Each team has to travel across the globe to compete, with flight durations of ≥ 19h and total travel durations of ≥ 30h leading to notable travel fatigue.[4,5] Likewise, travelling across different time zones may induce important circadian disturbances (e.g. thermoregulation, sleep) due to jet lag.[6]

The match demands and training periodization for rugby sevens are well described.[1,7,8] In contrast, research on the influence of intercontinental travel in this population is scarce, despite the potential impacts on performance and wellbeing before, during and post competition. Research suggests that long haul travel preceding a rugby sevens tournament can impact neuromuscular function two days after arrival.[3] The workload sustained during a full rugby sevens tournament is higher than in individual rugby union games.[9] As sleep can be disturbed by high workloads,[10] it is likely that sleep disturbances during the two days of tournament would be greater than those observed in other rugby codes. To date, only one study has assessed sleep before, during and after competition in international rugby sevens players,[11] and found no deterioration in subjective assessments of sleep quality. Based on the substantial travel challenges, this finding warrants further investigation using objective measures. Moreover, as teams are required to compete all around the world, travel direction (eastward vs. westward) could be another factor to consider for the maintenance of sleep health among rugby sevens players. Indeed, travel direction is well known to induce circadian adjustments that differ depending on the direction of travel.[6] The ability to manage the effects of these circadian adjustments may have important performance implications in this population.

To the best of our knowledge only one study has investigated the impacts of the return travel on international rugby sevens players.[3] They found a larger amount of fatigue post-tournament compared to pre-competition, highlighting the cumulative effects of tournament participation and travel.

Due to the lack of information describing the effects of long-haul travel on sleep among elite rugby sevens players, the aim of this study was to characterise both the objective and subjective sleep responses to key periods of travel and to determine whether these responses differ as a result of different travel directions. We hypothesised that 1) long-haul travel may have negative effects on sleep patterns during subsequent week, and that different travel directions would elicit different responses.

Methods

Design

A prospective, observational and longitudinal design was used to assess the time course of sleep responses to participation in two HSBC sevens World Series competition legs in 2016 and 2017. The first competition leg observed was the "Oceanic leg" in Wellington (New Zealand) and Sydney (Australia) from January to February. The second window of observation occurred during the 'North America leg' with tournaments in Las Vegas and Vancouver from February to March. During these periods, actigraphic sleep assessment subjective sleep quality assessments were performed on a daily basis to measure sleep patterns. During all long-haul flights the team flew in economy class, and it was not practically possible to record sleep during these journeys. Prior to each journey, advice regarding jet lag and travel fatigue management were provided to players by team medical staff. These encompassed, a sleep schedule and appropriate time to sleep during the flight, an explanation of sleep hygiene strategies to be used and the availability of melatonin pills if necessary. Details about departure and arrival times and travel durations for each competition leg are provided in Figure 1 and Table 1.

Insert figure 1 about here

** Insert Table 1 about here**

Subjects:

Seventeen male international rugby sevens players (body mass 88.4 ± 11.3 kg; height 183.3 ± 9.5 cm; age 25.4 ± 5.1 years) from an international team based in Europe participated in this study. If players had sleep disorders diagnosed by the medical staff, they were removed from the analysis. These data arose from the monitoring processes implemented by the team's sports science and medicine staff to support player recovery and performance. Ethics approval was granted by the University ethics board and the recommendations of the Declaration of Helsinki were respected.

Procedures:

Sleep assessment: Players were allocated an Actiwatch MotionWatch 8 (Cambridge Neurotechnology Ltd., Cambridge, UK) which applies published algorithms to activity counts to produce reliable and valid estimations of sleep parameters.[12] The methodology employed in this study was exactly the same as that used by Leduc et al. (2019) with the same cohort during a pre-season period. The sleep variables were calculated by the software MotionWare 1.1.25 (Cambridge Neurotechnology Ltd., Cambridge, UK) and are presented in Table 2. Additionally, players were asked to daily subjective sleep quality ratings in a diary on a customized mobile application (typeform©, Bac de Roda 163, Barcelona, Spain). Ratings were recorded using a Likert visual 10- point analog scale, where 1 corresponds to 'very poor' and 10 equals 'excellent'.

** Insert Table 2 about here**

Data analyses. Over the study period, 1239 nights of sleep were collected for analyses. Data from 348 nights was incomplete as a result of measurement error or lack of player compliance, and was thus excluded from the dataset. Consequently 891 nights of sleep were included in the final analysis. Data from the pre-season were pooled to determine baseline sleep values. These data were collected from October to November in the home location and has been already described in a previous publication.[10] Each competition leg was sub-divided into key periods to allow for comparison with baseline and between the “Oceanic” and “North America” legs (figure 1). The pre-tour week corresponded to the week before departure to the competition location (n= 5 to 7 nights). Pre-competition started from the day of arrival in the competition location to the day before the 1st tournament (n= 5 to 7 nights). Tournament 1 and 2 corresponded to the nights that followed tournament participation days (n= 2 to 3 nights). The relocation was the week between two tournaments (n= 5 days). Finally, the post-tour week started after arrival at home until players restarted training (n= 5 to 7 nights).

Statistical Analyses:

Analysis were performed using linear mixed models in R (Version 1.1.442, R Foundation for Statistical Computing). Those models were chosen due to their ability to handle repeated measures and nested data by considering random factors. In this study, two different models were used. The first model pooled data from both World Series competition legs and compared each of the key periods defined with the pre-season period (e.g. pre-season vs pre-competition). The second model aimed to compare the effects of the direction of the travel (eastward or westward) on sleep during each specific key period. Player identity was treated as random factor in both the aforementioned models while the period and the travel direction were treated as fixed effects. In an attempt to assess the practical importance of travel effects, further analysis was conducted using magnitude-based decisions (MBD).[13] Effect sizes (ES) and 90% confidence limits (90% CL) were quantified to indicate the practical meaningfulness of the differences in mean values. The ES was classified as trivial (<0.2), small (>0.2-0.6), moderate (>0.6-1.2), large (>1.2-2.0) and very large (>2.0-4.0) (Hopkins, 2009). Quantitative chances of greater or smaller changes in sleep parameters were assessed qualitatively as follows: <1%, *almost certainly not*; 1–5%, *very unlikely*; 5–25%, *probably not*; 25–75%, *possibly*; 75–95%, likely; 95–99.5%, very likely; >99.5%, *almost certainly*.

Results

Comparison between pre-season and key periods of the competition legs.

Descriptive data gathered per period and respective comparisons with pre-season are displayed in Table 3. The evolution of sleep schedule is displayed in Figure 2. *Most likely* to *possibly* shorter total sleep time was observed during pre-tour week (-0.26 [-0.46 to -0.05]), relocation (-0.61 [-0.84 to -0;39]) and tournament 2 (-0.81 [-1.27 to -0.36). *Very likely* to *possibly* shorter wake time after sleep onset (WASO) were observed during pre-tour week (-0.49 [-0.70 to -0.29]), relocation week (-0.27 [-0.50 to -0.05]), tournament 2 (-0.89 [-1.36 to -0.41]) and post-tour (-0.36 [-0.58 to -0.14]) and *likely* to *possibly* worse sleep quality was observed during tournament 1 (-0.33 [-0.62 to -0.03]) and 2 (-0.50 [-0.96 to -0.04]) as well as during the relocation week (-0.20 [-0.43 to 0.03]).

Insert Table 3 about here

Comparison between travel directions.

Differences in sleep schedule are displayed in Figure 2. Comparisons related to sleep quality and quantity in relation to different travel directions are displayed in figure 3. During the eastwards travel leg, players displayed *very likely* earlier fall asleep time during tournament 1 (-0.57 [-1.12 to -0.01]), relocation week (-0.70 [-1.11 to -0.28]), and post-tour (-0.57 [-0.95 to -0.18]). During the westwards travel leg, players displayed *most likely* to *likely* earlier wake up times during relocation (-1.02 [-1.38 to -0.65]), tournament 2 (7.51 [6.16 to 8.85]) and post-tour week (-0.37 [-0.74 to -0.01]). Participants had *likely* less (0.70 [0.13 to 1.27]) sleep during tournament 1 of the westwards travel leg, and compensated by extending sleep (-0.46 [-0.89 to -0.03]) during the relocation week of the same travel leg. Players experienced *likely* better sleep quality (0.51 [0.20 to 0.83]) and sleep efficiency (0.46 [0.15 to 0.78]) during the pre-competition week on the eastwards travel leg, while players experienced *likely* greater WASO (-0.33 [-0.64 to -0.02]) during the same period on the westwards travel leg.

Insert Figure 2 about here
Insert Figure 3 about here

Discussion

The aim of this study was to assess how the key periods of travel during Sevens World Series competition legs affect objective and subjective sleep measures of international rugby sevens team players. The present results did not support the hypothesis that long-haul travel affected sleep patterns negatively in the short term, probably due to efficient strategies used by players and staff members. However, a key finding was that the largest sleep disturbances occurred during tournament periods and the relocation week suggesting that specific protocols should be implemented by staff during these key periods. There was some evidence to support the secondary hypothesis, that direction of travel elicits different responses during key periods of travel, but these effects could also be explained by contextual factors (e.g. tournament duration, game time, staff strategy).

It would be expected that the effects of long-haul travel would be most pronounced during the pre-competition period, immediately after the players take their long-haul flight. However, findings of this study showed that jet lag had negligible effects on sleep quantity and quality during this period (table 2). During the pre-competition week, players adjusted fall asleep time and wake up times to maintain similar total sleep times to what was observed during pre-season. These results agree with those of Fowler et al.[11] who showed sleep quality and quantity over a similar time period either did not change or improved compared to baseline. The availability of expert sport science and medicine support staff to players competing at this level could explain these results. Indeed, during the pre-tour week, explanations and advice regarding travel schedule and jet lag management were provided to all players and staff members. Moreover, most of the players were experienced with long-haul travel and had already established personal strategies (*e.g.* melatonin, compression garments) to minimise the potential effects of jet lag and travel fatigue. The use of these strategies was difficult to control by the research team due to the ecological nature of the study, and represents a limitation of this study. From a practical standpoint, these results suggest that professional support provided by the sports science and medicine staff were adequate to maintain sleep quality and quantity during this period.

Our data demonstrated that players accumulated more sleep during the pre-competition week, than they did during the pre-tour week when they were at home in their own beds. This is not the first study showing better sleep patterns when players are away from their home environment.[14] Ramirez et al.[14] demonstrated an increase in total sleep time (35.4±12.7min) resulted from a delayed wake-up time set by the staff members in order to promote recovery. This level of control was not present during the pre-tour week when players were at home. It is possible that players prepared themselves (or not) differently during this week. Differences resulting from individual sleep strategies are highlighted by the high levels of interindividual variability observed over this period (Table 3).

While the effect of jet lag during the pre-competition period was negligible, moderate to large changes in sleep patterns were observed during tournaments and relocation period. Notably, players reduced total sleep time to approximately 6 hours during these periods, which is well below the proposed recommendation for athletes and the general population.[15,16] During competition, elite players are required to repeat high intensity efforts (e.g. acceleration, collision, jumping)[17] leading to high levels of muscle damage.[18] It has been proposed that this high workload results in the sleep disturbances experienced by athletes[19] and may explain the reduction in total sleep time observed in this study.

Sleep restriction could explain the slow recovery kinetics among rugby sevens players observed between tournaments in a precedent study.[20] On the morning of the second tournament (*i.e.* ≈ 5 days post 1st tournament), the authors found that neuromuscular function was still decreased by 26%.[20] Chronic sleep restriction has been linked to negative changes in physiological (decreased immune function and energy storage) and psychological functions which may increase the risk of musculoskeletal injury.[21] Staff members are encouraged to promote sleep during this period in order to support the physiological and psychological recovery process. There is evidence that sleep extension has positive effects on athletic performance and is easy to implement in any sport context.[22] Therefore, the adjustment schedules to increase sleep quantity or the implementation of a specific time for napping during tournaments and relocation periods represent prudent recovery strategies.

Differences were observed between eastward and westward travel (Figure 2). During the pre-competition week, despite similar total sleep times, players were affected by *likely* small reductions in sleep quality and sleep efficiency and increased WASO on the westward travel leg. Substantial differences in sleep scheduling and total sleep time between westward and eastward travel legs were observed during tournaments and the relocation week. To some extent these differences may have been driven by contextual factors. First, two-day tournaments have earlier start than 3 days tournaments, and the time of the team's first game is affected by the ranking from the previous tournament. In this particular case, the staff implemented a strategy of earlier wake-up times during the relocation week of the eastward tour leg in order to acclimate to a scheduled early tournament start (i.e. 1st match at 09:00 AM), which resulted in a decrease in total sleep time. Regardless of travel direction the tournament and relocation periods resulted in reduced total sleep time and require better management. As previously discussed by Fowler et al.[5] during these periods staff should find the best balance between effective sleep and competition requirements.

Limitations

Due to the ecological nature of this study a number of practical limitations were present. Firstly, the sample size is limited due to the squad size allowed for World Series tournaments and as a result all conclusions should be interpreted with some caution. Additionally, match load data were not available for this study and it remains unknown if the effects observed were the result of tournament workload or due to other contextual factors (*e.g.* hotel night, competition schedule, competition results). Further studies should be conducted with multiple teams in order to assess if the results observed are context dependent. Moreover, no fatigue monitoring was performed during this study thus it cannot be determined whether the changes in sleep quantity and quality observed in this study ultimately affected player performance. Finally, it was not practically viable to measure sleep during the long-haul flights that preceded each tour leg, making it difficult to assess players sleep status on arrival in the tournament destination. Future sleep studies that include fatigue and recovery measures are warranted to understand the dose response relationship between sleep and fatigue in this ecological sport context.

Conclusion

This study described the sleep patterns during the journey of an international rugby sevens team. The results suggest that elite rugby sevens players sleep patterns were robust to the effects of long-haul travel and jet lag. This is probably due to factors such as experience and efficient sleep hygiene strategies used by players. Despite efficient strategies put in place by staff members to counteract the effect of jet lag during pre-competition week, sleep was altered during the competition and relocation periods. Nevertheless, it remains unknown how these disturbed sleep patterns could affect recovery and consequently requires further work.

Practical applications and research perspectives

- Effective staff management of long-haul travel and jet lag may limit sleep disturbances after arrival
- Sleep may be deteriorated during tournaments and the relocation period. Consequently, staff should try to optimise sleep during those two periods where recovery is crucial.

- The effects of travel direction are unclear and likely influenced by contextual factors (e.g. tournament duration, start time, staff strategy), but it seems that sleep quality is compromised in response to westward travel
- Monitoring sleep parameters on an individual basis remains important due to large between players variability.

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Table and Figure

Table 1: Competitions details.

Table 2: Definitions of each sleep variable from wrist watch actigraphy

Table 3: Sleep characteristics for the different periods. Data are presented as mean±SD. *: possibly, **: likely, ***: very likely, ****: most likely change/difference compare to pre-season.

Figure1: Schematic representation of the study design. (n=) stands for the number of nights of sleep recorded per periods. Plane logos represent the flight periods. Pad and watch logos represent the subjective and sleep measures respectively.

Figure 2: Sleep schedule comparison between competition and travel direction. *: possibly, **: likely, ***: very likely, ****: most likely change/difference. Greys zone stands for trivial.

Figure 3: Sleep quality and quantity comparison between competition and travel direction. Black dots and lines represent effect size and 90% confidence interval respectively. Horizontal axis represents the magnitude of the effect expressed as effect size. vertical axis represents the period of analysis. *: possibly, **: likely, ***: very likely, ****: most likely change/difference. Greys zone stands for trivial. WASO: wake time after sleep onset.

Table 1.

		Location	Local temperature (°C)	Tournament duration	Finishing position
Competition 1 Oceania	Tournament 1	Wellington	18.2±1.4	2	7th
	Tournament 2	Sydney	26.8±3.6	2	10th
Competition 2 America	Tournament 1	Las Vegas	17.2±3.9	3	11th
	Tournament 2	Vancouver	6.1±2.9	2	15th

Table 2.

Sleep variables (units)	**Definition**
Fall asleep time (hh:mm)	Estimated clock time at which the player fell asleep
Wake time (hh:mm)	Estimated clock time at which the player woke up
Sleep onset latency (min)	Time between bed time and sleep onset
Total sleep time (min)	Time spent asleep determined from sleep onset to wake up time, minus any wake time
Wake time after sleep onset (WASO) (min)	The total time spent in wake according to the epoch-by-epoch wake/sleep categorisation
Sleep efficiency (%)	Total sleep time divided by the time in bed

Table 3.

	Pre-season	Pre-tour	Pre-competition	Tournament 1	Relocation	Tournament 2	Post-tour
Fall asleep time (hh:mm)	23:37 ± 1:04 (20:24 – 03:12)	00:01 ± 01:11** (20:51 – 03:44) *Small*	23:06 ± 00:54**** (20:52 – 01:55) *Moderate*	00:09 ± 01:02** (20:25 – 01:38) *Small*	23:23 ± 01:05* (19:49 – 02:01) *Small*	22:51 ± 01:09** (20:21 – 01:27) *Moderate*	23:36 ± 01:20** (21:06 – 03:47) *Trivial*
Wake up time (hh:mm)	07:48 ± 01:04 (04:07 – 12:25)	07:45 ± 01:27** (04:45 – 11:54) *Trivial*	07:26 ± 00:40*** (05:44 – 08:57) *Small*	08:11 ± 00:46* (05:35 – 09:52) *Small*	06:49 ± 01:13**** (03:40 – 08:58) *Moderate*	06:06 ± 01:00**** (04:24 – 07:37) *Large*	07:36 ± 01:21* (03:49 – 11:19) *Trivial*
Total sleep time (hh:mm)	06:52 ± 01:00 (02:42 – 09:21)	06:34 ± 01:24* (01:47 – 10:00) *Small*	06:59 ± 00:56* (04:11 – 09:34) *Trivial*	06:43 ± 00:58* (04:54 – 08:29) *Trivial*	06:09 ± 01:09**** (03:52 – 08:2) *Moderate*	06:16 ± 01:08*** (03:36 – 08:01) *Moderate*	06:46 ± 01:23** (03:41 – 11:12) *Trivial*
Wake time after sleep onset (hh:mm)	01:19 ± 00:27 (00:14 – 04:11)	01:08 00:28*** (00:09 – 02:44) *Small*	01:21 ± 00:25** (00:31 – 02:44) *Trivial*	01:18 ± 00:20* (00:37 – 02:07) *Trivial*	01:17 ± 00:28* (00:32 – 03:04) *Small*	00:58 ± 00:29*** (00:23 – 02:06) *Moderate*	01:13 ± 00:28** (00:03 – 02:21) *Small*
Sleep quality (AU)	6.5 ± 1.8 (0 – 10)	6.7 ± 1.6* (1 – 10) *Trivial*	6.8 ± 1.8* (2 – 10) *Trivial*	6.1 ± 2.0** (1 – 10) *Small*	6.3 ± 1.5* (4 – 10) *Small*	5.7 ± 1.2** (4 – 9) *Small*	6.5 ± 1.7* (3 – 10) *Trivial*
Sleep efficiency (%)	80.1 ± 6.5 (50.4 – 91.4)	80.6 ± 6.6** (58.8 – 93.0) *Trivial*	81.2 ± 5.6** (63.1 – 93.8) *Small*	80.7 ± 5.9* (65.2 – 90.1) *Trivial*	78.3 ± 8.3* (48.2 – 92.4) *Trivial*	84.0 ± 6.8** (66.5 – 92.8) *Small*	81.5 ± 6.9* (64.7 – 99) Small
Sleep onset latency (min)	00:19 ± 00:27 (00:00 – 03:11)	00:22 ± 00:29* (00:00 – 02:57) *Trivial*	00:10 ± 00:15*** (00:00 – 01:17) *Small*	00:14 ± 00:15* (00:00 – 00:55) *Small*	00:21 ± 00:31* (00:00 – 03:17) *Trivial*	00:11 ± 00:12 (00:00 – 00:35) *Unclear*	00:13 ± 00:19* (00:00 – 01:42) *Trivial*

Figure 1.

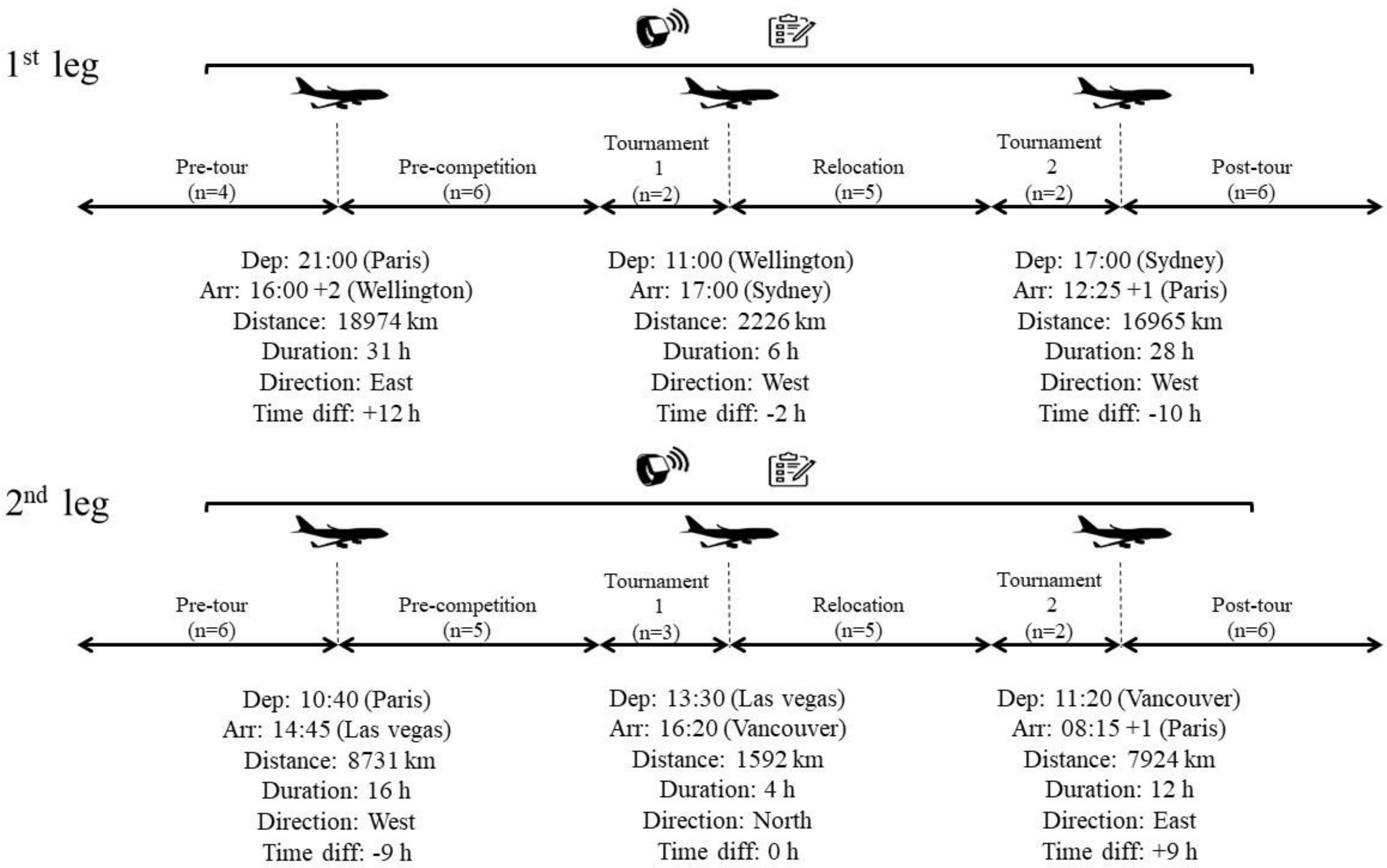

1st leg
Pre-tour
(n=4)
Pre-competition
(n=6)
Tournament
1
(n=2)
Relocation
(n=5)
Tournament
2
(n=2)
Post-tour
(n=6)
Dep: 21:00 (Paris)
Arr: 16:00 +2 (Wellington)
Distance: 18974 km
Duration: 31 h
Direction: East
Time diff: +12 h
Dep: 11:00 (Wellington)
Arr: 17:00 (Sydney)
Distance: 2226 km
Duration: 6 h
Direction: West
Time diff: -2 h
Dep: 17:00 (Sydney)
Arr: 12:25 +1 (Paris)
Distance: 16965 km
Duration: 28 h
Direction: West
Time diff: -10 h
2nd leg
Pre-tour
(n=6)
Pre-competition
(n=5)
Tournament
1
(n=3)
Relocation
(n=5)
Tournament
2
(n=2)
Post-tour
(n=6)
Dep: 10:40 (Paris)
Arr: 14:45 (Las vegas)
Distance: 8731 km
Duration: 16 h
Direction: West
Time diff: -9 h
Dep: 13:30 (Las vegas)
Arr: 16:20 (Vancouver)
Distance: 1592 km
Duration: 4 h
Direction: North
Time diff: 0 h
Dep: 11:20 (Vancouver)
Arr: 08:15 +1 (Paris)
Distance: 7924 km
Duration: 12 h
Direction: East
Time diff: +9 h

Figure 2.

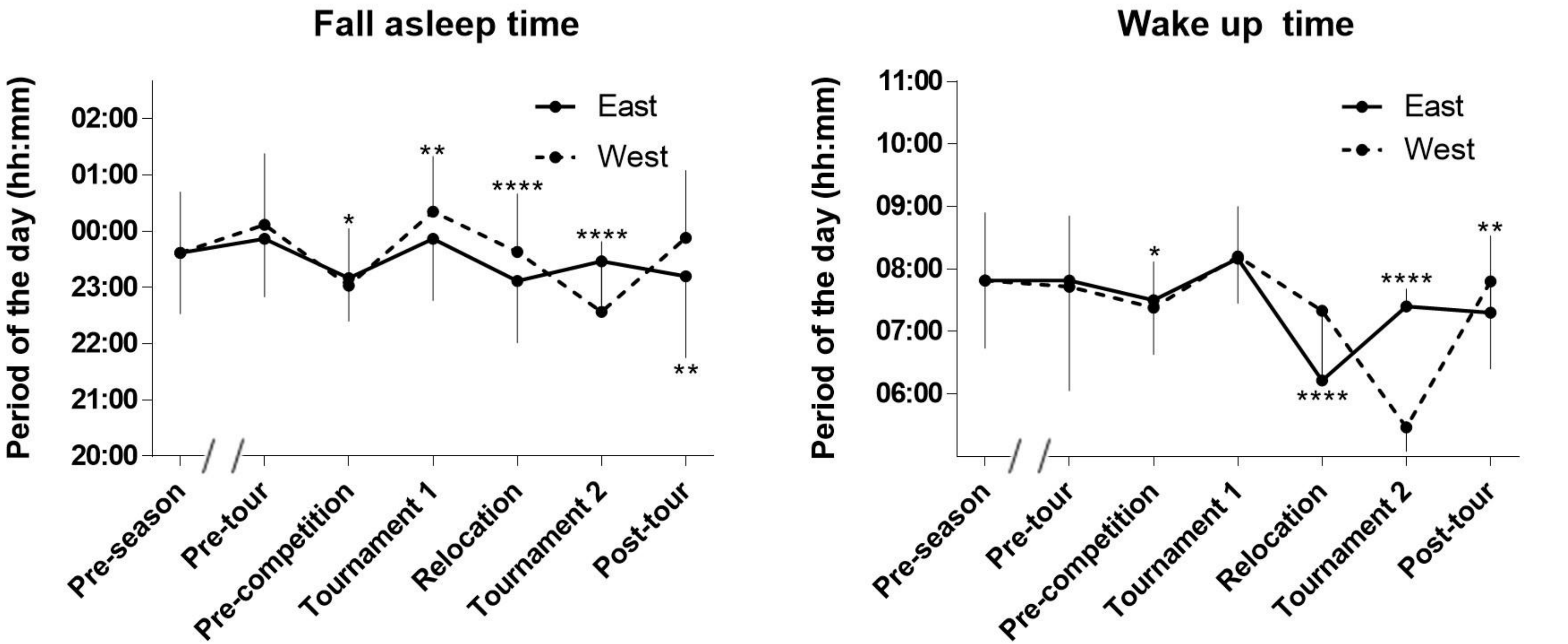
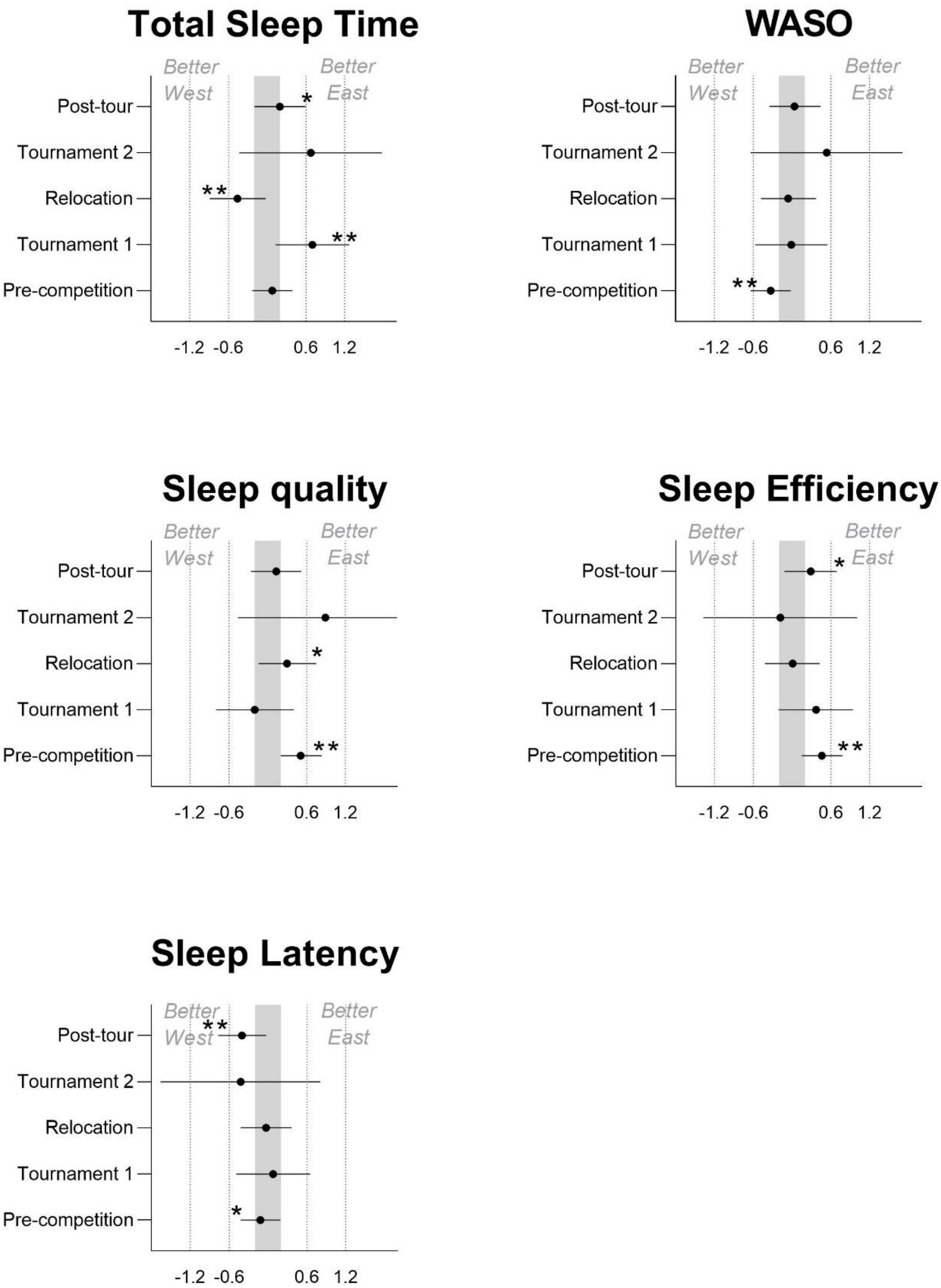

Fall asleep time
Period of the day (hh:mm)
02:00
01:00
00:00
23:00
22:00
21:00
20:00
East
West
*
**
****
****
**
Pre-season
Pre-tour
Pre-competition
Tournament 1
Relocation
Tournament 2
Post-tour
Wake up time
Period of the day (hh:mm)
11:00
10:00
09:00
08:00
07:00
06:00
East
West
*
****
****
**
Pre-season
Pre-tour
Pre-competition
Tournament 1
Relocation
Tournament 2
Post-tour

Figure 3.


Total Sleep Time
Better West
Better East
Post-tour
Tournament 2
Relocation
Tournament 1
Pre-competition
*
**
**
-1.2
-0.6
0.6
1.2
WASO
Better West
Better East
Post-tour
Tournament 2
Relocation
Tournament 1
Pre-competition
**
-1.2
-0.6
0.6
1.2
Sleep quality
Better West
Better East
Post-tour
Tournament 2
Relocation
Tournament 1
Pre-competition
*
**
-1.2
-0.6
0.6
1.2
Sleep Efficiency
Better West
Better East
Post-tour
Tournament 2
Relocation
Tournament 1
Pre-competition
*
**
-1.2
-0.6
0.6
1.2
Sleep Latency
Better West
Better East
Post-tour
Tournament 2
Relocation
Tournament 1
Pre-competition
**
*
-1.2
-0.6
0.6
1.2