Title: Subjective sleep patterns and jet-lag symptoms of junior netball players prior to and during an international tournament: a case study

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Authors:
Jonathon R. Lever[1]
Dina C (Christa) Janse van Rensburg[2,3]
Audrey Jansen van Rensburg[2]
Peter Fowler[4]
Hugh H.K. Fullagar[1]

Institutions:
[1]Sport & Exercise Discipline Group, UTS: Health, University of Technology, Australia
[2]Section Sports Medicine & Sport Exercise Medicine and Lifestyle Institute (SEMLI), Faculty of Health Sciences, University of Pretoria, Pretoria, Gauteng, South Africa
[3]Medical Board Member, International Netball Federation, Manchester, UK
[4] School of Exercise and Nutrition Sciences, Queensland University of Technology, Brisbane, Queensland, Australia

Corresponding author:
[1] Jonathon R. Lever
Sport & Exercise Discipline Group, UTS: Health, University of Technology, Australia
University of Technology Sydney Rugby Australia Building Moore Park Rd and Driver Ave, Moore Park NSW 2021 Australia
Email: jonathon.r.lever@student.uts.edu.au
Phone: 0415092965
Fax: N/A

Abstract

Purpose: To assess the impact of long-haul transmeridian travel on subjective sleep patterns and jet-lag symptoms in youth athletes around an international tournament. ***Methods:*** An observational descriptive design was used. Subjective sleep diaries and perceived responses to jet-lag were collected and analyzed for a national junior netball team competing in an international tournament. Sleep diaries and questionnaires were completed daily prior to and during travel, and throughout the tournament. Results were categorised into Pre-travel, Travel, Training and Match nights. Means were compared performing a Paired-Students-T-Test with significance set at $p<0.05$. Data are presented as means±SD and median (minimum, maximum)**.** ***Results:*** Athletes reported significantly greater Time in Bed on Match days compared to Training ($p<0.001$) and Travel ($p=0.002$) days, and on Pre-travel days compared to Travel ($P<0.001$) and Training ($p=0.028$) days. Sleep ratings were significantly better on Pre-travel days compared to Match ($p=0.013$) days. Perceived jet-lag was worse on Match ($p=0.043$) days compared to Pre-Travel days. Significant differences were also observed between a number of conditions for Meals, Mood, Bowel Activity and Fatigue. ***Conclusion:*** Youth athletes experience significantly less opportunity for sleep during long-haul transmeridian travel, and face disruptions to daily routines during travel which impact food intake. Young athletes also experience disturbed sleep prior to and during competition. These results highlight the need for practices to alleviate jet-lag symptoms and improve the sleep of young athletes travelling for tournaments, in an effort to optimise recovery and performance.

Keywords: athlete, travel, competition

Introduction

Long-haul transmeridian travel is a frequent requirement for athletes competing at the highest level[1,2]. Such travel can lead to the deleterious, combined effects of travel fatigue and jet-lag which typically require 1-day per time-zone crossed east and ½ a day per time-zone crossed west to subside[3]. In particular, jet-lag symptoms include sleep disruption, daytime fatigue and gastrointestinal disturbance, which are likely to have a detrimental impact on performance[4]. These symptoms pose a specific challenge to athletes who often have limited time between arriving at their destination and competition.

Youth athletes (under 18 years of age) who are less accustomed to international competition and travel requirements may face heightened stress from being away from home, where typically greater guidance and resources may be available[2]. Athletes have been shown to experience inadequate sleep prior to competitions, reportedly due to nervousness and ruminating about the competition causing an inability to fall asleep[5]. In light of these potential causes of disruption, practitioners and researchers should look for solutions to alleviate these issues. Despite this need, there is limited evidence of the impact of long-haul travel on athletes, particularly youth athletes, in preparation for competition[1].

A recent systematic review highlighted the poor quality of evidence and lack of translation from laboratory-based research to field-based application for strategies to manage travel fatigue and jet-lag in athletes[1]. An important first step to improving this translation of evidence requires a greater understanding of the impact of long-haul travel on athletes' preparation for competition. Thus, the aim of the present study was to assess the impact of long-haul transmeridian travel on subjective sleep patterns and jet-lag symptoms in youth athletes around an international competition.

Methods

Subjects

A total of 11 junior national level netball players participated in this study (age = 17.4 [0.5] y, height = 173.1 [6.85] cm, weight = 70.0 [9.3] kg). All subjects were members of the same national team, having been selected from their respective high schools in South Africa. All players were fully familiarized with all procedures prior to the commencement of the study and were medically cleared by the team doctor. Ethical approval was received from the University of Pretoria, South Africa (REC 428/2015).

Design

This study was a descriptive research design, where data were collected prior to, during and after the International Schools Netball Championships that took place in New Zealand in May 2019. The players departed from Johannesburg (5:15pm GMT) and arrived in Sydney (3:55am GMT) for a four-hour stopover, before departing from Sydney (7:45am GMT) continuing to Wellington (10:50am GMT), resulting in a total of 14hr flight time, 4hr transit time and the crossing of 11 time zones. Upon return, players departed from Wellington (6:45pm GMT), arriving in Sydney (10:30pm GMT) for a 2.5hr before departing Sydney (0:55am GMT) and arriving in Johannesburg (3pm GMT), resulting in total of 17hr50min flight time and 2.5hr transit time and the crossing of 11 time zones. All flights were in economy class and throughout travel players were instructed to sleep at night-time at the place of departure. The tournament included nine games between 12pm and 6pm, across five days including finals, with two games per day excluding the final match (Figure 1).

Methodology

Players' sleep patterns were monitored through self-report diaries, from which time in bed (the time between bedtime and final wake time), sleep latency (the time it took to fall asleep), number of awakenings, sleep rating (1 = very good to 5 = very poor) and restfulness upon waking (1 = very well rested to 5 = not rested). The Liverpool John Moores Jet-lag Questionnaire (LJMJL) was also completed to indicate perceptual responses to jet-lag, with 15 total questions leading to a score over the 6 following categories; Jet-lag, Sleep, Fatigue, Meals/Food Consumption, Bowel Activity and Mood[6]. The LJMJL scoring systems indicates how different from normal the player is in regard to each category. Players also completed the Athlete Sleep Screening Questionnaire (ASSQ) which indicates the severity of sleep disturbance an individual is experiencing at a particular time point[7].

The sleep diary and LJMJL were completed daily, at 8am and 4pm local time respectively, throughout the study timeframe (3 days pre-travel, during travel and the tournament). During travel, these were completed on the plane. The ASSQ was completed on the day before departure and 1-week following the return home.

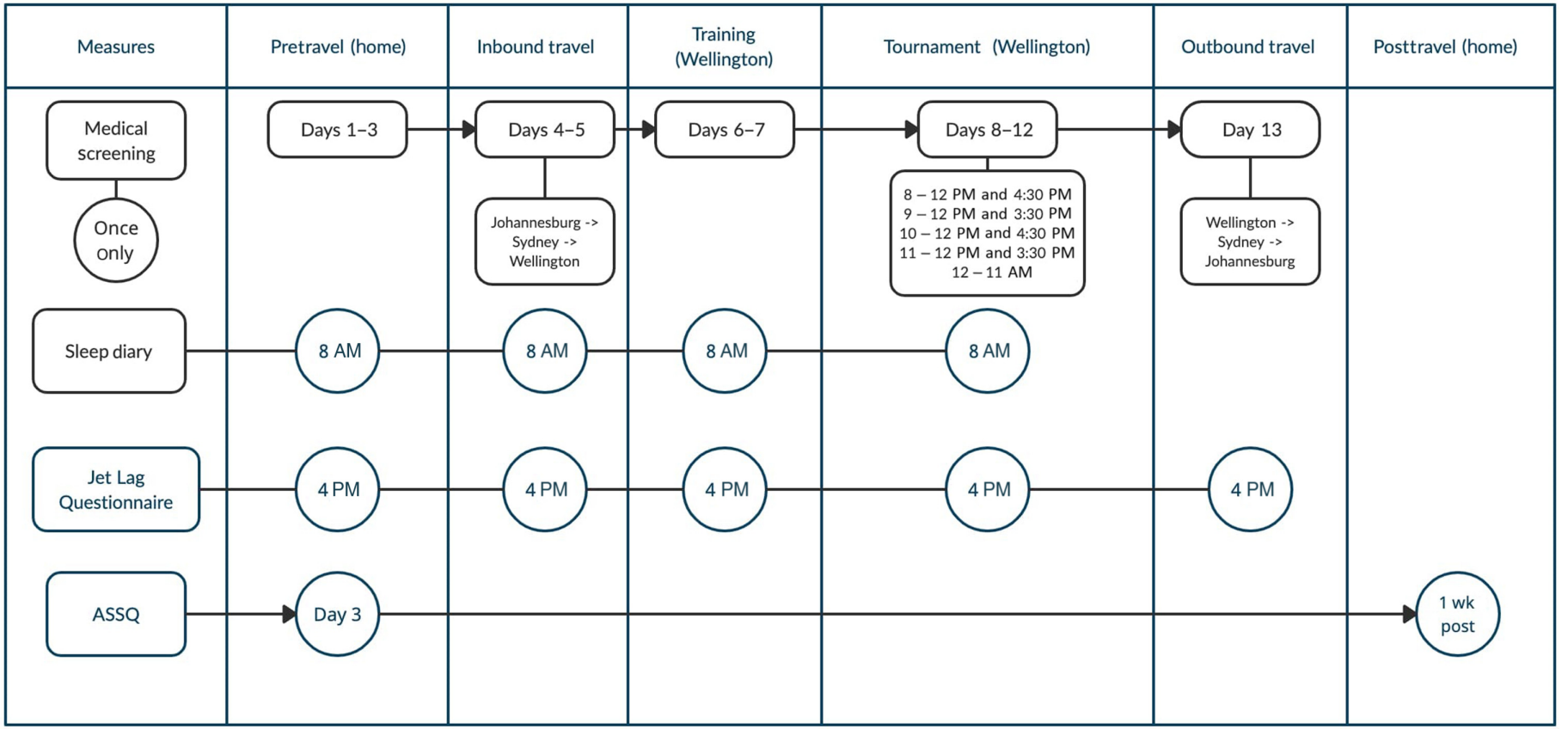

Figure 1 — Diagrammatic representation of the study design. ASSQ indicates Athlete Sleep Screening Questionnaire.

Table 1 Subjective Sleep Diary

	Pretravel		Travel		Training		Match	
Measure	**mean ± SD**	**Median**	**mean ± SD**	**Median**	**mean ± SD**	**Median**	**mean ± SD**	**Median**
Time in bed, min	488.54 (143.03)	592.5 (0, 775)	358.82 (107.74)[a]	349 (240, 590)	423.31 (114.18)[b]	441 (240, 620)	539.69 (110.04)[d,f]	555 (270, 780)
Sleep onset latency	1.86 (0.89)	2 (1, 4)	1.59 (0.79)	1 (1, 3)	1.56 (0.96)	1 (1, 4)	1.78 (1.07)	1 (1, 4)
No. of awakenings	1.18 (1.49)	0 (0, 5)	0.12 (0.33)[a]	0 (0, 1)	1.06 (1.48)[d]	0 (0, 4)	1.59 (0.79)[e]	1 (0, 5)
Sleep rating	2.5 (0.92)[c]	3 (1, 4)	2.35 (0.99)	2 (1, 4)	2.31 (1.01)	2 (1, 5)	1.94 (0.98)	2 (1, 4)
Restfulness	2.71 (0.85)	3 (1, 4)	2.71 (0.85)	3 (1, 4)	2.5 (1.1)	3 (1, 4)	2.19 (0.86)[c]	2 (1, 4)

Note: Sleep onset latency scoring: 1 ≤ 15 minutes, 2 = 15–30 minutes, 3 = 30–60 minutes, 4 = 60 minutes+; sleep rating scoring: 1 = very good, – 5 = very poor; restfulness scoring: 1 = very well rested, – 5 = not rested. Significant differences between conditions: [a] pretravel versus travel; [b] pretravel versus training; [c] pretravel versus match, [d] travel versus training; [e] travel versus match; [f] training versus match.

Table 2 Liverpool John Moores Jet Lag Questionnaire

	Pretravel		Travel		Training		Match		Posttravel	
Measure	**mean ± SD**	**Median**	**mean ± SD**	**Median**	**mean ± SD**	**Median**	**mean ± SD**	**Median**	**mean ± SD**	**Median**
Jet lag	0.47 (1.43)	0 (0, 5)	1.05 (1.56)	0 (0, 4)	2.46 (2.33)	3 (0, 7)	1.63 (2.07)[b]	0 (0, 7)	2.28 (3.05)[a,c]	1 (0, 10)
Sleep	2.63 (5.42)	2 (–5, 18)	3.1 (5.67)	3 (–8, 14)	0.69 (2.53)	1 (–4, 4)	2.29 (3.65)	2 (–5, 10)	–0.84 (4.68)[f,i]	0 (–15, 6)
Fatigue	0.21 (1.69)	0 (–3, 4)	0.05 (2.16)	0 (–3, 5)	–0.77 (1.92)	–1 (–4, 3)	–0.32 (1.60)	0 (–4, 3)	–0.97 (1.86)[c,f,i]	0 (–5, 4)
Meals	1.05 (3.24)	0 (–6, 7)	1.86 (3.18)	1 (–3, 8)	1.46 (3.45)	1 (–4, 8)	–0.05 (4.25)[b,e,g]	0 (–12, 9)	0.22 (4.86)[h]	0 (–15, 9)
Mood	0.58 (4.31)	0 (–13, 7)	1.19 (3.41)	0 (–5, 7)	–0.69 (2.32)[d]	–1 (–4, 3)	0.29 (3.20)	0 (–9, 8)	–0.09 (2.28)	0 (–5, 5)
Bowel	–0.16 (2.36)	0 (–5, 5)	–1.14 (3.05)	0 (–8, 6)	–1.85 (3.83)	0 (–10, 1)	–0.87 (3.53)[b]	0 (–10, 8)	–0.03 (2.51)	0 (–5, 9)
Overall	4.79 (10.26)	2 (–11, 31)	6.1 (11.3)	4 (–21, 30)	1.31 (4.85)	3 (–9, 6)	2.97 (10.33)	3 (–25, 27)	0.56 (9.35)[f]	1 (–24, 22)

Note: The Liverpool John Moores Jet Lag Questionnaire scoring system: Jet lag: 0 = insignificant, 10 = very bad; Sleep, Fatigue, Meals, Mood and Bowel: 0 = normal, –5 = less/worse than normal, +5 = more than normal. Significant differences between conditions: [a] pretravel versus travel; [b] pretravel versus match; [c] pretravel versus posttravel; [d] travel versus training; [e] travel versus match; [f] travel versus posttravel; [g] training versus match; [h] training versus posttravel; [i] match versus posttravel.

Statistical Analysis

Data are presented as means±SD and median (minimum, maximum). Data was categorised into pre-travel, travel, training and match nights, and means were compared using a Paired-Students T-Test, with significance set at $p<0.05$. Analysis was performed on Statistical Package for the Social Sciences (SPSS Statistics for Macintosh version 25.0; IBM, Armonk, NY).

Results

Results from the subjective sleep diary are presented in Table 1. Players reported significantly greater Time in Bed (TIB) on Match days compared to Travel ($p<0.001$) and Training ($p=0.002$) days, and on Pre-travel days compared to Travel ($p<0.001$) and Training ($p=0.028$) days. Players reported significantly more awakenings on Pre-travel ($p=0.005$), Training ($p=0.014$) and Match ($p=0.002$) days compared to Travel days. Pre-travel sleep rating was also significantly greater than Match days ($p=0.013$). Results from the LJMJL are presented in Table 2. Perceived jet-lag was significantly worse on Match ($p=0.043$) days compared to Pre-travel days. Sleep was reported to be significantly worse on Pre-travel ($p=0.029$), Travel ($p=0.007$) and Match ($p=0.001$) days compared to Post-travel days. Significant differences were also observed between a number of conditions for the following categories: Meals, Mood, Bowel Activity, Fatigue and Overall, as seen in Table 2. There was no difference between the Pre and Post ASSQ scores.

Discussion

This study assessed the impact of long-haul transmeridian travel on subjective sleep patterns and jet-lag symptoms in junior athletes around an international competition. The main finding was a significantly reduced TIB on nights that involved travel. In addition, we observed an increased TIB on match days. Finally, the travel requirements seemed to have minimal to no effect on perceptual sleep quality and jet-lag symptoms. These findings suggest that travel limits the opportunity for sleep (TIB) in junior female athletes, thus potentially interfering with preparation and recovery.

Disrupted and shortened sleep is typical during, and even following, long-haul travel and may largely be attributed to circadian misalignment and/or the flight schedule interfering with habitual sleep phases[8,9]. This study indicated TIB is significantly less during days of travel (359±108 min) compared to days preceding travel (489±143 min) and 3 days post-arrival in Wellington (Training) (423±114 min), suggesting that the travel itself reduced TIB more than the misalignment between

the body clock and new time-zone post-travel. In addition, TIB was significantly greater during the tournament compared to the 2 Training days immediately following Travel (423±114 min). This suggests that athletes may benefit from additional days prior to competing following long-haul travel to make up for any sleep debt accumulated. By allowing junior athletes to have the chance to return to homeostasis (i.e., increased opportunity to sleep) prior to competition, there is the potential for performance to improve and a reduced risk of injury [1,2,8,9].

Interestingly, our study also indicated that athletes obtained greater TIB on match nights compared to all other conditions. However, with increased sleep onset latency, more awakenings and lower feelings of restfulness upon waking. On Match nights, all category responses in the LJMJL are close to normal, which suggests this more disrupted sleep may be caused by pre-competitive nerves, which is common for athletes prior to matches/competition[5], rather than symptoms of jet-lag, and may cause younger athletes greater sleep disruption. In addition, the ASSQ results indicate the group suffers from habitual mild sleep disruption. Considering the risk for this junior cohort, sleep hygiene education and routines could be utilised to improve sleep during competition[10].

In addition to sleep patterns changing, the LJMJL suggests that travel also altered food consumption. In particular, meal responses were significantly different from normal during Travel (1.86±3.18) and Training (1.46±3.45) days compared to Match (-0.05±4.25) days. These changes are likely due to meal times on the flights and the individuals adjusting to appropriate meal times upon landing[11]. Food consumption seems to return to normal levels by the time the tournament starts, which is ideal considering the importance of adequate nutrition in preparation for and recovery from competition[11]. As such, athletes and coaching staff undertaking long-haul travel should plan their intake en route as far as possible in advance and aim to continue their pre-competition nutrition plan where possible.

While this study provided additional insight into the perceived sleep habits and feelings of jet-lag prior to, during and following long-haul transmeridian travel, it has some limitations. With 11 total subjects, it is a small sample size. In addition, this is just a snapshot of one team and due to the individual nature of sleep, these results may not be generalisable to a broader population. Furthermore, while subjective sleep reporting may be

important, it may not be as accurate as some objective measures (e.g., polysomnography or actigraphy) and as such there may be a discrepancy between perceived sleep and actual sleep among junior athletes[12].

Conclusion

The current study showed that junior netball players competing in an international tournament experience significantly less opportunity for sleep during long-haul transmeridian travel in comparison to pre-travel and during the tournament. In addition to disrupting daily routines such as food intake, the study also supports previous evidence that athletes may experience disturbed sleep prior to and during competition[5].

Practical Applications

These results may be used by practitioners to guide plans for future overseas tournaments in the hope to minimise the impact travel requirements have on sleep and general wellbeing of young athletes. Practitioners may seek additional days between arrival at the destination and beginning to tournament to allow for jetlag symptoms to alleviate and to overcome sleep debt accrued during travel. In addition, sleep education is recommended for these younger cohorts to assist with gaining adequate sleep quality and duration while away from home.

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