Journal of Science and Medicine in Sport 19 (2016) 113–116

Contents lists available at ScienceDirect

Journal of Science and Medicine in Sport

journal homepage: www.elsevier.com/locate/jsams

Original research

Sleep patterns and injury occurrence in elite Australian footballers

Jackson Dennis[a,b,*], Brian Dawson[a,b], Jarryd Heasman[b], Brent Rogalski[b], Elisa Robey[a]

[a] School of Sport Science, Exercise and Health, The University of Western Australia, Australia
[b] West Coast Eagles Football Club, Australia

ARTICLE INFO

Article history:
Received 5 June 2014
Received in revised form 29 January 2015
Accepted 14 February 2015
Available online 21 February 2015

Keywords:
Actigraphy
Sleep duration and efficiency
Team sports

ABSTRACT

Objectives: To examine the potential relationship between sleep duration and efficiency and injury incidence in elite Australian footballers.
Design: Prospective cohort study.
Methods: Australian footballers ($n = 22$) from one AFL club were studied across the 2013 competitive season. In each week sleep duration and efficiency were recorded via actigraphy for 5 nights (the 3 nights preceding a game, the night of the game and the night after the game). Injury incidence was monitored and matched with sleep data: $n = 9$ players suffered an injury that caused them to miss a game. Sleep in the week of the injury (T2) was compared to the average of the previous 2 weeks (T1). A two-way repeated measures ANOVA was used to determine any effect of sleep duration and efficiency on injury. Significance was accepted at $p < 0.05$.
Results: Injury incidence was not significantly affected by sleep duration, sleep efficiency or a combination of these factors. Analysis of individual nights for T2 versus T1 also showed no differences in sleep quality or efficiency. However, a main effect for time was found for sleep duration and efficiency, with these being slightly, but significantly greater ($p < 0.05$) at T2 (437 ± 61 min and $82 \pm 7\%$) than T1 (414 ± 64 min and $79 \pm 7\%$).
Conclusions: No significant effect of sleep duration and efficiency on injury occurrence was found in elite Australian footballers.

1. Introduction

At elite levels Australian football is a high intensity team sport involving rapid changes of speed and direction, repeated jumping and proficient ball skills[1,2] and consequently, injury risk is high.[3] Injuries can broadly be classified as intrinsic (internal; overuse, over-exertion) or extrinsic (external; collision, contact), with intrinsic being regarded as more controllable and preventable than extrinsic injuries.[4] During the 2012 Australian Football League (AFL) season, each club experienced an average of 38.1 new injuries that caused players to miss one or more games. Overall, injuries resulted in an average of 147.7 missed games per club.[3]

Understanding potential mechanisms of injury is important to professional sporting clubs, as they manage players to be fit for as many matches as possible.[5] In Australian football, Rogalski et al.,[5] recently studied the relationship between training and game loads (defined by perceived exertion ratings) and injury risk, finding that larger 1 weekly (odds ratio: OR = 2.44–3.38), 2 weekly (OR = 4.74) and previous to current week changes in load (OR = 2.58) significantly related to increased in-season injury risk. Similarly, Colby et al.,[6] investigated the overall physical workload (derived from GPS data) and intrinsic injury risk in AFL players. During the preseason, 3 weekly sprint distance and 3 weekly total distance were the best injury indicators, while in-season, 2–4 weeks cumulative running loads were again found to be the best injury indicator. In both studies, players with 7 or more years AFL experience suffered more injuries than younger players.[5,6]

It is widely recognised that high player workloads[5,6] and increased fatigue[7] can increase injury risk. Consequently, methods such as massage, cold water immersion and stretching are commonly used by athletes to manage fatigue and accelerate recovery from training and playing. Further, good sleep (quality and quantity) is also considered an important recovery method.[8] Poor sleep across several days/weeks may potentially predispose athletes to injury via chronic fatigue levels remaining higher; therefore, monitoring longitudinal sleep behaviour may be important as another potential (and controllable) mechanism of injury. Sleep behaviour is ideally monitored via polysomnography (PSG),[9,10] however this method requires a specialised sleep laboratory and is limited by availability/cost.[10] Commonly, wristwatch actigraphy is

* Corresponding author at: Corresponding author.
E-mail addresses: jackson.dennis@hotmail.com, jacksond@wce.com.au (J. Dennis).

http://dx.doi.org/10.1016/j.jsams.2015.02.003
1440-2440/

used in situations where PSG cannot be implemented: for sporting teams it is less intrusive, cheaper and more practical.[9,11,12]

Reilly and Edwards[13] reported that swimmers who experienced acute partial (2.5 h) sleep deprivation, had a negative mood state, as depression, tension, confusion, fatigue and anger were increased, while vigour was decreased. A chronic negative change in mood states (possibly due to regular poor sleep) may be a specific factor associated with increased injury risk, but there is little research available on this topic. Previously, Lavallée and Flint[14] examined the effects of stress, competitive anxiety, mood states and social support on athletic injury incidence and severity in varsity level American football and Rugby players. They reported that high competitive state anxiety and tension were significantly related to injury rates, while tension, anger and total negative mood state were significantly related to injury severity.

To our knowledge, research on sleep patterns and injury risk in athletes is extremely limited. The known relationships between poor sleep and negative mood states, and negative mood states and injury, underpin the aim of this study, which was to examine the potential link between sleep and injury incidence in elite Australian footballers. It was hypothesised that lower levels of sleep quantity and quality would be associated with higher injury incidence.

2. Methods

Elite ($n = 30$) Australian footballers were initially involved in this prospective study, but a final sample of $n = 22$ (due to insufficient data points) were eventually used for analysis. Their mean (±SD) age, stature and mass were 23.8 ± 3.2 y, 188.5 ± 7.6 cm and 88.8 ± 9.0 kg, respectively. All were from one AFL club, with data collected throughout the 2013 season. Only players who competed in AFL matches during this season were used in the sample, and all were regular senior players. Informed written consent was provided by all players, with ethical approval granted by the Human Research Ethics Committee of the University of Western Australia.

Sleep and injury data were recorded each week in-season, until a player suffered an injury that caused them to miss a game: at this point, using a "survival model" analysis, they were removed from further data collection, to avoid pseudo replication (i.e., bias arising from repeated measures on the same player). Each week, players wore an actigraph for 5 nights: the 3 nights before a game, the night of the game and the night after the game. When travelling away (interstate: 1–2 time zones crossed), players spent the 2 nights before a game in an unfamiliar environment. For comparison against the week of injury, baseline mean values (for sleep duration and efficiency) for the combined 3 nights before, the night of and the night after a game were calculated as an average of scores from the preceding (or closest) 2 weeks.

After pre-season familiarisation, sleep was quantified in-season via wristwatch actigraphy (16 Hz sampling rate: Readiband, Fatigue Science, Vancouver), with data collected and analysed after each 5 nightly block. Wristwatch actigraphy has been shown to be valid and reliable in normal, healthy adult populations[9,11] (a small validation study was completed on these actigraphs, included here as supplementary information). The actigraphs were placed on the non-dominant wrist and worn continuously, except during training or games. Data was collected via the zero-crossing mode[15–17] and then sleep variables were scored via the 'sports mode', using the Fatigue Science software.

The variables analysed were:

- Sleep duration: total time spent sleeping (min).
- Rest duration: total time spent resting (includes sleeping/not sleeping) (min).
- Sleep efficiency: (sleep duration/rest duration) × 100.

Table 1
Mean (±SD) sleep duration (min), sleep efficiency (%) and absolute injury incidence.

Variable	Injury	*N*	Mean (+SD)
Duration T1	0	22	414 ± 64
Duration T2	9	22	437 ± 61[a]
Efficiency T1	0	22	79 ± 7
Efficiency T2	9	22	82 ± 7[b]

T1 = preceding (or closest) 2 weeks prior to injury; T2 = week of injury.
[a] Sleep duration significantly ($p < 0.001$) greater at T2 than at T1.
[b] Sleep efficiency significantly ($p < 0.05$) greater at T2 than T1.

Injury episodes in games were classified by the senior club physiotherapist, collated and then uploaded to their database: injury occurrence at training was much lower and were not included here as sleep monitoring was only possible across 5 (rather than 7) nights of each week. Injuries were classified as either moderate severity (player missed 1–2 weeks of training and 1–2 games) or high severity (player missed 2+ weeks of training and 2+ games). Injuries were further classified by type (description) and body site (location) and as intrinsic (internal; overuse, over-exertion), extrinsic (external; collision, contact), "unknown" or "pre-existing" in nature.

A two way repeated measures ANOVA (no assumptions were violated) was used to analyse sleep duration and efficiency across the combined 5 nightly block for each game for injury weeks (time point 2:T2) and for the preceding (or closest) 2 (non-injury) weeks (time point 1:T1). Data were analysed using IBM SPSS 20.0 and reported as mean ± SD. Significance was accepted at $p < 0.05$.

3. Results

Table 1 presents descriptive data at T1 and T2 for sleep duration, sleep efficiency and injury incidence. It shows that 9 of the 22 players in the sample suffered an injury during the season that caused them to miss a game. There were 8 intrinsic and 1 extrinsic injury recorded in the data set, with 6 injuries of moderate severity and 3 of high severity. The sites injured were lower leg (2), thigh (2), hip/groin (2), ankle (2) and forearm (1). A main effect for time is also indicated in Table 1, showing that sleep duration and efficiency were slightly but significantly greater ($p < 0.05$) at T2 than T1. This is further detailed in Table 2, which also shows that no significant interaction existed between sleep duration and efficiency and injury. Additional analysis also compared individual nights (3, 2 and 1 nights before, the night of and the night after a game) from T1 and T2, but no differences were seen.

4. Discussion

This study examined the potential link between sleep quality and quantity and injury incidence in AFL players. Sleep duration and efficiency were measured via actigraphs and injury incidence was monitored across a full AFL season. The results here showed no significant effect of sleep on injury occurrence, therefore, our hypothesis that lower levels of sleep quantity and quality would increase the incidence of injury was not supported. Nevertheless, further research into the sleep patterns of AFL players should be conducted, ideally over multiple seasons and clubs, so that a large database is acquired, in order to fully examine whether sleep may be a related factor in injury incidence. In addition, whether sleep can impact on individual player game performance should also be considered, as this was not investigated here.

In contact team sports, non-contact and soft tissue (intrinsic) injuries are considered largely controllable, in contrast to contact and collision (extrinsic) injuries.[4] Both intrinsic and extrinsic injuries were included in this study in line with previous research,[5]