The effects of air travel on performance measures of elite Australian rugby league players

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Abstract

Objective: The current study explored the effects of short haul air travel within the same country on elite Australian rugby league players (n = 12) during two away and two home games of elite competition. Methods: Physiological tests of handgrip strength and leg power were assessed along with psychological tests and perceptions of leg soreness and tiredness on the day before the game (Time 1 and Time 2) and on game day (Time 3). Game statistics of tackles and metres gained were assessed for the games analysed. Results: Significant differences were found for DALDA worse than normal responses at Time 2 (2.50 ± 3.23 vs. 3.50 ± 3.93; P = 0.04), KSS at Time 2 (2.88 ± 1.51 vs. 3.71 ± 1.37; P = 0.011) and leg tiredness at Time 3 (3.38 ± 1.66 vs. 2.35 ± 1.70; P = 0.004) between home and away games. The analysis of game statistics identified that more metres were gained during home games (83.6 ± 49.1 vs. 63.0 ± 30.1; P = 0.02) and more tackles made while playing away (18.4 ± 9.2 vs. 14.3 ± 6.7; P = 0.016). Conclusions: The results suggest that short haul air travel without crossing time zones results in symptoms of travel fatigue but does not appear to negatively impact on elite rugby league players ability to perform strength and power tasks. Different game tactics (attacking vs. defensive) occurred between home and away games however it is unclear whether travel fatigue or a HA is associated with this finding.

Key words: travel fatigue, home advantage, game performance

Introduction

Rugby league (RL) is a physically demanding team sport that requires well developed lower body power and upper and lower body force production (Brewer & Davis, 1995; Gabbett, Jenkins & Abernethy, 2011). Previous studies therefore have examined leg power via counter movement jumps (Kilduff et al., 2007) along with upper body strength (Meir, Newton, Curtis, Fardell & Butler, 2001), with differences in playing positions and playing division identified.

Home advantage (HA) is a phenomenon considered to be common in many team sports and along with crowd support and familiarisation of playing ground, the negative effects of travel has been proposed as a potential explanation for the occurrence of HA (Schwartz & Barsky, 1977). Throughout a season, many professional teams are required to commute via air over vast distances to compete which may negatively impact on sporting performances (Youngstedt & O'Connor, 1999). In professional RL within Australia, teams (15 Australian and 1 New Zealand team) are required to play their opposition both at home and away, with the majority of travel occurring along the east coast of Australia. Consequently, Australian-based teams only cross time zones when a game is played in New Zealand or when daylight savings are in place, resulting in 1-3 hr time differences. The distances travelled by RL teams to play at away games during the season range from as little as 20 km across town via ground transport to > 3000 km via air travel, therefore it is considered short haul travel.

Although jet-lag is unlikely to occur due to minimal time zones being crossed, air travel may result in 'travel fatigue' or 'travel weariness' (Waterhouse, Reilly & Edwards, 2004). Symptoms of travel fatigue include disorientation, general weariness and an increased occurrence of headaches however the effects of travel fatigue generally abate by the following day (Waterhouse, Reilly, Atkinson & Edwards, 2007). Collectively, the evidence of travel

disadvantaging an away team is inconclusive with little research investigating the influence of travelling distances that cross three or less time zones on athletic performance which frequently occurs with professional RL teams playing in Australia.

To date, there is no research surrounding professional RL and the effect that air travel may have on performance within Australia, however, one study has examined the effects of jet-lag on student RL players travelling from Britain to Australia to compete (Reilly & Mellor, 1987). The study suggested that travel reduced handgrip strength in the first three days of testing. In other travel studies, the use of handgrip strength, leg power, muscle soreness and sleepiness have been assessed in sporting populations (Hill, Hill, Fields & Smith, 1993; O'Connor et al., 1991; Reilly, Atkinson & Budgett, 2001), general populations (Reilly et al., 2001) and military personnel (Wright et al., 1983) with conflicting results reported for upper and lower body strength due to travel (Wright et al., 1983; Hill et al., 1993; Reilly et al., 2001). Although there are variations between the effects of jet-lag compared to travel fatigue, both may lead to an athlete performing suboptimally during training and competition (Waterhouse et al., 2004).

Due to the arduous travel that all professional RL teams in Australia endure, it is essential to identify if air travel may impair performance. Therefore the aim of the current study was to investigate if short haul air travel has an impact on performance variables of professional RL players using psychological, physiological and key game performance measures. It was hypothesised that the effects of air travel without crossing time zones would not induce decrements in performance of professional RL players.

Methods

Participants (n = 12) in the study were all Australian professional RL players (age: 26.2 ± 2.8 years; height: 181.8 ± 7.6 cm; weight: 96.8 ± 11.7 kg). The team analysed in the current study had a HA (58.7%) between 2001-2010, and was located in northern Queensland, where they were required to travel by air to compete against all other teams (approximately 1300 - 3615 km). All players volunteered to participate and informed consent and pre-screening data was obtained. Approval for this study was obtained from the management of the RL team and ethics approval from the James Cook University Human Ethics Committee in accordance with the Declaration of Helsinki. Players were included in the analysis if they were selected in the playing team for each week of testing. Participants were familiar with the testing procedures after familiarisation sessions were held during both an away and a home game preceding the testing period.

Four consecutive alternating home and away professional RL games each played on a Saturday night were selected to ensure minimal impacts from training, with each week consisting of similar numbers and types of training sessions.

Travel time for away games commenced at check-in for flights and concluded upon arrival at the team's accommodation, which consisted of air travel (2.5 ± 0.7 hrs) and bus travel from the airport to the accommodation (0.6 ± 0.5 hrs) with an average total travel time of 3.1 ± 1.2 hrs. No time zones were crossed during travel. The testing sessions for home and away games were conducted indoors on similar surfaces and in air conditioning. The testing was performed indoors in an attempt to negate differences in outdoor environmental conditions with away destinations approximately 10°C cooler than home.

Three testing times were conducted in each of the four selected weeks with all sessions being on the day prior to the game (Time 1 and 2) or on game day (Time 3). The first testing session (Time 1) was held prior to the travel component in an away week or at a similar time during a home week; the second testing session (Time 2) was conducted immediately on arrival at the arranged accommodation in an away week or at a similar time during a home week; and the third testing session (Time 3) was held on the morning of the game day either away or at home.

Once players arrived at the testing session, they completed the daily analyses of life demands for athletes (DALDA) questionnaire which is an assessment tool to evaluate if an athlete is feeling stressed and what the symptoms of the stress may be (Rushall, 1990). The questionnaire required participants to respond to variables as either worse than normal, normal or better than normal, with an increased number of worse than normal responses indicating signs of stress. The symptoms of stress component (Part B) of the questionnaire was analysed in the current study as previous studies have identified significant differences in the symptoms of stress and the DALDA questionnaire was identified as a practical method of monitoring Olympic athletes (Coutts, Slattery & Wallace, 2007). Participants also completed the Karolinska Sleepiness Scale (KSS) which is a nine-point likert scale questionnaire which has been used previously to assess the sleepiness/alertness of active individuals (Akerstedt & Gillberg, 1990). The scale ranges from 9 = extremely sleepy or fighting sleep to 1 = extremely alert.

Maximum handgrip strength (HG_{max}) was examined using a handgrip dynamometer (Smedley, Tokyo, Japan). Previously handgrip strength has also been used in the evaluation of jet-lag effects in school aged RL players (Reilly & Mellor, 1987) and military personnel

(Wright et al., 1983). Participants held their hand in the anatomical position and then exerted maximal pressure on the dynamometer with three trials performed alternately on the left and right hands to ensure sufficient recovery with the maximum value used for analysis.

Squat jumps were performed in the back squat position (Kilduff et al., 2007) with all participants being familiar with performing an explosive back squat through their resistance training history. Participants held a light-weight pole across their shoulders with the Gymaware equipment secured to one end. A self-selected depth and foot position was utilised (Argus, Gill, Keogh, Hopkins & Beaven, 2010) and three jumps were completed with peak power (PP), relative peak power (RPP) and peak velocity (PV) being recorded. The jumps were examined using a Gymaware optical encoder (Kinetic Performance Technology, Canberra, Australia), which has previously been validated (Drinkwater, Galna, McKenna, Hunt & Pyne, 2007). Perceptions of leg soreness and leg tiredness were also determined via a 10 point likert scale (0 = normal to 10 = extremely sore/tired). Leg soreness has previously been used by Cleak and Eston (1992) and leg tiredness was presented in the same format. Due to pre-existing injuries, only nine participants were included in the vertical jump analysis.

Training loads were calculated for each individual player using the session RPE method (Foster et al., 1995) which is a product of training time in minutes and RPE response (RPE; 10 point scale, 0 = rest to 10 = maximal; Borg, 1998) with the accumulative score for each week used in the analysis (Coutts, Murphy, Pine, Reaburn & Impellizzeri, 2003).

Key game performance indicators (metres gained and tackles made) for the four consecutive games were obtained from a freely accessible game statistics website for the Australian national RL competition for analysis.

Statistical analyses were conducted using the Statistical Package for the Social Sciences software (PASW v18, SPSS Inc., Chicago, WI, USA). Data are presented as means ± standard deviation. To reduce the variation of individual patterns of psychological and physiological measures, all raw data for each participant (expect for DALDA) was converted to a Z-score for statistical analysis. A Z-score produces a score which indicates the number of standard deviation units a raw number is below or above the mean of the distribution and is calculated using [(individual players score - individual players average) / individual players standard deviation (SD)] (McLean, Coutts, Kelly, McGuigan & Cormack, 2010). All Z-scores were analysed using paired samples t-tests between home and away data for each of the three times. Game statistics and training loads were analysed using a paired samples t-test between home and away. An alpha level set at 0.05 for all statistical analyses.

Results

Significant differences were found for DALDA worse than normal responses (Time 2) , KSS (Time 2) and leg tiredness (Time 3) between home and away games (Table 1). There was a higher frequency (at least two more responses) of DALDA worse than normal responses when away at Time 2 compared to home at time 2 for six of the 25 variables (Table 2).

Table 1 near here

Table 2 near here

The analysis of training loads indicated that there was no differences between home and away games (1283.0 ± 213.9 vs. 1299.9 ± 272.5; t(21) = 0.337, P = 0.739).

Analysis of the key game performance indicators found that the players averaged significantly more metres during home games (83.6 ± 49.1 m) compared to away games (63.0 ± 30.1 m; t(23) = -2.493, P = 0.02), and tackled significantly more during away games (18.4 ± 9.2 tackles) compared to home games (14.3 ± 6.7 tackles; t(23) = 2.590, P = 0.016).

Discussion

Although previous research has provided empirical evidence to suggest that a HA exists within many other sports (Schwartz & Barsky, 1977), the underlying causative effects of this phenomenon are inconclusive. Travel has been associated with an away disadvantage and therefore a HA for the non-travelling team. Consequently the primary aim of the current study was to investigate if short haul air travel had an impact on performance of professional RL players. The current results indicate the players reported reduced alertness (KSS) and greater stress (DALDA) upon arrival at the away locations compared to the same time at home. Despite no differences in strength and power variables, leg tiredness was significantly greater at home on the morning of game day compared to the same time when away. Furthermore, key game performance indicators also differed between locations. Collectively, the results indicate that the hypothesis was not upheld as some variables were negatively influenced by short haul air travel.

The DALDA inventory indicated that more players reported worse than normal responses for tiredness, need for a rest, boredom, irritability, general weakness and running noses upon

arrival at the away locations (Time 2 away). Furthermore, upon arrival at the away location a total of 87 worse than normal responses were reported for the team in comparison to 60 worse than normal responses for the same time at home. The higher number of worse than normal responses immediately following travel to away locations indicates increased symptoms of stress in the players (Rushall, 1990). The current results are similar to those of other studies that identified lower levels of anxiety in club level hockey players when at home (Bray, Jones & Owen, 2002) and that game location influenced the psychological states of university and club level rugby union players with players suggesting they feel they have greater vigor and reduced anxiety, fatigue and anger when playing at home (Terry, Walrond & Carron, 1998). The results of the KSS with players indicating they are less alert upon arrival at the away locations confirms the increased frequency of worse than normal responses of tiredness and need for a rest in the DALDA inventory. The results of the current study suggests that the players felt symptoms of travel fatigue over short haul travel, such as travel weariness and general fatigue, as identified previously by Waterhouse and colleagues (2007).

Leg power has previously been identified as an important component of RL (Gabbett et al., 2011), with a decline in leg power potentially resulting in suboptimal game performance. As reported previously for air travel across multiple time zones (Wright et al., 1983; Reilly et al., 2001), the current study which assessed short haul travel found no effect of travel on leg power, which may have positive implications for the travelling team in a game situation.

Within the current study, leg soreness did not differ across location, however leg tiredness was significantly greater at home compared to when away at Time 3. It is important to note that at both home and away, the degree of leg tiredness further reduced at each consecutive time. This represents a progressive time-based recovery from the last training session

undertaken for the week. The rate of decline in leg tiredness was greater while away which caused the significant difference at Time 3 to occur. Specifically, leg tiredness at home reduced by 4% at each testing time while away was initially reduced by 10% (between Time 1 and 2) with a further 26% reducing occurring by Time 3. From the variables assessed during the current study the authors are unable to specifically identify the mechanism for this result, however it may be due to the sedentary travel behaviours (enforced rest) and requires investigation.

Maximum handgrip strength showed no differences between away and home games which is in contrast to previous research which has identified changes due to the effects of travel on handgrip measures (Wright et al., 1983; Hill et al., 1993; Reilly et al., 2001). In particular, the study conducted by Reilly and Mellor (1987) identified a decrease in handgrip strength in school-aged RL players after air travel. The potential reason for the variations between the current study and previous studies is that no time zones were crossed in the present study compared to ≥ 5 time zones crossed in previous studies (Wright et al., 1983; Hill et al., 1993; Reilly et al., 2001).

In regards to game performance, the team performed more tackles when away and ran more metres when at home. This may suggest that the team is required to play more defensively when away, although the team's coaching staff indicated that the team playing defensively during away games was not a deliberate playing tactic for the games under analysis. The ability of the opposing team may influence team tactics, match-to-match variability of player work rates and possession of the ball may ultimately determine the key performance indicators. Future research should endeavour to analyse game statistics of key performance indicators in more detail potentially through the use of global positioning systems.

When completing data collection on an elite team, some methodological limitations are present. The ability to include a wider variety of performance measures was not possible due to time restrictions and availability of testing locations. Additionally, the number of players who obtained injuries or were not selected to play in each week decreased the possible number of participants for the study. The outcomes of the study should take into consideration that only four games were analysed due to the time of season and access to the team.

Conclusion

The current study aimed to investigate short haul air travel in more detail compared to previous air travel research by including direct measures of performance. The current study suggests that during a regular competitive season short haul air travel without crossing time zones results in symptoms of travel fatigue but does not appear to negatively impact on elite rugby league players ability to perform strength and power tasks. Different game tactics (attacking vs. defensive) occurred between home and away games however it is unclear whether travel fatigue or a HA is associated with this finding. These findings support the notion that HA may be attributed to a combination of learning, crowd and travel factors (Schwartz & Barsky, 1977) and psychological states (Bray et al., 2002; Terry et al., 1998).

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Table 1 – Mean ± SD and z-scores for psychological and physiological measures for away vs. home games

Variable	Data	N	Time 1		Time 2		Time 3	
			Home	Away	Home	Away	Home	Away
DALDA	Mean ± SD	24	2.63 ± 2.93	2.50 ± 2.15	2.50 ± 3.23	3.50 ± 3.93	2.63 ± 2.70	2.21 ± 1.82
	t(df), P		-0.257(23), 0.799		2.181(23), 0.040 [a]		-0.834(23), 0.413	
KSS	Mean ± SD	24	3.54 ± 1.67	[illegible]	2.88 ± 1.51	3.71 ± 1.37	3.25 ± 1.29	3.58 ± 1.35
	Z score		-0.37 ± 0.72	-0.06 [illegible]	0.45 ± 0.73	0.29 ± 1.13	-0.21 ± 0.73	0.04 ± 0.82
	t(df), P		0.434(23), 0.669		2.779(23), 0.011 [a]		1.019(23), 0.319	
Leg Soreness	Mean ± SD	21	4.05 ± 2.06	3.86 ± 2.37	3.95 ± 2.11	3.61 ± 2.41	3.62 ± 2.20	3.13 ± 2.32
	Z score		-0.07 ± 0.88	-0.26 ± 0.91	-0.11 ± 0.75	-0.18 ± 0.78	-0.37 ± 0.66	-0.61 ± 0.70
	t(df), P		-0.639(20), 0.530		-0.322(20), 0.751		-1.264(20), 0.221	
Leg Tiredness	Mean ± SD	21	3.67 ± 1.65	3.51 ± 1.85	3.52 ± 1.50	3.17 ± 2.10	3.38 ± 1.66	2.35 ± 1.70
	Z score		-0.03 ± 0.88	-0.10 ± 0.87	-0.13 ± 0.67	-0.19 ± 0.79	-0.28 ± 0.74	-0.83 ± 0.66
	t(df), P		-0.280(20), 0.782		-0.304(20), 0.764		-3.294(20), 0.004 [b]	
HGmax (kg)	Mean ± SD	24	62.65 ± 6.25	63.35 ± 6.50	63.35 ± 6.51	64.64 ± 7.71	65.83 ± 6.33	64.85 ± 7.19
	Z score		-0.22 ± 1.04	-0.03 ± 0.87	-0.10 ± 0.84	0.13 ± 1.01	0.47 ± 1.05	0.33 ± 0.92
	t(df), P		0.716(23), 0.481		0.852(23), 0.403		-0.480(23), 0.636	
PP (W)	Mean ± SD	18	6431 ± 1346	6626 ± 1365	7273 ± 1773	7228 ± 1779	7294 ± 1776	6692 ± 2243
	Z score		-0.28 ± 0.64	0.08 ± 0.65	0.37 ± 1.02	0.28 ± 1.11	0.31 ± 1.14	-0.12 ± 1.12

	t(df), P		1.556(17), 0.138		-0.257(19), 0.801		-1.096(17), 0.288	
RPP (W/kg)	Mean ± SD	21	59.5 ± 12.47	61.30 ± 12.65	67.25 ± 16.31	66.85 ± 16.40	67.48 ± 16.41	64.52 ± 15.75
	Z score		-0.37 ± 0.72	-0.06 ± 0.69	0.42 ± 0.98	0.38 ± 1.08	0.39 ± 1.16	0.16 ± 0.84
	t(df), P		1.442(20), 0.165		-0.151(20), 0.882		-0.688(20), 0.500	
PV (m/s)	Mean ± SD	21	3.67 ± 0.37	3.41 ± 0.31	3.51 ± 0.32	3.53 ± 0.39	3.49 ± 0.33	3.44 ± 0.38
	Z score		-0.21 ± 0.79	-0.03 ± 0.74	0.44 ± 1.03	0.47 ± 1.12	0.31 ± 1.16	0.07 ± 0.78
	t(df), P		0.736(20), 0.470		0.079(20), 0.938		-0.823(20), 0.420	

[a] = away > home ($p < 0.05$); [b] = home > away ($p < 0.05$)

Table 2 - Frequency of worse than normal responses for the DALDA inventory for home and away games

Variable	Home	Away	Difference (away – home)
Muscle pain	11	12	1
Techniques	1	2	1
Tiredness	3	5	2
Need for a rest	3	6	3
Supplementary work	1	0	-1
Boredo[illegible]	1	4	3
Recov[illegible]y time	3	3	0
Irritabilit[illegible]	1	3	2
Weigh[illegible]	2	3	1
Throat	2	3	1
Internal	1	0	-1
Unexplained aches	7	8	1
Technique strength	5	5	0
Enough sleep	1	2	1
Between session recovery	3	4	1
General weakness	5	7	2
Interest	2	2	0
Arguments	0	1	1
Skin rashes	2	2	0
Congestion	0	1	1
Training effort	1	1	0
Temper	1	1	0
Swellings	3	3	0
Likability	0	1	1
Running nose	1	5	4
TOTAL	60	87	24