Ground travel-induced impairment in wellness is associated with fitness and travel distance in young soccer players

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Abstract

The aims of this study were to 1) investigate the influence of ground travel on wellness measures, and 2) examine the possible influence of travel distance and fitness on the magnitude of these possible changes. Compared with home matches, wellness measures showed moderate–to-large impairments for away matches the day prior to the match (D-1) (range; +5 to 68%, (90%CL 1-88); standardized difference: range; +0.6 to +1.75 (0.1-2.07)) and small-to-large impairments the day of the match (D0, range; +7 to +68.1(-1.6-87.5); standardized difference, range; +0.24 to 1.78, (-0.06-2.15)), respectively. There were large and very large negative relationships between the increases of fatigue (r = -0.84, 90%CL -0.95; -0.56) or soreness at D-1 (r = -0.80, -0.93; -0.84) and players’ fitness. There were also very large positive correlations between actual wellness measures and traveling distance to away locations (r range; 0.70 to 87). Ground travel-induced impairment in wellness is associated with fitness and distance of away locations in young soccer players. Simple wellness questionnaires could be used to effectively monitor young soccer players’ freshness and readiness to train or compete during away games.

Key words: association football; fatigue; psychometric measures; monitoring; home advantage.
**Introduction**

Soccer teams in all leagues all over the world have to travel regularly for away matches during the competitive season, with the travel distance often related to playing standard (with the higher the playing standard, the greater the travel distance). There is a tendency for teams to perform better at home than away, which is generally referred as home advantage (Goumas, 2013; Pollard, 2008). Although a myriad of variables has been proposed as the underlying causes of this phenomenon, the potential impairments in players’ wellness known as ‘travel fatigue’ or ‘travel weariness’ is of particular interest for physiologists and sports scientist when monitoring players’ readiness to compete and/or train (Waterhouse, Reilly & Edwards, 2004).

According to results of the very recent studies investigating the effect of air travel on wellness (Fowler, Duffield & Vaile, 2014; Fowler, Duffield & Vaile, 2015; Fowler, Duffield, Waterson & Vaile, 2015), there seems to be a negative effect of air travel on wellness in team sport players. In particular, Fowler et al (2014) not only highlighted the negative effect of travel on overall wellness, but also the subsequent performance decrement in soccer players, demonstrating the important effect of wellness on performance. However, these latter investigations were conducted in adult players to date, and the effects of travel on wellness responses in young academy soccer players are yet to be determined.

While in a professional environment, adult teams usually fly to away locations (Fowler, et al., 2014; Fowler, Duffield & Vaile, 2015; Fowler, Duffield, Waterson & Vaile 2015; McGuckin, Sinclair, Sealey & Bowman, 2014), young academy players have generally to travel by bus or train due to their restricted budget. Various factors determine travelling distance, such as playing standard and country size. For teams playing in the highest youth leagues in wide countries, travelling distance can vary from a couple of kilometers (same city, <30 min) up to 1300 km (travel
across the country, >14-16 hrs). Although it seems that the amount of travel-induced impairment in wellness in young soccer players might be greater than for adults (i.e., using systematically ground vs. air travel, which leads to longer travel durations) no data exist on the effects of ground travel on their wellness and/or performance. Since it has been reported that traveling for long hours (i.e., international air travel) impairs wellness measures more than shorter trips (i.e., domestic air travel), an association between wellness impairment and distance/hours of traveling might be expectable (Fowler, Duffield & Vaile, 2015). However, whether the distance of ground travel also plays a role and has a relationship with wellness change/impairment is also unknown. An important factors that may affect the time course of recovery in soccer is fitness (Johnston, Gabbett, Jenkins & Hulin, 2015; Nédélec, et al., 2012). Following these lines, it could be hypothesized that fitter players may experience less fatigue or soreness when recovering from training/matches but also when travelling extensively for away matches. At present however, the relationship between players’ wellness, fitness and travel distance for away matches is still unclear.

When it comes to monitor players’ fatigue/freshness to train/compete, both objective and subjective indices are generally collected by practitioners working with teams (Buchheit, 2014; Saw, Main & Gastin, 2016). Objective measures (e.g., heart rate data, saliva measures, jump performance) usually need sophisticated devices that are not commonly available in many clubs, particularly for young academy players. In contrast, subjective measures such as perceived physical and psychological well-being are relatively simple to implement, cheap and non-invasive (Saw, et al., 2016). Importantly, subjective measures may have a superior sensitivity and greater consistency than objective measures, and could reflect both acute and chronic training loads (Saw, et al., 2016). For these aforementioned reasons, perceived wellness measures are today considered as one of the most promising tools to monitor (young) soccer players. Therefore, the aims of the
The present study were to 1) investigate the influence of ground travel on perceived wellness measures, and 2) examine the possible influence of travel distance and fitness on the magnitude of these possible changes.

**Methods**

**Participants**

Data from seventeen young soccer players (mean ± SD, 17.8 ± 0.4 y, 68.5 ± 5 kg, 178.1 ± 5.1 cm and 12.5 ± 1 body fat) from a U19 Iran premier league team were used. Their high-intensity intermittent running performance, assessed using the Yo-Yo Intermittent Recovery Test Level 1 (Yo-YoIR1 (Bangsbo, Iaia & Krstrup, 2008) one week after the 8 weeks of preparation period was 1920 m ± 264. The players trained 6 times per week plus a weekend match. The first day after the match (D+1) consisted in a recovery session including jogging and stretching. In the second day following the match (D+2) players were performing resistance training. The third day following the match (D+3) included high-intensity interval training as well as tactical training. The fourth day (D+4) was a training session including speed, agility, quickness training and tactical training. The fifth (D+5) and sixth (D+6) training days (i.e., D-1) included technical and tactical training with a trend to reduce the training load to prepare the players for the upcoming match day. All trips were organized for the team to reach the away location in the morning (i.e., before 12 A.M) the day before the match (D-1). In practice, for trips less than 6 hours long, the team departed early in the morning (D-1). For trips of longer durations/distances (> 6 hours), the team would leave the preceding night (range of time; 8-12 P.M). All training sessions at D-1 were scheduled according to the match kick-off time (i.e., 2 to 3 P.M). These data arose as a condition of player monitoring, in which player activities are routinely measured over the course of the competitive
season; therefore, ethics committee clearance was not required (Winter & Maughan, 2009). The study conformed nevertheless to the recommendations of the Declaration of Helsinki.

**Data Collection**

During an entire in-season period which included 10 home and 10 away matches (11 teams in the league), wellness variables were collected for each player about 1 hours before each training or match. Wellness data were consistently collected immediately before training at D-1, i.e., 2 to 4 hours after arrival. Departure to return home was consistently within 1 to 2 hours after the match. Data collection at D+1 was consistently in the afternoon (range of time; 2 to 4 P.M).

**Monitoring wellness (Hooper Scales)**

The Hooper scales questionnaire was used to assess players’ wellness (Hooper & Mackinnon, 1995). The questionnaire comprised 4 questions related to perceived sleep quality, stress, muscle fatigue and soreness, with each question scored on a 7-point scale (with 1 and 7 representing very good and poor wellness ratings, respectively) (Hooper & Mackinnon, 1995). The overall wellness known (Hooper Scales) was determined by summing the 4 scores.

**Statistical analyses**

Data are presented as mean (SD). Changes in the Hooper Scales and its separate wellness variables (i.e., sleep, stress, fatigue and soreness) for home and away matches (D-1, D0 and D+1) were analyzed using standardized differences or effect size (ES) (Cohen, 1988). The Hopkins scale (www.sportsci.org/resource/stats) was used for their interpretation: < 0.2: Trivial; 0.2 – 0.6: Small; 0.6 – 1.2: Moderate; > 1.2: Large. A magnitude-based inference approach was used to analyze the chance that the true changes were clear or trivial. Probabilities were also calculated to determine whether the true differences was lower than, similar to, or higher than the smallest worthwhile difference or change (SWC, 0.2 × between-subject SD) (Hopkins, Marshall, Batterham & Hanin,
2009). Person correlation coefficient were also used to 1) measure the relationship between travel-induced responses in wellness measure with Yo-YoIR1 performance and 2) determine the relationship between the travel distance for each away matches with players’ wellness for each day (D-1, D0 and D+1). The magnitude of the correlations (r, 90% confidence limits, CL) was assessed according to the scale of Hopkins (Hopkins et al., 2009). The effect size and the magnitude-based inferences were calculated using specifically designed spreadsheets (Batterham & Hopkins, 2006) available at http://www.sportsci.org/.

Results
Data for one match could not be collected, so the final dataset includes data for 19 matches (10 home and 9 away). The complete data set for all matches including Yo-YoIR1 and wellness measures is 11 x 19.

Differences in wellness between home and away matches
Differences in wellness measures between home and away matches are shown in table 1, 2 and 3 respectively. At D-1, there were certain and large impairments in all wellness measures for away compared with home matches, except stress which showed only a likely moderate impairment (Table 1). At D0, there were possibly-to-very likely small impairment in sleep, stress and fatigue, while soreness showed almost certainly large decreases in away matches (Table 2). At D+1, differences in wellness measures were trivial-to-small with probabilities ranging from unclear-to-possibly.

***Table 1 to 3 near here***

Relationship between wellness responses and distance to away matches
All actual wellness measures showed positive and large relationships with distance to the away locations, ranging from 0.70 to 87 (Figure 1).

***Figure 1 near here***

Related to travel-induced wellness responses and fitness

The negative correlations between travel-induced responses at D-1 and Yo-YoIR1 performance were very large for fatigue and soreness (Figure 2). All other correlation analyses for D0 and D+1 were trivial or unclear.

***Figure 2 near here***

Discussion

Monitoring players’ wellness is receiving increased popularity in today’s football to adjust training loads, prevent excessive fatigue and injuries (Saw, et al., 2016) and understand wellness responses to extensive travels during away matches (Fowler, Duffield & Vaile, 2015). The aims of this study were to 1) investigate the influence of ground travel on wellness measures, and 2) examine the possible influence of travel distance and fitness on the magnitude of these possible changes.

Differences between home and away in wellness measures

We observed for the first time that simple self-reported wellness measures such as the Hooper Scales were sensitive to ground travel in young academy players. More precisely, most of the wellness measures were almost certainly and largely impaired at D-1 (Table 1), confirming the negative effect of long travels on freshness after arrival (Fowler, Duffield & Vaile, 2015). Our data showed however that these wellness impairments had almost recovered at D0 (Table 2). This suggests that travelling to the away locations the day before the match is likely efficient for players to globally recover from their travel, and that securing one night at the away location may be of
paramount importance for teams playing far away from home, particularly when travelling by bus or train in young academy players.

Interestingly however, while sleep, stress and fatigue bounced back within their normal levels at D0, soreness was still almost certainly and largely impaired. Such impairment was even larger when compared with D-1 (i.e., ES of 1.78 vs 1.3 at D and the D-1, respectively), which might be related to a delayed onset muscle soreness (DOMS) following travels (Cheung, Hume & Maxwell, 2003). This suggests that the recovery of travel-induced DOMS may last longer than general fatigue. Some special recovery strategies targeting neuromuscular recovery (e.g., cold water immersion, massage, not implemented in the present study though) may therefore be of special interest to attenuate player’s muscle soreness after such types of travels (Nédélec, et al., 2012).

At D-1, stress showed a moderate increase in away locations, probably due to a higher anxiety during the journey (Waterhouse, et al., 2004). Sleep showed also a large detrimental response at D-1 in away locations, suggesting that ground traveling may impair players’ sleep pattern/quality. The impairment of sleep quality is very likely related to the changes in sleep environment during the longer trips and the anxiety of early wake up when departing in the morning for shorter distances (Waterhouse, et al., 2004). The wellness responses at D+1 were more equivocal (trivial to small effects) and might be more due to individual responses to match load and match outcomes than travel per se.

The increased fatigue and soreness that we observed contrast however with some of the previous investigations on short air travels (Fowler et al., 2014; Fowler, Duffield, Waterson & Vaile 2015; McGuckin, et al., 2014). This directly shows the substantial physical stress imposed by long ground trips compared with short air travels. Interestingly, Fowler et al (2015), reported a wellness impairment prior to the match when simulating air travel for 24 hours, but not after a 5-hr domestic
flight in physically active males (estimated maximal oxygen uptake: 52.8 ml/min). Taken together, these data suggest that the trip duration, rather than travelling conditions per se (i.e., bus vs. airplane) may determine players’ wellness responses.

**Relationship between mean wellness measures and distance in away matches**

Another interesting and novel result in the present study was the very large and positive association between all subjective wellness scores and travel distance (Figure 1). This result confirms that the distance and/or time spent on the roads when traveling may be a decisive factor in determining wellness responses to travel, and it must be carefully considered by team managers when planning their trips. Considering the potentially detrimental effect of poor wellness on physical performance (Fowler, Duffield & Vaile, 2015), all possible actions to shorten the duration of the trips, and/or make the trip more comfortable should be investigated (e.g., standard of bus or train, regular stops to stretch and exercise). Present data also suggest that simple, non-invasive and subjective monitoring tools such as the Hooper Scales are well sensitive to the distance or duration of ground travels. The sensitivity of self-reported measures in our study supports the results of a very recent review (Saw, et al., 2016) demonstrating the usefulness of subjective measures to monitor athletes’ training status.

All wellness subscales (i.e., sleep, stress, fatigue and soreness, Figure 1) worsened linearly with increases in travelling distances, although a tendency to plateau was observed after 600-700 km. While this suggests that there might be a ceiling effect of travel on wellness impairment, that plateaus after 600-700 km (or 7-8 hours), more invasive measures (e.g., electroencephalogram) might be needed to draw definitive conclusions. Differences in departure times, and in turn, sleep time in the bus may have also impacted this relationship. For instance, for the longest trips (>1000
km), departure time be early enough at D-2 for players to have a full night of sleep in the bus, which may actually be longer than for shorter overnight trips departing later (e.g., 700 km).

Relationship between travel-induced impairment in wellness and fitness
Another interesting result of this study was the substantial association between mean travel-induced impairments in wellness measures at D-1 and Yo-YoIR1 performance (i.e., very large and large relationships for fatigue and soreness respectively, Figure 2). The beneficial effect of fitness on physical recovery is actually in line with the faster post game recovery reported in fitter vs. less fit rugby players (Johnston, et al., 2015). While correlations don’t imply causality, these results suggest that the fitter the players, the lower the wellness impairment when ground traveling. Improving players’ physical fitness may therefore not only enhance their physical and technical performance during matches (Carling, 2013), but could also attenuate the fatigue and soreness-induced impairments when travelling.

Conclusion
In conclusion, we showed for the first time in young academy players that compared with home matches, wellness measures are impaired the day before and the day of away matches, and that the greater the travel distance, the greater the wellness impairment. We also showed that fitter players may experience less ground travel-induced wellness impairment when travelling than their less fit counterparts. Present results confirm the need to arrive the day prior to matches when traveling over prolonged hours and to use some recovery strategies like cold water immersions (Nédélec, et al., 2012) after arrival to attenuate the increased soreness that may last until game day. Our results also suggest that, despite the somewhat questionable impact of fitness on match outcomes (Carling, 2013; Mendez-Villanueva & Buchheit, 2011), physical conditioning may still be regarded as an important component of training preparation in academy players subjected to long travels.
Following these lines, players’ fitness level may also need to be taken into account when selecting players in team roosters for some of the away matches with the longer trip durations. Finally, our study confirms the value of self-reported wellness questionnaires such as the Hooper scales, which are cheap, non-invasive, non-fatiguing, sensitive and effective for monitoring players’ readiness/fatigue to train/compete.

Acknowledgements
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References


Carling, C. (2013). Interpreting physical performance in professional soccer match-play: should we be more pragmatic in our approach?. *Sports Medicine, 43*(8), 655-63.


Figure legends

**Figure 1**- Relationship between team-average wellness responses (with 90% confidence intervals) and the distance of away locations on the day prior to a match (D-1).

**Figure 2**- Relationship between player-average travel-induced changes in fatigue and soreness and fitness on the day prior to a match (D-1).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Home</th>
<th>Away</th>
<th>% difference</th>
<th>Standardized difference (90% CI)</th>
<th>% greater/similar/lowe values for away vs. home matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hooper scales</td>
<td>6.9 (1.50)</td>
<td>10.55 (1.31)</td>
<td>56.5</td>
<td>1.75 (1.43; 2.07)</td>
<td>100/0/0</td>
</tr>
<tr>
<td>Sleep</td>
<td>2.12 (0.61)</td>
<td>3.50 (0.74)</td>
<td>67.9</td>
<td>1.7 (1.33; 2.07)</td>
<td>100/0/0</td>
</tr>
<tr>
<td>Stress</td>
<td>1 (0)</td>
<td>1.06 (0.12)</td>
<td>5.9</td>
<td>0.68 (0.11; 1.25)</td>
<td>92/7/1</td>
</tr>
<tr>
<td>Fatigue</td>
<td>2.13 (0.64)</td>
<td>2.96 (0.30)</td>
<td>44.1</td>
<td>1.23 (0.9; 1.57)</td>
<td>100/0/0</td>
</tr>
<tr>
<td>Soreness</td>
<td>2.16 (0.49)</td>
<td>2.96 (0.30)</td>
<td>40.5</td>
<td>1.3 (0.95; 1.65)</td>
<td>100/0/0</td>
</tr>
</tbody>
</table>

Greater wellness values stand for impaired wellness. Values are mean ± SD. CI: confidence interval. %: Percentage.
Table 2: Wellness measures on the match day (D) for home and away locations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Match day (D0)</th>
<th>% difference</th>
<th>standardized difference (90% CI)</th>
<th>Rating</th>
<th>% greater/similar/lower values for away vs. home matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hooper scales</td>
<td>6.4 (1.27)</td>
<td>7.2</td>
<td>0.31 (0.03; 0.59)</td>
<td>Small</td>
<td>Likely</td>
</tr>
<tr>
<td></td>
<td>6.81 (1.30)</td>
<td>(0.7 ; 14)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep</td>
<td>1.70 (0.44)</td>
<td>7</td>
<td>0.24 (- 0.06; 0.54)</td>
<td>Small</td>
<td>Possibly</td>
</tr>
<tr>
<td></td>
<td>1.81 (0.44)</td>
<td>(- 1.6 ; 16.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>1.33 (0.4)</td>
<td>- 9.8</td>
<td>-0.36 (- 0.64; -0.08)</td>
<td>Small</td>
<td>Likely</td>
</tr>
<tr>
<td></td>
<td>1.16 (0.14)</td>
<td>(-16.8 ; -2.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>1.68 (0.48)</td>
<td>17.2</td>
<td>0.47 (0.23; 0.72)</td>
<td>Small</td>
<td>Very Likely</td>
</tr>
<tr>
<td></td>
<td>1.94 (0.48)</td>
<td>(8.1 ; 27.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soreness</td>
<td>1.81 (0.46)</td>
<td>68.1</td>
<td>1.78 (1.41; 2.15)</td>
<td>Large</td>
<td>Almost Certain</td>
</tr>
<tr>
<td></td>
<td>2.95 (0.24)</td>
<td>(50.7 ; 87.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Greater wellness values stand for impaired wellness. Values are mean ± SD. CI: confidence interval. %: Percentage
**Table 3:** Wellness measures on the day after to the match (D+1) for home and away locations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>day of the match</th>
<th>% difference</th>
<th>standardized difference (90% CI)</th>
<th>% greater/similar/lower values for away vs. home matches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Home</td>
<td>Away</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hooper scales</td>
<td>10.27 (1.52)</td>
<td>10.19 (2.55)</td>
<td>- 5.7 (-14.7 ; 4.1)</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unclear</td>
</tr>
<tr>
<td>Sleep</td>
<td>2.55 (0.59)</td>
<td>3.09 (0.86)</td>
<td>17.20 (0.9 ; 36.3)</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Likely</td>
</tr>
<tr>
<td>Stress</td>
<td>1.06 (0.14)</td>
<td>1.07 (0.17)</td>
<td>- 0.6 (-8.7 ; 8.3)</td>
<td>Trivial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unclear</td>
</tr>
<tr>
<td>Fatigue</td>
<td>3.53 (0.64)</td>
<td>3.06 (0.9)</td>
<td>- 15.7 (-26.8 ; -2.9)</td>
<td>Trivial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Likely</td>
</tr>
<tr>
<td>Soreness</td>
<td>3.14 (0.71)</td>
<td>3.14 (0.89)</td>
<td>- 4.9 (-13 ; 3.9)</td>
<td>Small</td>
</tr>
</tbody>
</table>

Greater wellness values stand for impaired wellness. Values are mean ± SD. CI: confidence interval. %: Percentage
Figure 1- Relationship between team-average wellness responses (with 90% confidence intervals) and the distance of away locations on the day prior to a match (D-1).
Figure 2 - Relationship between player-average travel-induced changes in fatigue and soreness and fitness on the day prior to a match (D-1).