PHYSICAL DEMANDS OF FIELD UMPIRES IN THE NORTH EASTERN AUSTRALIAN FOOTBALL LEAGUE

Mr Nathan Elsworthy
Dr Ben Dascombe

EXERCISE AND SPORT SCIENCE RESEARCH GROUP
SCHOOL OF ENVIRONMENTAL & LIFE SCIENCES,
UNIVERSITY OF NEWCASTLE
SUMMARY
The current study examined the physical and cognitive demands of Australian Football field umpires officiating in the North Eastern Australian Football League (NEAFL). This brief report highlights a range of significant results which may be useful for the future development of physical conditioning programs. Also, this study may provide a basis for future research examining the efficacy of a cognitive training program of umpires.

In total, 7 matches were analysed resulting in 19 files from 7 individual umpires. Overall, umpires covered 12,886 m during an entire match with 28% covered at high intensity (>14.4 km·h⁻¹). The average speed maintained throughout a match was 111 m·min⁻¹ (6.5 km·h⁻¹). Decision making accuracy was 68% across the 7 matches. The physical demands were greatest during the first quarter, and decisional accuracy was greatest during the third and fourth quarters. As such, it appears that there is an existing relationship between the physical exertion and the decisional accuracy of umpires.

BACKGROUND
The NEAFL encompasses teams from New South Wales, The Australian Capital Territory, Queensland and Northern Territory and this competition was developed to provide a pathway towards elite AFL for both players and umpires. This competition was designed to bridge the gap between community level football and elite AFL across these states and this is now considered a second-tier competition, equivalent to other state-league competitions (i.e. VFL, SANFL and WAFL) around the country.

An examination of the physical components of match play is important for the development of training programs to ensure that these demands are met when completing the physical conditioning aspects of training. The use of global positioning system (GPS) technology in Australian Football has increased over the last 5 years, with every team now utilising this technology during training and matches. This provides a simple and efficient method of determining the physical demands of players during match play to monitor their training load throughout the season for the prevention of injury.

The use of GPS in umpires has been limited over this time. Wisbey (2009) compiled a report on the match demands of all umpire disciplines during the 2009 AFL season. Additionally, Elsworthy and Dascombe (In Press), reported the demands of field and boundary umpires within the Sydney AFL. As such, information regarding the match demands of AFL umpires is relatively limited and this provides the opportunity for additional research to examine the current demands of elite AFL umpires.
Additionally, the decision making performance of each umpire is scrutinised by match day observers. This is considered the major performance measure of field umpires. However, the level of physical exertion has been shown to influence the speed and accuracy of decisions in a number of field and laboratory based research studies (Kashihara et al. 2009, Oudejans et al. 2005, Tomporowski 2003, Verheijen et al. 1999). Results suggest that initially, decision making performance is reduced with low physical exertion, however as exercise intensity increases, decision making accuracy is improved, before a decline in performance with further increases in intensity. This is known as the inverted-U hypothesis. Additionally, this has been briefly examined in soccer referees and results indicate that more correct decisions were made when a lower movement speed was undertaken at the time of a decision (Oudejans et al. 2005).

This has not been examined in Australian Football umpires and the purpose of this current research was to:

- Quantify the physical demands of NEAFL umpires
- Examine the decision making performance across a match
- Determine the relationship between movement demands and decision making performance

**METHODOLOGY**

*Movement Data*

The study utilised global positioning system (GPS) technology to record latitude and longitude at a sampling rate of 5 Hz. Both field and boundary umpires wore GPS units underneath their normal umpiring uniform during match play. This data was then downloaded to a personal computer for analysis and interpretation. Erroneous data was manually removed from analysis.

The time spent and distance covered within 6 velocity bands were created and these were set out as detailed in the table below.
Table 1: Velocity bands used in the assessment of the match running demands of Australian Football umpires.

<table>
<thead>
<tr>
<th>Velocity band</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing</td>
<td>0-0.7 km·h(^{-1})</td>
</tr>
<tr>
<td>Walking</td>
<td>0.7-7 km·h(^{-1})</td>
</tr>
<tr>
<td>Jogging</td>
<td>7-14.4 km·h(^{-1})</td>
</tr>
<tr>
<td>Running</td>
<td>14.4-20 km·h(^{-1})</td>
</tr>
<tr>
<td>Higher speed running</td>
<td>20-23 km·h(^{-1})</td>
</tr>
<tr>
<td>Sprinting</td>
<td>&gt;23 km·h(^{-1})</td>
</tr>
</tbody>
</table>

Additionally, low intensity activity (LIA <14.4 km·h\(^{-1}\)) and high intensity activity (HIA > 14.4 km·h\(^{-1}\)) zones were created to provide a more global analysis of match running demands.

Decision making performance

The decision making performance was assessed by a match day observer who was positioned in an elevated grandstand at or around the half way point. They were provided with a clear view of the entire playing surface. Information collected from each decision was consistent with AFLUD regulations.

In addition to the match day observation, each match was reviewed using match video an additional two times. This information was collated and the overall decision making performance of each umpire was completed. The GPS, match video and decision making run sheets were all synchronised with the opening bounce of each quarter to ensure the time of decisions were accurate across all three data sets.

Study Participants

Overall, 7 subjects were included in this study which examined their performance across 7 matches over the 2011 NEAFL season. A total of 19 files were used for analysis.
RESULTS

A summary of all results can be observed in the table below. A brief description of each measure is also included below the table.

Table I: Summary of the physical demands of Australian Football umpires during match play

<table>
<thead>
<tr>
<th>Quarter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Match</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total distance (m)</td>
<td>3,391 ± 612</td>
<td>3,318 ± 463</td>
<td>3,189 ± 366</td>
<td>2,968 ± 398</td>
<td>12,886 ± 1,839</td>
</tr>
<tr>
<td>HIA distance (m)</td>
<td>1,016 ± 329</td>
<td>939 ± 266</td>
<td>925 ± 212</td>
<td>799 ± 252</td>
<td>3,679 ± 1,058</td>
</tr>
<tr>
<td>Average speed (m·min⁻¹)</td>
<td>117 ± 14</td>
<td>113 ± 12</td>
<td>110 ± 11</td>
<td>105 ± 9</td>
<td>111 ± 12</td>
</tr>
</tbody>
</table>

Total distance

In agreement with previous research, the TD covered in the current study was 12,886 ± 1,839 m. Additionally, a consistent decline across each quarter was also observed. Previously, Wisbey (2009) reported that elite AFL umpires covered a slightly greater distance across a match (13,160 ± 2,320 m), however failed to report the trend across each quarter. Furthermore, Elsworthy and Dascombe (In Press) indicated reduced demands in sub-elite field umpires (11,492 ± 1,729 m).

The data shows that the distance covered by NEAFL field umpires is lower than that of elite matches, and higher than that experienced by sub-elite (i.e. Sydney AFL) umpires. Additionally, there appears to be a consistent trend for umpires to cover less distance during the concluding stages of matches, possibly due to fatigue, or a decline in the overall match intensity. The trend across a match has not been recently examined in umpires at the elite level and this should be examined in future studies.

High-intensity activity demands

The distance covered at high intensity followed a similar trend with umpires covering the greatest distance in the first quarter, before a decline across the rest of a match. Overall, the distance covered in high-intensity activity was 3,679 ± 1,058 m. High intensity activity is considered movements performed at speeds greater than 14.4 km·h⁻¹. The distance covered at high intensity has not been examined at the elite level.

However, the proportion of high intensity activity completed across a match is increased compared to previous research on sub-elite matches (Elsworthy and Dascombe In Press). Previously, 3,096 ± 752 m was covered in high intensity activity, however, a similar trend
exists across a match, whereby the first quarter in the most demanding before declining across the remaining quarters.

**Average running speed**

The average running speed is an important measure to examine the overall demands of each quarter of a match and is useful in identifying a variation in running performance across a match. The current study identified a consistent decline across the entire match. An average speed on 111 m·min⁻¹ equates to approximately 6.5 km·h⁻¹.

Similarly to other physical performance measures, average speed appears to follow a similar trend. Elite umpires appear to maintain a higher intensity for the entire match (125 ± 9.8 m·min⁻¹) compared to NEAFL umpires, which furthermore is greater than other sub-elite umpires (103 ± 14 m·min⁻¹). As expected, a reduction in average speed declines across each quarter of a match, in conjunction with declines in high intensity activity and total distance. However this decline in elite umpires is unknown as it has not been previously reported.

**Decision making performance**

Overall, the decision making accuracy of the matches observed was 68% when asked to adjudicate on a selection of infringements. Umpires were more accurate during the third quarter than in any other quarter. It should be noted that these results are only a small representation of the decision making performance as it included a selected number of matches and umpires across the season as opposed to the entire umpiring cohort.

When there was a breach in the laws of the game, the observer collected relevant information (see methods) in relation to the decision. All instances which related to a breach in the laws of the game were considered and examined according to the match day observers run sheet and match video. General play decisions (i.e. marks, field bounce, boundary or goal umpire decisions) were not examined. Additionally, if vision was not clear or the incident occurred outside the field of view, the decision was excluded from analysis.
Table II: The decision making performance of Australian Football field umpires across each quarter

<table>
<thead>
<tr>
<th>Quarter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Match</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>2.7 ± 2.7</td>
<td>2.9 ± 2.0</td>
<td>3.5 ± 2.7</td>
<td>3.1 ± 1.8</td>
<td>12.3 ± 4.1</td>
</tr>
<tr>
<td>Missed</td>
<td>1.1 ± 0.8</td>
<td>1.3 ± 0.7</td>
<td>0.9 ± 1.3</td>
<td>1.0 ± 0.9</td>
<td>4.7 ± 1.9</td>
</tr>
<tr>
<td>Unwarranted</td>
<td>0.5 ± 0.9</td>
<td>0.5 ± 0.8</td>
<td>0.2 ± 0.4</td>
<td>0.3 ± 0.6</td>
<td>1.7 ± 1.4</td>
</tr>
<tr>
<td>DMA (%)</td>
<td>59 ± 31%</td>
<td>63 ± 20%</td>
<td>78 ± 20%</td>
<td>68 ± 27%</td>
<td>68 ± 7%</td>
</tr>
</tbody>
</table>

**Relationship between physical demands and decision making accuracy**

A strong relationship between the instantaneous velocity and decision making accuracy existed, particularly during the last quarter. When a correct free kick was made, it was identified that the movement velocity at that time was reduced. Conversely, more missed free kicks occurred at times when the umpire was moving at an increased speed. As such, it is likely that the movement demands of umpires may impact on the accuracy of decisions, particularly towards the end of a match where accumulative physical fatigue may exist.

**CONCLUSION**

Previously, research examining the match demands of Australian Football umpires has been relatively limited when compared to players. Until recently, GPS technology has not been used to examine these demands and now there is a better understanding of the match demands than what was previously known. The current study presents some results which are in agreement with previous research (Elsworthy and Dascombe In Press, Wisbey 2009).

The physical demands appear similar to previous research with 12,886 m covered across an entire match. Additionally, 28% of this distance was covered at speeds greater than 14.4 km·h⁻¹. As such these results indicate that Australian Football umpires experience considerable physical demands during match play. Furthermore, key physical performance measures (including TD, HIA distance and average speed) were greatest during the first quarter before declining during the third and fourth quarters. The decline may be due to a number of factors. Firstly, accumulative physical fatigue may result in the inability to maintain a high workload for an entire match and as such, performance declines. Alternatively, a decline in the overall match intensity, as identified by a reduction in the player demands, may not require the umpire to work as hard to obtain the correct position around the play. Further research is required to strengthen these suggestions.

The decision making accuracy of umpires in this study suggests that they are more accurate during the third and fourth quarters. Several studies have identified a relationship between
exercise intensity and cognitive performance and this may explain the decreased decision making accuracy during the early stages when physical demands are high. Additionally, towards the end of a match, running intensity may also impact on the accuracy of decisions. It was identified that more errors were made when the movement speed was increased. As such, it appears that umpires are more accurate when the movement speed is reduced. However, this has only been examined on a limited number of umpires and a greater cohort is required to provide more meaningful results.

**RECOMMENDATIONS AND FUTURE RESEARCH DIRECTIONS**

Despite the importance of the role of the umpire in team sports, the decision making performance has not been examined in great detail. Despite numerous laboratory based research studies reporting a relationship between exercise intensity and changes in cognitive performance, this has not been examined in umpires. This may play a significant role in the performance during match play. By limiting certain movements during match play, this may have a positive effect on the decisions made at certain situations during matches.

Furthermore, the development of a cognitive training program may also be beneficial to umpires. By encompassing both the physical and cognitive requirements during training, this will present stressors which will closely replicated the match day conditions experienced.

This is a method that could be implemented in the future and may lead to improvements in the on field performance of field umpires. To determine if a similar trend exists in Australian Football, further research needs to be completed to analyse this. Due to the nomadic nature of team sports, there are unavoidable factors that may results in a decisional error by an umpire (i.e. obstructed view, secondary focus). However, there may be some characteristics of the umpires’ physical demands which may impact on the likelihood of making an error.

Furthermore, it is important to replicate the match day conditions during training in order to prepare adequately for competitive matches. By identifying the various characteristics of a decisional error, concurrent training of the physical and cognitive components may be beneficial. Training these aspects provides adequate preparation for matches as the demands of match play are replicated and will likely improved the overall performance of umpires.
REFERENCES


