Increased High-Intensity Activity in Elite Australian Football Finals Matches

Robert J. Aughey

Background: Australian football (AF) is a highly intermittent sport, requiring athletes to accelerate hundreds of times with repeated bouts of high-intensity running (HIR). Players aim to be in peak physical condition for finals, with anecdotal evidence of increased speed and pressure of these games. Purpose: However, no data exists on the running demands of finals games, and therefore the aim of this study was to compare the running demands of finals to regular season games with matched players and opponents. Methods: Player movement was recorded by GPS at 5 Hz and expressed per period of the match (rotation), for total distance, high-intensity running (HIR, 4.17–10.00 m·s–1) and maximal accelerations (2.78–10.00 m·s–2). All data was compared for regular season and finals games and the magnitude of effects was analyzed with the effect size (ES) statistic and expressed with confidence intervals. Results: Each of the total distance (11%; ES: 0.78 ± 0.30), high-intensity running distance (9%; ES: 0.29 ± 0.25) and number of maximal accelerations (97%; ES: 1.30 ± 0.20) increased in finals games. The largest percentage increases in maximal accelerations occurred from a commencement velocity of between 3–4 (47%; ES: 0.56 ± 0.21) and 4–5 m·s–1 (51%; ES: 0.72 ± 0.26), and with <19 s between accelerations (53%; ES: 0.63 ± 0.27). Conclusion: Elite AF players nearly double the number of maximal accelerations in finals compared with regular season games. This large increase is superimposed on requirements to cover a greater total distance and spend more time at high velocity during finals games. Players can be effectively conditioned to cope with these increased demands, even during a long competitive season.

Keywords: motion analysis, functional performance, physical performance, sport physiology

Australian football (AF) is a highly intermittent sport, requiring athletes to accelerate hundreds of times with repeated bouts of high-intensity running (HIR) overlaid on lower intensity activity. The running demands of AF have recently been documented using global positioning system (GPS) technology. Australian football is also a contact sport, and its athletes require a blend of physiological capacities with a prominent requirement of endurance, but also strength power,
speed and agility. Further, players need to maintain or develop these capacities over the course of a long competitive season, with a view to peaking for finals games. Currently, there is no published data on whether the running demands actually change in finals games.

Elite Australian footballers undertake a lengthy and rigorous preseason training regime. Typically, the training year is divided into the general preparatory phase (November and December), the specific preparatory phase (January to early February), the precompetition (February and March) and competition phases (March through September). Most physical development of players is therefore complete by the commencement of the competitive season. There is evidence of players increasing vertical jump performance as a measure of muscular power over the course of a 3 y period. However, it is unclear if this physiological capacity can be enhanced during the course of the competitive season. One study reported a maintenance of peak power, jump height and peak jump velocity performance in June compared with the preceding March. However, the sampling time point in relation to games was not mentioned in this study. The timing of the sample is critical in evaluating this data, as players can present with reduced vertical jump performance for up to 72 h postgame. In another study from this group, it was noted that long periods of neuromuscular fatigue, as evidenced by reduced vertical jump performance, occur in the middle stages of the competitive season, from games 11 through 15 of 22, with a possible delayed effect of this fatigue on actual player performance in matches. If this fatigue is evident for a large fraction of the possible training week, for several weeks in a row, it is unclear how the performance of players could be increased in the lead-in to finals games in September. Further, it could be surmised that the actions of players during games most susceptible to this type of fatigue would be the highest intensity actions such as accelerating or high velocity running.

Various training regimes for enhancing the aerobic conditioning for team sport athletes have been attempted, ranging from traditional aerobic interval training, classical team sport conditioning, defined in a recent review as the integration of strength, power, speed and aerobic conditioning, and the use of small sided games. While traditional training conducted during a competitive season improved maximal aerobic speed and 40 m sprint performance of elite soccer players, it is likely that these players had less accumulated fatigue between matches than elite AF players due to both a lower work rate during matches and the lack of physical contact in soccer compared with AF. Small-sided games improved each of 10, 20, and 40 m sprint performance as well as VO2peak in rugby players, but participants in this study were subelite. Importantly, in the studies reporting performance enhancement of team sport athletes “in-season” the duration of the interventions described has been approximately 9–10 wk. This training duration in AF would therefore coincide with the periods of a season where players were experiencing long-term fatigue, and thus it is not clear if AF players could adapt to an increased training load during this time to allow subsequently enhanced running performance in finals games.

The aim of this study, therefore, was to compare the game running performance of matched players and opponents from regular season games to finals games in elite Australian footballers.
Methods

Participants

Eight elite Australian footballers (mean ± SD: age, 24.8 ± 3.0 y; height, 184.4 ± 2.7 cm; body mass, 84.5 ± 3.5 kg and games played, 116.5 ± 3.5 at commencement of the study) gave informed consent to participate in this study. The study conformed to the Declaration of Helsinki. Participants were all registered players of an elite Australian Football Club.

Selection of Games and Players for Analysis

To minimize the influence of differences in running occurring as a result of the activity completed by the opponent team and the competitive level of that team, data were only included for the same eight players in three regular season games against the same opponents competed against during finals in the 2008 AF season. Further, each player played the same strategic role during each of these games, and each was classified as a nomadic player. Thus, a total of 24 individual regular season and 24 individual finals games were compared.

Player Work Rate

Traditional Time-Motion Analysis. Player work rate was measured via a GPS unit sampling at 5 Hz (MinimaxX Team Sports 2.0, Catapult Innovations, Melbourne, Australia). The 5 Hz sample rate used here is more applicable for measuring the demands of team sports, especially high-intensity movements. The player movement variables analyzed, expressed in meters were total distance and high-intensity running (HIR, 4.17–10.0 m·s⁻¹). The high-intensity running band used here was first applied based on previous definitions in soccer, and then checked against the speed at the second ventilatory threshold during laboratory testing conducted during preseason testing on these players. As the results of the players tested, and the players included for analysis here, were reasonably homogenous (all are nomadic players, and all have a maximum oxygen uptake between 62 and 67 mL·kg⁻¹·min⁻¹), the same absolute zones was used for analysis of each player in regular season and finals games here. All movement data and frequency of accelerations were expressed per rotation and per minute of game time played, as previously described. That is, in AF, players are often rested, or rotated to the bench during quarters of play. A rotation equals a period of play within a quarter of football that a player is on the field. Rotations were thus named for the quarter of play they occurred in, and the sequential number of the rotation in that quarter (Q1R1, Q1R2, Q2R1, Q2R2, Q3R1, Q3R2, Q4R1, and Q4R2, respectively).

Changes in Velocity. The number of maximal (2.78–10.00 m·s⁻²) changes in velocity (accelerations) were calculated from GPS data using the manufacturers software (Logan Plus, v4.1, Catapult Innovations, Melbourne, Australia) as previously described. The reliability of accelerations from starting velocities similar to reported here expressed as a coefficient of variation (CV) was between 11 and 16% and the validity of this method was assessed against a laser as a criterion measure and percentage bias was between −5 to −10%, and typical error expressed
as a coefficient of variation of between 7 and 14% (Varley, Fairweather and Aughey; unpublished data). A key point of difference between the results of this pilot work and our previous work\(^1\) is that we have tightened the study design to compare instantaneous velocity from GPS to instantaneous velocity from a laser, rather than the average values obtained when using timing gates. This greatly reduces the inherent error in the criterion measure, and likely explains the superior validity and reliability presented above. In summary, this more recent work clearly establishes the ability of GPS to detect small important changes in velocity of team sport athletes. To enhance the ecological validity and reliability of this measure, our software rules required two consecutive measures (ie, 0.4 s) at the same rate of change in velocity to classify as acceleration. The statistical method we employ here can also account for this uncertainty in measurement.\(^1\) The definition of accelerations here differs from the only other studies to use acceleration data from GPS. One study counted accelerations of greater than > 1.11 m·s\(^{-2}\) as moderate accelerations\(^3\) and another counted accelerations > 4 m·s\(^{-2}\) as maximal accelerations.\(^1\) World-class 100 m sprinters accelerate at a rate of approximately 6 m·s\(^{-2}\) in the first second of a race, and, subsequent to that, acceleration occurs at a maximum rate of approximately 2 m·s\(^{-2}\). Further, elite team sport athletes accelerated from a standing start at a maximal rate of approximately 3 m·s\(^{-2}\).\(^1\) In recent pilot testing, trained but subelite team sport athletes accelerated maximally at a rate of between 2.5 and 2.7 m·s\(^{-2}\) measured by laser (Varley, Fairweather and Aughey; unpublished data). It is, therefore, likely that 4 m·s\(^{-2}\) is too high a threshold for elite team sport athletes,\(^1\) and a rate of between 2.7 and 3 m·s\(^{-2}\) is appropriate. Based on this, I believe 2.78 m·s\(^{-2}\) is an appropriate threshold for maximum acceleration in elite AF players.

**Training Load: Session-RPE Method.** The training load was determined from the session rating of perceived exertion (sRPE) method\(^2\) that is commonly applied in team sport settings.\(^2\)\(^3\)\(^2\)\(^1\) Players were asked to rate the intensity of training on a modified 10 point Borg scale within 30 min of the conclusion of the session.\(^2\)\(^1\) Training load was calculated using the following equation:

\[
\text{Load} = \text{RPE} \times \text{total time (in minutes)}
\]

**Statistical Analyses**

Data on training load is presented descriptively as mean ± SD for 4 wk training blocks commencing from week 1 of the season, including two weeks of byes. All other variables were log transformed to reduce bias due to nonuniformity of error and analyzed using the ES statistic with 90% confidence intervals (CI) and percentage change to determine the magnitude of effects using a custom spreadsheet.\(^2\)\(^4\)\(^2\)\(^5\) Magnitudes of change were classified as a substantial increase or decrease when there was a ≥ 75% likelihood of the effect being equal to or greater than the smallest worthwhile change estimated as 0.2 × between subject standard deviation, and classified as trivial to moderate. 0.2–0.6; moderate to large. 0.6–1.2; large to very large, 1.2–2.0; and very large to nearly perfect, 2.0–4.0. Effects with less certainty were classified as trivial, and, when the ± 90% CI of the ES crossed the boundaries of ES –0.2 and 0.2, the effect was reported as unclear.\(^2\)\(^4\)\(^2\)\(^5\) The smallest worthwhile change (SWC) in performance and typical error expressed as a coefficient of variation (CV) is reported for each performance parameter measured. This SWC
was calculated from the regular season games and players sampled in this study, estimated as $0.2 \times$ between subject standard deviation, and can be used to interpret the magnitude of effects reported here. This statistical approach was utilized to account for the normal variance in running performance seen in chaotic complex team sports, and also to identify worthwhile changes while accounting for the precision of measurement through confidence intervals.

**Results**

**Training and Match Load**

The training load changed from the preceding 4 wk block by $-6$ (ES: $-0.25 \pm 0.65$, unclear); $+6$ (ES: $0.33 \pm 0.32$, trivial–nontrivial increase); $-2$ (ES: $-0.13 \pm 0.35$, unclear); $+8$ (ES: $0.44 \pm 0.31$, trivial–nontrivial increase); and $-12\%$ (ES: $-0.97 \pm 0.31$, nontrivial decrease) respectively (Figure 1). There was no clear difference between total load determined by the session-RPE method for regular season $(1035.8 \pm 116.0)$ and finals games $(1043.3 \pm 115.2)$.

**Traditional Time-Motion Analysis (TMA)**

**Total Distance.** The SWC in total distance per minute of game time was 3%, or $3.9 \text{ m}\cdot\text{min}^{-1}$, with a typical error (TE) expressed as a CV of 9.8%. During finals games, players completed on average $11\%$ (ES: $0.78 \pm 0.30$, small–moderate increase) more total distance when expressed per minute of game time played. The greatest increases in total distance occurred during rotations in the second half of matches (Table 1).

**High-Intensity Running.** The smallest worthwhile change in total distance was $7\%$, or $2.6 \text{ m}\cdot\text{min}^{-1}$, with a TE expressed as a CV of 9.5%. During finals games, HIR distance increased on average $9.2\%$ (ES: $0.29 \pm 0.25$, small increase) when expressed per minute of game time played. In a slightly different pattern of increase to total distance, HIR distance increased in the first rotation of the first and fourth quarters of the match, with the largest increase in the fourth quarter. It should be noted that despite small–moderate effect sizes (0.57 ± 0.23, 0.32 ± 0.74 and 0.34 ± 1.28 for Q2R2, Q3R1 and Q3R2 respectively; Figure 2), the variability in this measure meant findings were unclear for these periods.

**The Number of Maximal Accelerations.** The smallest worthwhile change in maximal accelerations was $13\%$, or 0.1 accel·min$^{-1}$, with a TE expressed as a CV of 50.9%. On average, the number of maximal accelerations per minute of game time played nearly doubled (96.6%, ES: $1.30 \pm 0.20$, large increase) during finals games. The changes per rotation were between 2- and 16-fold larger than the smallest worthwhile we were able to detect. Despite this measure from GPS data inherently having the largest variability, the effect sizes for maximal accelerations ranged from small to very large ($0.56 \pm 0.34$, $1.43 \pm 0.46$, $0.92 \pm 0.47$, $1.61 \pm 0.63$, $1.20 \pm 0.62$, $3.01 \pm 0.70$, $2.22 \pm 0.55$ and $1.17 \pm 0.89$ for Q1R1, Q1R2, Q2R1, Q2R2, Q3R1, Q3R2, Q4R1 and Q4R2 respectively; Figure 3). It should also be noted that this quality increased in each participant in each (8/8) finals game sampled here.
Figure 1 — Training load calculated from mean session-RPE scores, and expressed in 4 wk blocks of training from the first game of the regular season including two bye weeks. All data are means ± SD and expressed in arbitrary units (AU).
Table 1  The mean ± SD and percentage difference in total distance per period of time (rotation) expressed per minute of field time (m·min⁻¹) during regular season and finals games. Periods were named for the quarter of play they occurred in, and the sequential number of the rotation in that quarter (Q1R1, Q1R2, Q2R1, Q2R2, Q3R1, Q3R2, Q4R1 and Q4R2, respectively). Data area percentage differences from regular season games, with ES ± 90% CI.

<table>
<thead>
<tr>
<th>Period</th>
<th>Regular</th>
<th>Finals</th>
<th>% Diff</th>
<th>ES ± 90% CI</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1R1</td>
<td>137.9 ± 17.7</td>
<td>152.7 ± 17.8</td>
<td>10.7</td>
<td>0.60 ± 0.47</td>
<td>Substantial ↑</td>
</tr>
<tr>
<td>Q1R2</td>
<td>137.0 ± 12.5</td>
<td>145.6 ± 22.8</td>
<td>6.3</td>
<td>0.49 ± 0.81</td>
<td>Unclear</td>
</tr>
<tr>
<td>Q2R1</td>
<td>136.2 ± 10.8</td>
<td>149.3 ± 26.0</td>
<td>9.6</td>
<td>0.85 ± 1.04</td>
<td>Substantial ↑</td>
</tr>
<tr>
<td>Q2R2</td>
<td>123.2 ± 16.7</td>
<td>139.0 ± 52.0</td>
<td>12.9</td>
<td>0.73 ± 1.56</td>
<td>Unclear</td>
</tr>
<tr>
<td>Q3R1</td>
<td>119.0 ± 16.0</td>
<td>130.6 ± 33.7</td>
<td>9.8</td>
<td>0.59 ± 1.16</td>
<td>Unclear</td>
</tr>
<tr>
<td>Q3R2</td>
<td>128.0 ± 8.2</td>
<td>146.3 ± 9.7</td>
<td>14.3</td>
<td>1.50 ± 0.64</td>
<td>Substantial ↑</td>
</tr>
<tr>
<td>Q4R1</td>
<td>121.6 ± 13.1</td>
<td>149.2 ± 13.7</td>
<td>22.7</td>
<td>1.60 ± 0.52</td>
<td>Substantial ↑</td>
</tr>
<tr>
<td>Q4R2</td>
<td>125.4 ± 13.6</td>
<td>133.3 ± 32.5</td>
<td>6.3</td>
<td>0.44 ± 1.18</td>
<td>Unclear</td>
</tr>
</tbody>
</table>

Note. Magnitudes of change were classified as a substantial increase or decrease when there was a ≥ 75% likelihood of the effect being equal to or greater than a small magnitude effect size (ES). Effects were described as per small 0.2–0.6; moderate 0.6–1.2; large 1.2–2.0; and very large 2.0–4.0. Effects with less certainty were classified as trivial and where the ± 90% CI of the ES crossed the boundaries of ES –0.2 and 0.2, the effect was reported as unclear. n = 24.

Figure 2 — High-intensity running (HIR, 4.17–10.00 m·s⁻¹) per period (rotation) expressed per minute of field time during games. Periods were named for the quarter of play they occurred in, and the sequential number of the rotation in that quarter (Q1R1, Q1R2, Q2R1, Q2R2, Q3R1, Q3R2, Q4R1 and Q4R2 respectively). Closed circles are for regular season games, open circles are for finals games. Data are means ± SD. *Denotes a small magnitude increase from regular season games; †Denotes a moderate increase from regular season games. n = 24.
Figure 3 — The number of maximal accelerations (2.78–10.00 m·s⁻²) per minute, expressed per period of time (rotation) on the field during games. Periods were named for the quarter of play they occurred in, and the sequential number of the rotation in that quarter (Q1R1, Q1R2, Q2R1, Q2R2, Q3R1, Q3R2, Q4R1 and Q4R2 respectively). Closed circles are for regular season games, open circles are for finals games. Data are means ± SD. *Denotes a small magnitude increase from regular season games; †denotes a moderate increase from regular season games; ‡denotes a large increase from regular season games and ‡‡a very large increase. n = 24.

The Commencement Velocity of Accelerations. Maximal accelerations commenced between 2 and 8 m·s⁻¹ movement velocity (Table 2). The largest percentage increases in finals occurred in the 3–5 m·s⁻¹ movement velocity band (Table 2).

The Time Between Accelerations. The majority of maximal accelerations occurred with less than 19 s of “recovery.” There were increases in maximal accelerations in finals games in each of the time-bands, but the largest increase was in the 0–19 s band, suggesting maximal accelerations occur both more often, and with less recovery during finals (Table 3).

Discussion

The major finding of this study was that there was an approximate doubling of the number of maximal accelerations players undertake during finals compared with regular season games. There was also a concomitant increase in both the total distance and HIR distance covered by players in finals games. For the first time, therefore, it is demonstrated that the running demands of elite AF finals matches increase substantially from regular season games.
The greatest increases in the number of maximal accelerations during finals games occurred at a starting velocity equivalent to approximately the lower end of the HIR band. This means that not only did players spend a greater amount of time running at moderate to high velocities, but that they also had to accelerate hard at these velocities. Further, the greatest increases in the number of maximal accelerations occurred with less than 19 s time between accelerations. That is, players accelerated more often from a higher velocity, with less time between accelerations. It is not possible to compare the number of accelerations undertaken by the AF players in this study to the only other study measuring accelerations in elite AF players due to very different classifications of magnitudes of acceleration.

Table 2  The mean ± SD and percentage difference from regular season to finals games in the frequency of commencements of maximal accelerations (2.78–10.00 m·s⁻²) by initial velocity band (m·s⁻¹). Data are percentage differences, with ES ± 90% CI.

<table>
<thead>
<tr>
<th>Start Velocity (m·s⁻¹)</th>
<th>Regular</th>
<th>Finals</th>
<th>% Diff</th>
<th>ES ± 90% CI</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3</td>
<td>1.5 ± 1.1</td>
<td>1.8 ± 1.4</td>
<td>16</td>
<td>0.30 ± 0.33</td>
<td>Trivial ↑</td>
</tr>
<tr>
<td>3-4</td>
<td>2.8 ± 2.4</td>
<td>4.2 ± 2.9</td>
<td>46.6</td>
<td>0.56 ± 0.21</td>
<td>Small ↑</td>
</tr>
<tr>
<td>4-5</td>
<td>1.8 ± 1.5</td>
<td>2.8 ± 2.1</td>
<td>51.4</td>
<td>0.72 ± 0.26</td>
<td>Moderate ↑</td>
</tr>
<tr>
<td>5-6</td>
<td>1.5 ± 1.2</td>
<td>1.9 ± 1.5</td>
<td>17.1</td>
<td>0.32 ± 0.30</td>
<td>Small ↑</td>
</tr>
<tr>
<td>6-7</td>
<td>1.4 ± 0.9</td>
<td>1.5 ± 1.3</td>
<td>7.9</td>
<td>0.19 ± 0.35</td>
<td>Unclear</td>
</tr>
<tr>
<td>7-8</td>
<td>1.2 ± 0.7</td>
<td>1.6 ± 1.1</td>
<td>39.6</td>
<td>0.90 ± 0.63</td>
<td>Moderate ↑</td>
</tr>
</tbody>
</table>

*Note.* Magnitudes of change were classified as a substantial increase or decrease when there was a ≥ 75% likelihood of the effect being equal to or greater than a small magnitude effect size (ES). Effects were described as per small 0.2–0.6; moderate 0.6–1.2; large 1.2–2.0; and very large 2.0–4.0. Effects with less certainty were classified as trivial and where the ± 90% CI of the ES crossed the boundaries of ES –0.2 and 0.2, the effect was reported as unclear. n = 24.

Table 3  The mean ± SD and percentage difference in the frequency of time between maximal accelerations (2.78–10.00 m·s⁻²) for regular season versus finals games. Data are percentage differences with ES ± 90% CI.

<table>
<thead>
<tr>
<th>Time Between (s)</th>
<th>Regular</th>
<th>Finals</th>
<th>% Diff</th>
<th>ES ± 90% CI</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–19</td>
<td>2.4 ± 2.1</td>
<td>3.7 ± 3.3</td>
<td>53.3</td>
<td>0.63 ± 0.27</td>
<td>Moderate ↑</td>
</tr>
<tr>
<td>20–39</td>
<td>1.8 ± 1.6</td>
<td>2.7 ± 2.5</td>
<td>31.7</td>
<td>0.45 ± 0.28</td>
<td>Small ↑</td>
</tr>
<tr>
<td>40+</td>
<td>4.3 ± 3.5</td>
<td>4.8 ± 3.4</td>
<td>11.6</td>
<td>0.15 ± 0.21</td>
<td>Unclear</td>
</tr>
</tbody>
</table>

*Note.* Magnitudes of change were classified as a substantial increase or decrease when there was a ≥ 75% likelihood of the effect being equal to or greater than the smallest worthwhile change estimated as a small magnitude effect size (ES). Effects were described as per small 0.2–0.6; moderate 0.6–1.2; large 1.2–2.0; and very large 2.0–4.0. Effects with less certainty were classified as trivial and where the ± 90% CI of the ES crossed the boundaries of ES –0.2 and 0.2, the effect was reported as unclear. n = 24.
It is important for future comparison of studies that a more consistent approach is taken with the classification of this important ability in AF players. Finally, even though this measure has poor reliability, the magnitude of change detected here is more than double the CV for a full game, and several orders of magnitude larger than the smallest worthwhile change for this parameter. Therefore, there can be confidence that this is a true reflection of the increased demands of finals.

The large increase in maximal accelerations recorded here has a related high additional metabolic cost for players. In finals games, it can be estimated that the extra distance covered in maximal accelerations was approximately 450 m. If we assume an average metabolic cost of sprint running during an acceleration to be 10.7 J·kg⁻¹·m⁻¹, then the elite AF players in this study required an additional 410 kJ of energy during finals from increases in accelerations alone. Obviously, there are limitations in extrapolating this model from 100 m sprint runners, but the additional energy cost is incontrovertible. In addition to a greatly increased number of accelerations, it stands to reason that players in this study also had a greater number of decelerations in finals games, although that quality was not measured in this study.

The players in this study undertook approximately 9% more HIR during finals games, for an average game total of approximately 3500 m. Even allowing for slight variations in classifications of velocity bands, this compares favorably with HIR distances recorded during Italian and Danish first-division soccer games earlier this decade (3080 and 2310 m respectively), as well as English premier league players (3397 m). However, the HIR distance in these players was approximately 10% lower than reported for players from a less successful elite AF team that did not play finals. In elite Italian soccer, less successful teams complete approximately 11% more HIR than successful teams, due mainly to technical deficiencies. It is possible that the ranking of AF teams and, more specifically, technical abilities and game style affect running characteristics in a similar manner.

There are no studies examining the game running performance of elite AF players after an acute phase of training; but some literature is present for soccer players. After 4 wk of training, elite junior soccer players increased the time they spent in high-intensity activities during games by approximately 25%. An 11% enhanced VO₂max resulted in improved soccer performance as evidenced by a 20% increase in distance covered, a 100% increase in the number of sprints and a 24% increase in the number of involvements with the ball. Although not measured in this study, it is possible that the players in this study had enhanced aerobic power for finals games. The players in this study had a small (8%) increase in total training load in the 4–8 wk preceding finals games. This increase was followed by a 12% reduction in total training load in the 4 wk immediately preceding finals games. It seems this was an effective strategy in overloading, and subsequently tapering the training of these athletes during this training phase, as subsequent match running performance was substantially elevated. Finally, an unchanged RPE with enhanced volume of running further supports the notion of an increased aerobic capacity in these players. This finding is in apparent disagreement with previous research on neuromuscular fatigue in elite AF players. In that study, players showed strong evidence of neuromuscular fatigue during the period 7–11 wk before finals games. However, no data was presented on weekly training loads, so it is difficult to conclude whether the evident fatigue was related to additional training undertaken. However, it should be noted that the session-RPE method used here records the
players’ perception of effort while training and this can be uncoupled from the actual training load, especially in intermittent sports. In elite soccer players there was variable change in capacity observed in Yo-Yo IR performance from the start to the end of a season. The mean decrement in performance reported was only approximately one-third of the variability with the test, making clear inferences difficult.

It is also possible that the different running demands observed in finals was due to a different game tempo, possibly related to tactical and strategic differences during these games. In my applied experience, the opponent affects the tempo of the game more than the type of game played, that is, regular season or finals, and the effect of opponent was controlled in this study. It is also possible that players played to a higher percentage of their individual physical capacity during finals games. The evidence for a changed effort is not strong. The total load using the session-RPE method was not different between regular season and finals games, indicating an equal perception of effort for players across game types. Players had a similar decline in running performance from the start to the end of the game in each game type, indicating similar levels of fatigue, and again not consistent with an altered effort. Finally, the HIR undertaken in games by soccer players is closely related to physical capacity.

The same players, playing similar roles were compared for matched opponents for regular season and finals games in this study. One difference in these games was the venue games were played at. Australian Football grounds are not uniform in dimension, and this may have affected the running employed by players. All finals games were played at the Melbourne Cricket Ground (MCG, 160 × 141 m), while regular season games were played at Skilled Stadium (170 × 115 m); Sydney Cricket Ground (SCG, 161 × 146.2 m); Manuka Oval (179 × 150 m); and York Park 175 × 145 m). It is difficult to ascertain the effect of the different ground dimensions on player running, as the only study to do so used files from all teams playing at each venue, and did not include information from games at the SCG, or Manuka Oval. Of the grounds compared, running volume in games was approximately 3% higher at the MCG than Skilled Stadium, and this is three times smaller than the changes we report between regular season and finals games. On balance, it is unlikely that ground size or location played a substantial role in the different running observed in this study.

The data presented here provides evidence that it is possible for team sport athletes to greatly increase their work rate in games conducted at the end of a long season. This has important application for most team sports, where critical games are played at the end of a season. The challenge for some sports will be managing the training load given champions league commitments may overlap with late domestic season games.

There are some limitations in the applied nature of the work undertaken here that must be acknowledged. For example, the relatively low sample size means inferences drawn to the wider elite AF population must be done with caution. In this study, the statistical method used requires fewer participants than more traditional statistical approaches, and thus the effect of limitation has been minimized. Further, there can only be speculation regarding the reason for the enhanced physical capacities in finals games, as no physiological testing occurred during this period to determine the mechanisms involved. Finally, the proprietary nature of the
knowledge encompassing the exact training undertaken during the period where additional training load was imposed does not allow the author full disclosure of methods utilized in this period.

**Conclusions**

Elite AF players nearly double the number of maximal accelerations in finals compared with regular season games. This large increase is superimposed on requirements to cover a greater overall total distance, and spend more time at high velocity during finals games. This increased volume of running appears to occur in specific periods of play, rather than uniformly across the game. Training for these periods, rather than an average increase across a game should be carried out.

**Practical Applications**

Elite AF players have different running profiles in finals games compared with regular season games, with seemingly short periods within games with greatest enhancement in running demands. Fitness and coaching staff can successfully manipulate training to condition athletes for increases in both the total distances run, and the number of high-intensity activities that players will need to undertake during finals games in the weeks preceding those games. Finally, a consistent approach to the activity classifications used is necessary when comparing changes in activity of players within and between seasons.

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**References**


