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Original research

# The effect of intense exercise periods on physical and technical performance during elite Australian Football match-play: A comparison of experienced and less experienced players

Georgia M. Black[a,*], Tim J. Gabbett[a], Geraldine A. Naughton[a], Blake D. McLean[a,b]

[a] School of Exercise Science, Australian Catholic University, Australia
[b] Collingwood Football Club, Australia

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ABSTRACT

*Objectives:* The physical and technical responses of experienced (≥5 years) and less experienced (1–4 years) elite Australian Football (AF) players were compared following the most intense passages of match-play.
*Design:* Descriptive cohort study.
*Methods:* Time–motion analyses were performed using global positioning systems (MinimaxX S4, Catapult Innovations, Melbourne, Australia) on one elite AF team during 13 matches. The global positioning data were categorised into total distance, low-speed activity (0–2.78 m $s^{-1}$), moderate-speed running (2.79–4.14 m $s^{-1}$) and high-speed running (≥4.15 m $s^{-1}$) distances. A standardised 5-point technical coding criteria was used to rate the number and quality of skill involvements during match-play.
*Results:* Following the most intense 3-min running period the experienced players covered greater distances at high-speeds in match quarters two (effect size, ES = 0.42 ± 0.30) and three (ES = 0.38 ± 0.33) than their less experienced counterparts. Compared with less experienced players, experienced players performed more skill involvements during the second quarter (ES = 0.42 ± 0.33) and fourth quarter peak 3-min bouts of exercise intensity (ES = 0.40 ± 0.30) and quarter one (ES = 0.49 ± 0.29) and three subsequent periods (ES = 0.33 ± 0.20).
*Conclusions:* Less experienced players exhibited greater reductions in physical and technical performance following peak periods of match-play. These findings suggest that training may require a greater emphasis on developing the ability of less experienced players to maintain physical performance and gain possession of the football following intense periods of match-play.


## 1. Introduction

Australian Football (AF) is an intermittent sport, requiring athletes to repeatedly perform accelerations and bouts of high-intensity running, separated by lower-intensity activity.[1–3] Global positioning system (GPS) devices can assess the activity profiles of players as well as variations in exercise intensity in elite AF.[1–3] It is well established that high-speed running ability is important for performance in high-intensity intermittent team sports[4] and that high-intensity activities are reduced during the final stages of competitive games, possibly due to match-induced fatigue.[1,5,6] However, further evidence is required to understand whether reductions in high-speed activity are evident following the most intense match periods throughout four quarters of an AF match.

As individual player performance in AF involves the multi-faceted interaction between activity profiles, play involvements and skill proficiency, it is difficult to quantify performance during match-play. As such, the subjective perceptions of experienced coaches are often used to rate individual player performance.[7,8] The number of involvements and proficiency of certain technical actions have shown strong correlations with coaches' subjective ratings and can differentiate between higher (Australian Football League, AFL) and lower calibre (West Australian Football League) AF players, irrespective of physical performance during a match.[7,8] Research in other team sports has shown an important link between physical and technical performance when under transient fatigue during team sport matches.[9,10] At present, it is unclear if intense periods of match-play influence the technical skill performance of players with differing levels of experience throughout an AF match.

* Corresponding author.
*E-mail address:* georgia.black@acu.edu.au (G.M. Black).

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Multiple studies have suggested that playing experience is related to match performance in team sports.[11–13] With this in mind, evidence states that younger players are being exposed to elite level senior AF more frequently than ever before.[14] In 2014, the average number of games for the top 20 AFL draft picks was 12 matches compared to 7 matches in 2004.[14] Veale et al.[15] highlighted body composition differences between elite junior athletes and their senior counterparts, despite the chronological age of the junior athletes suggesting that they were on the verge of participating in an elite senior competition. Given that players become eligible for the draft at the age of 18, and the assumption that these identified players are able to adequately perform in the AFL, it is difficult to determine the proportion of young players physically capable of tolerating the demands of elite senior football.[16] In 2014, the mean number of different players selected by each club to play in the AFL was 34; 47% of selected players were first-to-fourth year players and 35% were first-to-fourth year players that had played 10 or more career games.[17] Evidence suggests that expert team ball sport athletes are involved in their primary sport for ~13 years and invest approximately 4000 h of deliberate sport-specific practice before reaching national, open-age team selection.[18] Based on these findings[18] responses to intense periods of match-play may differ between experienced and less experienced players. Given the high proportion of less experienced (1–4 year) players in the AFL, it is important to understand how the most intense exercise periods affect their physical and technical performance. Therefore, the aims of this study were to: (1) describe the effects of the most intense periods (3 min peak periods) of physical activity during elite AF match-play on technical skill and physical performance in the subsequent 3 min period and (2) compare the effects of the most intense 3-min passage of play on physical and technical performance during the subsequent 3-min period in experienced (≥5 years) and less experienced AF players (1–4 years).

## 2. Methods

Twenty-four AF players (mean ± SD age: 24.1 ± 3.5 years, body mass: 88.5 ± 9.5 kg, and height: 186.9 ± 8.4 cm) from one elite Australian Football League team participated in this study. Data were obtained from 13 individual matches (totalling 163 appearances) played on the same arena (Melbourne Cricket Ground). All athletes received a clear explanation of the study, including information on the risks and benefits, and written consent was obtained following the approval of the institutional ethics committee. Players were divided into two subsets according to their playing experience. Players with five or more years of playing experience at the elite level were classified as the 'Experienced' group ($n = 14$) while players with four or less years of experience were classified as the 'Less Experienced' group ($n = 10$). At the start of the study, the 'Experienced' and 'Less Experienced' groups had participated in 6.7 ± 2.3 (mean ± SD) and 1.6 ± 1.1 elite playing years, and 137.7 ± 62.3 and 31.0 ± 13.6 elite career games, respectively. For the purpose of this study, players who represented the "generals" (forward/back pockets, half forward/back flanks) and midfield positional groups were the only two groups compared as these players have similar positional roles[19] (Supplementary figure).

Each player's match activity profiles and technical score data were recorded for each quarter. Player movement was recorded using a minimaxX GPS unit (S4, Catapult Innovations, Melbourne, Australia), sampling at 10 Hz, that was worn in a custom-built pocket between the shoulder blades of each players playing jersey. These 10 Hz GPS units have shown superior validity and inter-unit reliability compared with 1 Hz, 5 Hz, and 15 Hz units.[20] The GPS signal provided information on speed, distance, position, and acceleration. Player movement profiles were determined using movement speed distances analysed by the club, corresponding to low-speed activity (LSA) (0–2.78 m s$^{-1}$), moderate-speed running (MSR) (2.79–4.14 m s$^{-1}$) and high-speed running (HSR) (≥4.15 m s$^{-1}$) distances.

Game-specific skill data were manually coded from match broadcast video footage. All skill involvements were classified using a 5-point Likert scale (1 = poor; 5 = excellent). The standardised skill coding criteria were developed in consultation with Football Analysis professionals and an expert Australian Football coach (Table 1). The number and quality of the following skill involvements were coded:

*Kicks*—player disposes of the ball by foot.
*Handballs*—player disposes of the ball by hand.
*Handling*—attempted mark, handball received or gathering the football from the ground.
*Attempted tackles*—player attempts to apply direct physical contact to a player preventing an opposition disposal.

To assess intra-rater reliability of the technical skill criteria, eight quarters of AF matches were analysed twice. Re-test trials were conducted one month apart to decrease retention of information on selected video footage. To assess inter-rater reliability of the skill analysis, the eight quarters of AF matches were analysed by another trained individual who was familiar with the skill coding criteria. The Cronbach's alpha test for internal consistency was used to assess reliability of the skill coding criteria. The Cronbach's alpha ($\alpha$) results for internal consistency reliability of the coding scales used in this study were 0.93 and 0.85 for intra-rater and inter-rater reliability, respectively.

As 6 min was the minimum amount of time between rotations for a player at the football club, the measures of physical performance and technical skill performance were arranged into 3-min rolling periods.[21] To measure transient reductions in physical and technical performance, the same data measures were compared between the peak 3-min period of total distance per minute, the subsequent 3-min period, and the mean of all other 3-min periods (not including the peak and subsequent 3-min periods) for each individual player observation. Multiple physical and technical measures from individual players were included in the same group. There were 652 individual quarters (365 experienced, 287 less experienced) analysed; 145 quarters (97 [26.6%] experienced, 48 [16.7%] less experienced) were removed from the analysis as players were interchanged or rotated off the field in the 3-min following the peak period.

All data were log-transformed to reduce bias and non-uniform error. Cohen's effect size (ES) statistic and 90% confidence intervals (CI) (ES ± CL) were used to determine the magnitude of any differences.[22] Magnitudes of differences between the two groups were classified as substantially 'greater' or 'lesser' 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 (small ES). The magnitude of the ES was classified as trivial (<0.2), small (0.21–0.6), moderate (0.61–1.2), large (1.21–2.0) and very large (>2.1).[22] Data are reported as mean ± standard deviation, unless otherwise denoted.

## 3. Results

The experienced players were significantly older (mean ± SD age: 27.3 ± 2.2 yr *vs.* 21.4 ± 1.0 yr, ES = 1.74 ± 0.37, 100%, *almost certainly*) and heavier (mean ± SD body mass: 87.6 ± 5.3 kg *vs.* 83.2 ± 2.9 kg, ES = 0.88 ± 0.67, 95%, *very likely*) compared to their less experienced counterparts. There were no differences in height between the two groups. Fig. 1 shows the total, moderate-, and