



## Original research

## Physical qualities and activity profiles of sub-elite and recreational Australian football players

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## ABSTRACT

**Objectives:** To investigate the relationship between physical qualities and match activity profiles of recreational Australian football players.**Design:** Prospective cohort study.**Methods:** Forty players from three recreational Australian football teams (Division One, Two and Three) underwent a battery of fitness tests (vertical jump, 10 and 40 m sprint, 6 m × 30 m repeated sprint test, Yo-Yo intermittent recovery level Two and 2-km time trial). The activity profiles of competitive match-play were quantified using 10-Hz Global Positioning System units.**Results:** Division One players possessed greater maximum velocity, Yo-Yo level Two and 2-km time trial performances than Division Two and Three players. In addition, Division One players covered greater relative distance, and relative distances at moderate- and high-intensities during match-play than Division Two and Three players. Division Two players had better 2-km time trial performances than Division Three players. Positive associations ( $P < 0.05$ ) were found between 10 m acceleration, maximum velocity, Yo-Yo level Two and 2-km time trial performances and relative distance, and relative distances covered at moderate- and high-intensities during match-play. Moderate relationships were found between vertical jump and relative distance and high-intensity running.**Conclusions:** Sub-elite Australian football players competing at a higher level exhibit greater physical qualities and match-play activity profiles than lesser-skilled recreational players. Acceleration and maximum velocity, 2-km time trial and Yo-Yo level Two performances discriminate between players of different playing levels, and are related to physical match performance in recreational Australian football. The development of these qualities is likely to contribute to improved match performance in recreational Australian football players.

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## 1. Introduction

Investigating relationships between physical qualities and physical activity profiles of team-sport competition provides coaches with an understanding of the aspects of physical fitness that may influence match performance. Research has found significant relationships between multiple physical qualities and physical activity profiles across a number of different sports including Australian football, soccer and rugby league.<sup>1–3</sup> While the results differ from sport to sport due to the varying physical requirements, players with better-developed physical qualities have typically shown better physical activity profiles during competitive match-play.

Rampinini et al.<sup>1</sup> found significant relationships between the peak speed reached in a modified Montréal track test and total distance, high-intensity running and very high-intensity running during soccer matches. A recent of rugby league players found positive relationship between maximal aerobic power and total collisions, and prolonged high-intensity intermittent running ability and time on the field, total distance and distances covered in low- and high-speed running.<sup>3</sup> Collectively, these findings<sup>2,3</sup> demonstrate the importance of selected physical qualities to physical activity profiles in team sport athletes.

Despite some studies investigating the physical activity profiles of elite Australian football players,<sup>4–6</sup> only one has investigated the relationship between physical qualities and physical activity profiles in these athletes.<sup>7</sup> Mooney and colleagues<sup>7</sup> found that the Yo-Yo Intermittent Recovery level Two (Yo-Yo IR2) test performance was associated with the number of ball involvements

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during match-play, and was mediated by high-intensity activity performed. These findings suggest that players possessing better prolonged high-intensity running ability (as estimated from the Yo-Yo Intermittent Recovery test) have more ball possessions/disposals when they perform more high-intensity activity. To date, this is the only study to investigate the relationship between physical qualities and physical activity profiles in Australian football players, highlighting a large gap in the literature. It is unlikely that prolonged high-intensity intermittent running performance is the only physical quality related to match performance in Australian football. With the large total distances and high-intensity activity demands, coupled with the high number of maximal accelerations characteristic of Australian football,<sup>8</sup> it is likely that maximal aerobic power, repeated-sprint ability and other physical qualities may be related to match performance in Australian football players.

The nature of team sports requires athletes to perform for extended periods of time. Australian football matches are played over four 20 min quarters. With matches potentially lasting up to and beyond 100 min,<sup>4</sup> reductions in physical performance are expected. Aughey<sup>4</sup> measured the physical activity profiles of Australian football players during match-play and found reductions in both high-intensity activity and maximal accelerations later in games, with no meaningful reductions in total distance and low-intensity activity. Veale and Pearce<sup>9</sup> also found reductions in blood lactate concentration and time spent at near maximal heart rate in the second half in elite junior players during pre-season competition matches.<sup>9</sup> Both of these findings suggest that players suffer from fatigue in the latter stages of competition.

Most time-motion analyses have been conducted on athletes in professional or semi-professional competitions,<sup>5,8</sup> via clubs and sports institutes who have the expertise and necessary equipment.<sup>10</sup> However, this population comprises only a small percentage of the total participants in the sport, as the majority of players are amateurs, competing at lower levels. With this in mind, the purpose of this study was to (1) quantify the physical activity profiles and in game changes from quarter to quarter of sub-elite and recreational Australian football players competing at three different levels of competition; (2) investigate the physical qualities that discriminate sub-elite and recreational players competing in a recreational Australian football competition, and (3) determine the relationship between physical qualities and physical activity profiles of sub-elite and recreational Australian football players competing in sub-elite and recreational competitions.

## 2. Methods

Forty recreational Australian football players (mean  $\pm$  SD age, 26.6  $\pm$  4.5 years) underwent a battery of fitness tests. Each test was separated by between 48 and 120 h and conducted at the end of the pre-season training period. Players were instructed to wear football boots for testing (except for the 2-km time trial) and each session was preceded by a standardised 15 min warm-up. Global positioning system (GPS) data was collected for at least two games (mean  $\pm$  SD, 2.8  $\pm$  0.6, range = 2–4) per participant over the course of the season. A total of 28 participants were included in the GPS data analysis as a result of incomplete datasets or due to a lack of games played. Players were from three separate teams across two different leagues. Division One players ( $n = 14$ ) were sourced from a North Eastern Australian Football League club. Division Two ( $n = 10$ ) and Three ( $n = 16$ ) players were sought from the senior grade and reserve grade teams from a South East Queensland Australian Football Division Two club. Whilst training loads were not quantified in this study, Division One players trained three sessions per week,

whereas Division Two and Three players trained two sessions per week.

Australian football players are often required to perform repeated accelerations, change of direction and jumping efforts, and high velocity sprints in games.<sup>4–6</sup> As such, the tests of physical qualities used in this study were chosen due to their relevance to the sport, and also their use in other studies of Australian football players.<sup>7,11,12</sup>

Vertical jump height was assessed on a grass playing field using a Yardstick vertical jump device (Swift Performance Equipment, New South Wales, Australia). Three separate counter movement jumps (with arm swing) were performed. The best score from the three trials, separated by at least 60 s was recorded as the vertical jump height. No specific instructions were given on the speed or depth of each counter movement jump other than to jump from a standing start and to use the preferred arm for reaching. The vertical jump is considered a suitable estimate of lower limb muscular power with reasonable reliability and validity.<sup>11</sup>

Speed was assessed using a 40 m sprint test measured on a grass playing field using dual-beam electronic timing gates (Swift Performance Equipment, New South Wales, Australia). The starting gate was aligned with the participant's rear foot at 0 m, with further gates then positioned at 10, 30 and 40 m. Acceleration was calculated from the 0–10 m timing gates and the highest speed was calculated by dividing displacement over the last 10 m by the 30–40 m split time. The best of three attempts were recorded with each attempt separated by 5–10 min.

Repeated-sprint ability was assessed using a 6 m  $\times$  30 m repeated-sprint test adapted from Pyne et al.<sup>12</sup> Participants started each sprint on a 20 s cycle. Warnings were provided at 5 s followed by a verbal and visual starting cue for the subsequent sprint starting from the end of the previous sprint. The test was filmed with two high-speed digital cameras attached to tripods recording at 120 frames per second. The cameras were placed in an elevated position in line with the finish line to capture all participants crossing the finish line. Video footage was analysed using SiliconCoach Pro (Siliconcoach, Dunedin, New Zealand) to digitally identify start and finish lines. Scores were recorded as total accumulated time. The intra-class coefficient and typical error of measurement for this test have been reported as 0.96% and 1.5% respectively.<sup>13</sup>

Prolonged high-intensity intermittent running ability was assessed via the Yo-yo IR2.<sup>14,15</sup> Scores were recorded as the total distance covered at test completion. The test was performed on a grass playing field.

Time for a 2-km time trial was measured with a hand-held stopwatch. Participants completed the time trial in running shoes around the boundary line of the playing field. The distance along the boundary line was measured with a trundle wheel and participants completed the appropriate number of laps necessary to complete 2-km. The 2-km distance was selected as it was regularly performed by both clubs as part of their pre-season testing battery.

For game monitoring, each player wore a specifically designed garment containing a MinimaxX GPS unit (S4, Catapult Innovations, Melbourne, Australia) sampling at 10 Hz in a pouch on the back of each participant located between the top of the scapulae during competitive matches. Each unit was capable of recording acceleration, velocity, distance and repeated high-intensity efforts. Data were categorised into (i) velocity bands, corresponding to low-intensity activity (0–1.94 m s<sup>-1</sup>) moderate-intensity activity (1.95–4 m s<sup>-1</sup>) and high-intensity activity (>4.01 m s<sup>-1</sup>),<sup>16</sup> (ii) maximum accelerations (>2.78 m s<sup>-2</sup>)<sup>4</sup> and (iii) repeated high-intensity effort bouts.<sup>17,18</sup> A repeated high-intensity effort bout was defined as 3 or more maximal acceleration or high speed efforts with less than 21 s recovery between efforts.<sup>17,18</sup> Changes in physical activity profiles were also assessed from quarter to quarter across the duration of the match. The MinimaxX units have been shown to

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