**Physiological and anthropometric characteristics of starters and non-starters
and playing positions in elite Australian Rules football: A case study.**

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Abstract

A purpose of this study was to determine if pre-season anthropometric and physiological measures were significantly different for the players from one Australian Football League (AFL) club selected to play in the first game of the season compared to the players not selected. Another purpose was to compare fitness test results for defenders, forwards and mid-fielders in the same AFL club. Thirty-four players were tested for isolated quadriceps and hamstrings strength, leg extensor muscle strength and power, upper body strength, sprinting speed, vertical jump (VJ), endurance, skinfolds and hamstring flexibility. The starters that were selected to play the first game were a significantly older and more experienced playing group, and were significantly better ($p < 0.05$) in measures of leg power, sprinting speed and the distance covered in the Yo Yo intermittent recovery test compared to the non-starters. Although there were trends for the superiority of the starters, the differences in lower and upper body strength, VJ and predicted $\dot{V}O_2$ max were non-significant. The forwards generally produced the worst fitness scores of the playing positions with the mid-fielders having significantly lower skinfolds and the defenders possessing better hamstring strength and VJ compared to the forwards. It was concluded that some fitness qualities can differentiate between starters and non-starters, at least in one AFL club. Comparisons of playing positions and the development of fitness norms for AFL players requires further research.

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Introduction

Australian Rules football (ARF) is a fast moving sport played on a relatively large ground and places a high demand on fitness as well as technical, tactical and mental qualities. At the highest level the Australian Football League (AFL) is a professional competition, but little has been published regarding the physiological demands at this level. One way to study the physical requirements of play is via notational analysis from videotape footage provided by various computer software applications (1).

An alternative approach to evaluating the physiological demands of elite Australian football is to compare players at the highest level with players from various sub-elite populations. Such a research design has been used in soccer (2, 3), rugby league (4, 5) and American football (6, 7). In ARF, Marchant and Austin (8) compared senior AFL players with elite U-18 players on a number of fitness tests. While there were no significant differences between the groups in height, body mass, skinfolds, sprint times and vertical jump (VJ), the AFL players were superior in endurance (based on the 20 m multi-stage fitness test), as well as strength assessed by the bench press.

Care should be applied when noting significant differences between groups using this research design if the comparison of groups is made on players that are vastly different in playing ability. For example, Reilly et al. (3) compared 15-16 year old soccer players who had international experience and were aligned to a professional club with players from local and school teams. In this case differences are likely, and it may be tempting to overstate the importance of a fitness quality to achieve success at the elite level. Another research design is to compare players who are selected to participate in a team ("starters") with players that are not selected ("non-starters")

from the same squad (6). In ARF this approach was used with junior footballers aged 14-17 (9). The author reported that there were no significant differences in pre-season measures of endurance or sit and reach, but the starters were significantly taller, had superior bench press strength ($p < 0.05$) and tended to have better VJ to the non-starters ($p < 0.06$). An analysis of fitness levels of starters and non-starters at senior AFL level has not previously been reported. Further, there is little published data on fitness levels as a function of playing position in ARF. Therefore, one purpose of this study was to determine if pre-season fitness measures were significantly different for the players selected to play in the first game of the season (starters) to the players not selected (non-starters) from one AFL club. Another purpose was to compare fitness test results for defenders, forwards and mid-fielders in the same AFL club. While such data are insufficient to be considered “normative”, they may provide greater insights into the physiological demands of the modern game.

Methods

Subjects

For the comparison of starters and non-starters, the participants were 34 ARF players from the playing list of one AFL club with mean $\pm$ SD age, height and body mass of 22.7 ± 3.4 years, 1.87 ± 0.08 m and 88.0 ± 8.9 kg respectively. The average number of senior AFL games played for this group was sixty-one. For the comparison of playing positions, there were 38 players in total with a mean $\pm$ SD age, height and mass of 22.6 ± 2.9 years, 1.87 ± 0.08 m and 87.2 ± 8.5 kg respectively. The senior AFL playing experience for this group was an average of fifty-one games. The players gave informed consent as part of their club conditioning program. Written consent was provided for the isokinetic testing and verbal consent for the other tests.

Testing

Testing was conducted between January and March of the 2004 pre-season, and consisted of speed, strength, power, flexibility and endurance tests. The sum of 8 skinfolds was used to estimate subcutaneous fat. This test were conducted in accordance with the procedures reported in Norton et al. (10) and included measurements from triceps, sub-scapular, supra-iliac, mid-abdominal, biceps, axilla, front thigh and medial calf.

Leg muscle function was assessed by isokinetic dynamometry (Biodex 3, Biodex Corp.) with a seated knee extension and flexion test. A standardized warm-up was performed which consisted of 4 minutes of cycling on a stationary ergometer (2 minutes at 1.5 kp and 2 minutes at 3.0kp). This was followed by 3 sub-maximum continuous concentric knee extension/flexion contractions at 50 % of the subject's perceived maximum effort. The dynamometer was set to operate at 60 deg.s⁻¹.

Following a one minute rest, a second warm-up set of 3 repetitions was performed at 80% of maximum. These sub-maximum sets served as familiarization trials for the players who had no experience with the test. A two minute rest period was provided before the player performed the test consisting of 7 maximum effort continuous repetitions with the peak concentric torque from the quadriceps and hamstring muscle groups of both legs retained for analysis. The protocol of Brockett et al. (11) was used to analyse the torque-angle curves to determine the peak torque.

Leg extensor strength was tested with a 3 RM leg press using an inverted leg press machine (Calgym, Australia). The athlete was required to lower the weight under control to 90 degrees of knee flexion, which was measured by a manual goniometer.

Upper body pressing strength was assessed with a 3 RM bench press according to the procedures outlined in Stapff (12). The bar was gripped with the hands slightly wider than shoulder width and was slowly lowered to lightly touch the chest before being raised with no pause between the eccentric and concentric phases. While lifting, the player was required to maintain contact with the bench and ensure the feet were flat on the floor.

Upper body pulling strength was assessed by 3 RM chin-ups. In this test, additional weights were added to the body around the waist in increments of 2.5 kg until the maximum total weight (body weight plus additional weight) could be lifted only 3 times. A pronated grip was used with the hands slightly wider than shoulder width apart. The player was required to pull the body up so that the chin cleared the bar and then lower the body under control until the elbows were fully extended. No body swinging was permitted.

Leg extensor power was assessed under pure concentric contractions with a squat jump (SJ) and under stretch-shortening cycle (SSC) conditions with a countermovement jump (CMJ). For the SJ, the athlete adopted a squat position with a knee angle of 90 degrees as assessed by visual inspection, and held that position for 4 seconds before jumping for maximum height. For the CMJ, the athlete lowered the body to approximately the same position as for the SJ and immediately jumped vertically with no pause between the eccentric and concentric phases. No attempt was made to control the knee angle with the CMJ because it was felt that this would alter the technique used by the subjects.

The athlete stood on a portable force platform (Quattrojump, Kistler, Winterthur, Switzerland) while holding a light fibreglass bar on the shoulders to eliminate any arm swing. A cable extension transducer (Model PT5A-150-V62-UP-1K-C25, Celesco, Chatsworth, CA, United States) attached to the bar was used to measure vertical displacement. Data was collected and analysed using a Ballistic Measurement System (Fitness Technology, Adelaide, South Australia). The resulting vertical force and displacement data was used to measure maximum power output during the concentric phase. Both the SJ and CMJ tests were performed under unloaded conditions (no extra load) and loaded conditions by holding a 40 kg barbell on the shoulders. Three trials were allowed for each jump type with the best being retained for analysis. A drop jump (DJ) was also performed by stepping off 40cm and 80cm high boxes. The flight time and contact time ratios were calculated based on the force data and used to assess SSC function involving relatively high eccentric loading.

Sprinting speed was tested on an indoor basketball court using a 40m sprint from a standing start. The players started when they were ready and three trials were performed, with the best time being retained for analysis. Electronic timing gates fitted with dual beams (Swift Performance Equipment, Lismore, Australia) were placed at 10m and 40m and the 40m time minus 10m time was used to calculate a flying 30 m time. This allowed a measure of acceleration speed (10 m time) and an estimate of maximum speed (flying 30 m time), which are considered to be distinct sprint qualities (13). A Pearson correlation coefficient for these variables was $r=0.53$, representing a common variance of only 28%.

Vertical jumping ability was assessed by a jump with countermovement and arm swing, but no run-up. A Yardstick device (Swift Performance Equipment, Lismore, Australia) was used to record jump height to the nearest 0.01m. The best of 3 separate jumps was retained for analysis.

Endurance-related performance was assessed by two tests. The first was the 20m multi-stage fitness test (14) with the final shuttle level used to predict the $\dot{V} O_2 \text{ max}$. This test has been found to be a good predictor of $\dot{V} O_2 \text{ max}$ and 10 km running performance (15). The second test was the Yo Yo intermittent recovery test, level 2 (16). The Yo Yo test is a relatively recent test designed to be specific to the fitness demands of intermittent sports such as soccer (16). It involves 2 x 20 m runs back and forth at progressively increasing pace to exhaustion, but unlike the 20 m multi-stage test, it contains 2 x 5m jog recoveries. The test was considered valid for soccer because the test result correlated significantly with the amount of high intensity running ($>15 \text{ km.hr}^{-1}$) and the total distance covered in a game (16). Compared to aerobic power assessed by a treadmill test, it has been suggested that the Yo Yo test is more of an indicator of anaerobic qualities and recovery from intermittent high intensity exercise (16).

The flexibility of the hamstring muscle group was measured by an active knee extension test. The starting position was supine with the thigh of the measured leg vertical so that the hip joint angle was 90° as measured by a goniometer. This position was achieved by placing the axis of the goniometer over the greater trochanter and aligning each arm with the shoulder and knee joints. The 90° hip angle was maintained with the aid of a wooden frame. The test started from a 90° knee angle

which was measured with a goniometer by placing the axis over the centre of the femoral condyle with the one arm extended along the shaft of the femur towards the greater trochanter and the other arm along the line of the fibula towards the lateral malleolus. A Bubble Inclinator (Fabrication Enterprises Inc, New York) was then placed on the proximal third of the tibia. The subject then extended the knee as far as possible. The degree of knee flexion was measured from the inclinometer so that zero value indicated a fully extended knee and a smaller number indicates better flexibility. The flexibility score was recorded for both legs separately by the club physiotherapist and the best of 3 trials for each leg was retained for analysis.

For the test results of a player to be used in the comparison of starters and non-starters, the player had to be available for selection in the first game of the season at the end of March. Injured players that were unavailable for selection for the first game were excluded from the analysis. There were 34 available players, resulting in 22 selected and 12 not selected. Due to minor injuries not all players were able to participate in all tests. This meant that the sample sizes varied across all of the tests.

Players were classified into one of three playing positions by an experienced member of the coaching staff; defenders (n=13), forwards (n=9) and mid-fielders (n=16). The mid-field position included the centre line and the on-ball positions. If a player could not be clearly classified into one of these positions, he was excluded from the analysis. For the comparisons of playing positions, there were 38 players in total that participated in the pre-season testing, although four of these were subsequently not available for selection in round one of the season and were therefore not included in the starters and non-starters analysis.

Statistics

The groups were compared by one way ANOVA with significant differences accepted at a criterion alpha level of $p < 0.05$. Since the sample sizes were small for some tests, the effect size was calculated (17) and a significant and meaningful difference between the starters and non-starters was considered to occur when $p < 0.05$ and the effect size was greater than 0.8. Tukey's post-hoc analysis was used to locate significant differences between the three playing positions. Pearson correlation coefficients were also calculated to observe interrelationships between test measures.

Results

Starters vs non-starters

On average the starters were significantly ($p < 0.05$) older (24.0 ± 3.3 years) and had more AFL playing experience (90 games) compared to the non-starters (20.2 ± 2.0 years, 9 games). The mean $\pm$ SD height, mass and sum of skinfolds for the starters and non-starters were 1.86 ± 0.09 and 1.89 ± 0.06 m, 88.9 ± 8.6 and 85.9 ± 9.9 kg, 52 ± 16 and 52 ± 8 mm respectively. There were no statistically significant differences between the groups. The strength test results are shown in Table 1 and indicate no significant differences between the groups in isokinetic measures or the 3 RM tests, however there was a tendency ($p = 0.07$, $ES = 0.82$) for the starters to have superior bench press strength. Among the leg extensor power variables, the starters were significantly better in the CMJ performed with and without extra load. The speed, vertical jump and endurance test results are shown in Table 2. The starters were significantly better in the sprint tests and the Yo Yo test, but not in the VJ or predicted $\dot{V}O_2$ max.

Table 1 & 2 about here

The correlations between the measures of leg extensor power and sprinting and vertical jumping performance are shown in Table 3. Generally leg extensor power correlated significantly with maximum speed and vertical jump performance, but not with 10m time. There was also a significant correlation between the 3 RM bench press and flying 30m time ($r=-0.41$, $p<0.05$). The sum of skinfolds was significantly correlated to predicted $\dot{V} O_2 \text{ max}$ ($r=-0.50$) and Yo Yo performance ($r=-0.66$).

The hamstring flexibility scores were 13° and 18° for the starters and non-starters respectively for the left leg, which were not significantly different ($p>0.05$). However, for the right leg the starters produced a significantly better score (12°) than the non-starters (20°) ($p=0.02$, $ES=0.97$).

Table 3 about here

Comparison of positions

The mean $\pm$ SD height and mass for the defenders, forwards and mid-fielders were 1.87 ± 0.05 , 1.86 ± 0.1 , 1.88 ± 0.09 m and 87.7 ± 7.5 , 87.0 ± 10.1 , 86.8 ± 8.9 kg, respectively, and were not significantly different. The sum of skinfolds for these groups were 53.3 ± 12.1 , 59.7 ± 16.5 , 47.0 ± 7.8 mm respectively, with the mid-fielders significantly less than the forwards. The strength, power, speed, vertical jumping and endurance-related test results are shown in Tables 4 and 5. There were statistically significant differences ($p<0.05$) among the playing positions with defenders having greater right and left peak hamstring torque and vertical jump than forwards. There were almost significant differences ($p=0.06$) with the forwards having the poorest

scores on 3RM leg press, flying 30m and predicted $\dot{V} O_2$ max. There were no significant differences between the groups in the other fitness tests or hamstring flexibility.

Tables 4 & 5 about here

Discussion

The purpose of this study was to examine a range of pre-season fitness measures in elite ARF players and to compare starters versus non-starters to determine if certain physiological and anthropometric characteristics were related to successful selection. A second aim was to compare these measures across three broad playing positions.

Starters vs non-starters

The twenty-two players that were selected to play in the first game of the season were selected on the basis of their pre-season performance and perceived value to the team. The pre-season fitness test results were used primarily to monitor the fitness program and were not considered as team selection criteria.

Of the 19 variables representing fitness, the starters produced better scores on 18, with 10 of these reaching statistical significance ($p < 0.05$) and/or an ES of greater than 0.8. This tendency towards superior athleticism is probably a function of greater age, playing experience and years of exposure to physical conditioning. The main interest lies in the findings that some differences were large and statistically significant whereas others were not.

The height, body mass and skinfold values of the two groups were not significantly different, although the starters were slightly shorter and heavier. The similarity

between the groups is consistent with the findings of Marchant and Austin (8), who reported no differences between elite under-18 players and senior AFL players on these parameters. The strength and power testing revealed no significant differences in quadriceps and hamstrings strength as measured by isokinetic testing at 60 deg.s^{-1} . This may be a reflection of the fact that this test measures muscle function in isolated contractions at constant velocity, which is somewhat non-specific to the way in which these muscles function in football. This test was conducted primarily as a test of quadriceps and hamstring strength rather than as a test of sport-specific muscle function.

The starters achieved greater scores on the field tests of strength, although the differences were not statistically significant. Of the three strength tests, the bench press difference was the greatest (9.8 %) and produced a p value of 0.07 and ES of 0.82 (Table 1). This tendency for bench press strength to discriminate between higher and lower performance levels is in agreement with Keogh (9) and Marchant and Austin (8) in ARF. The mean 3RM loads lifted in the bench press can be adjusted to estimate the 1RM strength (18). The bench press strength for the starters in the present study appears to be somewhat less than the AFL average 1RM reported by Marchant and Austin (8) of 112.5 kg which may reflect the lack of emphasis on training with this exercise by the participating club.

Another way to view the role of bench press strength is to note the relationship between it and a relevant test of performance to ARF. The significant relationship between the 3 RM bench press and flying 30m time ($r=-0.41$, $p<0.05$) indicated stronger players also generally possessed better maximum speed. While the

correlation doesn't indicate cause and effect, it is possible that greater bench press strength results in a more vigorous arm drive during sprinting (19).

The starters produced better scores in all the leg extensor power tests and the differences were either statistically significant ($p < 0.05$) and/or the effect size was 0.97 or greater (Table 1). This may indicate that generally leg power is of importance to ARF. Arnason et al. (20) recently reported that leg power as measured by jump tests with no arm swing was the only fitness component from a battery of tests that was related to team success in soccer. Leg power has also been shown to discriminate between players of differing performance levels in rugby league (5) and American football (7). Further, the differences between the groups in the present study were generally larger for the DJ and CMJ tests ($ES = 1.01 - 1.26$), compared to the SJ tests ($ES = 0.97 - 1.03$) (Table 1). This suggests that SSC muscle power is relatively more important to ARF performance than pure concentric leg muscle power. This is logical since SSC contractions are more frequent in running, cutting and jumping activities found in football.

As with the bench press, we correlated the leg power variables with tests considered to be relevant to football performance (sprints and vertical jump)(1). There were no fitness test variables (including leg power) that correlated significantly with 10m time. However, with the exception of one variable (SJ power), five of the leg power variables were significantly related to flying 30m time ($r = -0.46$ to -0.57 , $p < 0.05$) and four to vertical jumping performance ($r = 0.40 - 0.57$, $p < 0.05$) (Table 3). Generally, a significant correlation between leg power measures and sprint performance is supported by the literature relating to football codes (21, 22, 23). The correlations

between the DJ tests and the sprint times indicated significant relationships with flying 30 m time ($r=-0.46$ to -0.51), but not with 10 m time ($r=-0.15$ to -0.24). This supports the notion that maximum speed is especially dependent on SSC function of the leg extensors, which has previously been described for sprinters (24).

The starters were significantly faster than the non-starters in both 10 m time and flying 30 m time (Table 2). The correlation coefficient between these variables was 0.53, representing a common variance of only 28 %. This supports previous research indicating that acceleration speed and maximum speed are distinct qualities (13, 22). The mean 10 m time of 1.86 s for the starters was similar to the 10 m time reported by Marchant and Austin (8), but slower than the 1.66 s for another AFL team in 1997 (25) and the 1.71 s reported for professional rugby league players (22). However it should be noted that comparisons between studies are made difficult by the lack of details provided on the testing protocols. The study by Marchant and Austin (8) found that senior AFL players were no faster than elite under-18 ARF players. While this may suggest that speed is not a limiting factor to ARF performance, this result was obtained in 1995-6, and a more recent report (26) indicates that AFL football has become a faster game, which may impose greater demands on sprinting speed. An analysis conducted on player movements during the 2000 AFL season indicated that players performed on average between 17-31 sprints of 6 s or less in a game, depending on playing position (1). Thus it appears that acceleration and maximum sprinting speed are both important at the professional level, at least for the AFL club tested in the present study.

There was a tendency for vertical jump (VJ) performance to be greater in the starters with a p value of 0.06 and ES = 0.75 (Table 3). Keogh (9) reported a similar finding for junior ARF players and Marchant and Austin (8) found no difference between elite juniors and seniors. The lack of clear difference between the groups may be explained by the fact that vertical jumping ability has a significant skill and coordination component, and cannot be considered as a substitute for leg power (27). The VJ requires an arm swing with a corresponding shoulder muscle contribution that is not contained in a test of leg muscle function such as the unloaded CMJ. A correlation between the VJ and unloaded CMJ of $r=0.47$ (common variance of 22 %) supports the dissimilarity between these tests. Although vertical jumping from a standing position would seem intuitively important in ARF, perhaps jumping from a run-up from either a double or single leg takeoff is more common and important. Previous research has demonstrated standing and run-up jumps for height can be somewhat independent skills (28). For example the common variance for a jump performed from a 5 stride run-up with a single leg takeoff and a standing jump from a double leg takeoff was only 46% (28).

The predicted $\dot{V} O_2$ max was obtained from the 20 m multi-stage fitness test and was similar to the 1997 data on AFL players reported by Buttifant (25); that is approximately $60 \text{ ml.kg}^{-1}.\text{min}^{-1}$. In the present study, this test did not differentiate between starters and non-starters. Keogh (9) also reported no difference between starters and non-starters in juniors, whereas Marchant and Austin (8) reported that senior AFL players were significantly better than juniors in this test. In soccer, $\dot{V} O_2$ max has been related to performance in some studies (29, 3), but not others (2, 20). Likewise in ARF, the relationship between $\dot{V} O_2$ max and performance is not clear.

The fact that there was no significant difference between starters and non-starters in the predicted $\dot{V} O_2 \text{ max}$ and there was a significant difference in the Yo Yo test suggests the latter is more related to performance in ARF. Like soccer, ARF requires high intensity running interspersed with brief recovery periods (1). Another soccer-specific test involving a combination of walking, jogging, “cruising” and sprinting was developed (2) and was found to distinguish between soccer players of different abilities, whereas the predicted $\dot{V} O_2 \text{ max}$ from the 20 m multi-stage test did not. These sport-specific tests should not necessarily be considered as replacements for a measure of $\dot{V} O_2 \text{ max}$ since they can be interpreted as tests of sport specific fitness with a significant endurance component, whereas $\dot{V} O_2 \text{ max}$ can be interpreted and used for other applications eg. training prescription. The correlation between the predicted $\dot{V} O_2 \text{ max}$ and the Yo Yo test in the present study was $r=0.56$ ($p<0.05$), representing a common variance of only 31 %. This supports the suggestion that they are assessing different and specific qualities.

The starters were better in relation to hamstring flexibility in both legs, and this difference was statistically significant for the right leg. The difference between the groups was less in the left leg, perhaps because of the greater proportion of players in the non-starting groups who were left leg dominant with regards to kicking (25% compared to 9% for the starters). It is difficult to explain the right leg difference between the groups with reference to football performance. It is possible that greater flexibility is an advantage for long kicking or for injury prevention but there is no evidence for this. It is possible that the difference is related to the greater age and therefore experience of the starters in a long term flexibility training program.

Comparison of positions

There were no significant differences between the three playing positions in height, body mass, quadriceps peak torque, upper body strength, leg extensor strength and power, sprint times, predicted $\dot{V} O_2$ max or the Yo Yo test performance (Tables 4 & 5). However there were tendencies ($p=0.06$) for differences in leg press, flying 30 m time and predicted $\dot{V} O_2$ max. Mid-fielders had significantly lower skinfolds than forwards and tended to have better predicted $\dot{V} O_2$ max and Yo Yo performance compared to forwards. This can be expected because skinfolds were significantly correlated to predicted $\dot{V} O_2$ max and Yo Yo performance. It has been shown that mid-fielders spend more game time playing with heart rates greater than 85 % maximum compared to the other positions (25). They also cover the greatest total distances in a game, consisting of over 11 km at jogging or faster running speeds (1). Therefore, it is not surprising that this playing position requires relatively good endurance and correspondingly low subcutaneous fat.

Defenders were found to possess significantly greater isokinetic hamstring strength but not quadriceps strength compared to forwards (Table 4). This is difficult to explain since hamstring muscle function would not seem to favour any one playing position over another. Further, defenders were better than forwards in the VJ. The relatively low score of < 60 cm for the forwards would seem to be a disadvantage for these players who are often required to jump in marking contests. Perhaps there is a greater demand for forwards to be good vertical jumpers following a run-up, which as mentioned earlier, is a separate skill from a standing VJ. There was no difference among groups in acceleration speed, perhaps reflecting the importance of this quality

for all playing positions. Mid-fielders tended to possess the best maximum speed, although they do not appear to perform a greater number of sprints in games (1).

Conclusion

Due to the small sample sizes in this analysis, the results are not intended to be interpreted as normative for AFL players, and the differences between playing positions as well as for starters and non-starters should be viewed with caution. This research essentially represents a case study of one AFL club. Further research involving larger group sizes is warranted, but problematic since fitness tests have not been standardised in AFL football and clubs can be reluctant to release their results to others. It is not known whether the results of this study would be similar for a different AFL club and therefore whether they can be generalized to ARF. It is possible that the results could be different for another club with a different philosophy of conditioning that places an emphasis on different fitness qualities. Nevertheless, the findings of this study suggest that in general, fitness can differentiate between players that are selected from those that are not, and provides some fitness levels that non-selected players can aspire to. At the beginning of the season, players may be selected on a variety of criteria including reputation from the previous season, pre-season playing performance, the opposing team, as well as expected ground and weather conditions. Clearly, there are many factors such as technical, tactical, psychological or cognitive aspects that contribute to performance in ARF, however fitness would seem to be a significant and trainable factor.

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Table 1. Mean $\pm$ SD strength and leg power results for starters and non-starters. The sample size is shown in brackets.

		Starters	Non-starters	P	Effect
				value	size
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Isokinetic					
Peak torque (N.m)					
Quadriceps	Right	236.3 $\pm$ 39.1 (17)	225.9 $\pm$ 19.6 (8)	0.49	0.34
	Left	235.2 $\pm$ 46.9 (17)	217.2 $\pm$ 19.1 (8)	0.31	0.50
Hamstrings	Right	127.1 $\pm$ 22.3 (17)	113.5 $\pm$ 16.2 (8)	0.14	0.70
	Left	127.3 $\pm$ 29.7 (17)	113.1 $\pm$ 16.9 (8)	0.22	0.59
3RM					
Leg press (kg)		400 $\pm$ 45 (15)	377 $\pm$ 49 (9)	0.26	0.49
Chin-ups (kg)		109.7 $\pm$ 7.8 (19)	102.2 $\pm$ 12.2 (10)	0.09	0.63
Bench press (kg)		98.8 $\pm$ 9.4 (20)	90 $\pm$ 11.8 (6)	0.07	0.82
Leg extensor power					
SJ (W/kg)		68.7 $\pm$ 6.2 (14)	63.5 $\pm$ 3.6 (5)	0.13	1.03
SJ 40 (W/kg)		58.9 $\pm$ 3.6 (14)	54.9 $\pm$ 4.6 (5)	0.06	0.97
CMJ (W/kg)		69.8 $\pm$ 7.3 (14)	60.1 $\pm$ 8.1 (5)	0.03	1.26
CMJ 40 (W/kg)		60.1 $\pm$ 4.1 (14)	54.7 $\pm$ 5.9 (5)	0.04	1.06
DJ 40 ratio		2.14 $\pm$ 0.89 (16)	1.34 $\pm$ 0.47 (6)	0.05	1.12
DJ 80 ratio		1.73 $\pm$ 0.55 (16)	1.22 $\pm$ 0.46 (6)	0.06	1.01

Table 2. Mean $\pm$ SD sprint, vertical jump, endurance and Yo Yo test results. The sample size is shown in brackets.

	Starters	Non-starters	P value	Effect size
10m time (s)	1.86 $\pm$ 0.06 (17)	1.94 $\pm$ 0.09 (10)	0.02	1.05
Flying 30m time (s)	3.46 $\pm$ 0.06 (17)	3.57 $\pm$ 0.13 (10)	0.004	1.09
Vertical Jump (cm)	62.8 $\pm$ 3.7 (17)	59.4 $\pm$ 5.2 (10)	0.06	0.75
Predicted $\dot{V} O_2$ max (ml.kg ⁻¹ .min ⁻¹)	61 $\pm$ 3.3 (16)	60 $\pm$ 3.8 (6)	0.46	0.34
Yo Yo (m)	747 $\pm$ 128 (12)	547 $\pm$ 61 (4)	0.023	1.99

Table 3. Pearson correlation coefficients for leg extensor power measures and sprinting and jumping performance.

	Flying 30 m time	10m time	Vertical jump
SJ	-0.39	-0.09	0.25
SJ 40	-0.54**	-0.18	0.56**
CMJ	-0.46*	-0.19	0.47*
CMJ 40	-0.57**	-0.20	0.57**
DJ 40 ratio	-0.46*	-0.24	0.37
DJ 80 ratio	-0.51**	-0.15	0.40*

* $p < 0.05$

** $p < 0.01$

Table 4. Mean $\pm$ SD strength and power results for player positions. The sample size is shown in brackets.

		Defenders	Forwards	Mid-fielders
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Isokinetic				
Peak torque (N.m)				
Quadriceps	Right	240.3 $\pm$ 41.2 (9)	203.8 $\pm$ 22.3 (7)	230.4 $\pm$ 30.0 (11)
	Left	237.8 $\pm$ 59.9 (9)	202.0 $\pm$ 12.4 (7)	226.9 $\pm$ 17.6 (11)
Hamstrings	Right	134.0 $\pm$ 28.8 (9) ^b	101.9 $\pm$ 8.9 (7)	121.5 $\pm$ 16.1 (11)
	Left	132.3 $\pm$ 32.7 (9) ^b	100.0 $\pm$ 20.2 (7)	121.5 $\pm$ 17.6 (11)
3RM				
Leg press (kg)*		410 $\pm$ 44 (9)	348 $\pm$ 64 (8)	399 $\pm$ 48 (9)
Chin-ups (kg)		106 $\pm$ 5 (11)	103 $\pm$ 12 (7)	109 $\pm$ 10 (14)
Bench press (kg)		98.8 $\pm$ 8.4 (10)	93.0 $\pm$ 10.4 (5)	97.9 $\pm$ 11.9 (12)
Leg extensor power				
SJ (W/kg)		68.1 $\pm$ 7.1 (7)	70.5 $\pm$ 7.4 (4)	68.3 $\pm$ 6.2 (7)
SJ 40 (W/kg)		58.0 $\pm$ 4.0 (7)	60.4 $\pm$ 5.0 (4)	56.9 $\pm$ 2.8 (7)
CMJ (W/kg)		69.1 $\pm$ 7.8 (7)	65.1 $\pm$ 9.4 (4)	70.2 $\pm$ 8.8 (7)
CMJ 40 (W/kg)		58.7 $\pm$ 4.8 (7)	60.1 $\pm$ 6.1 (4)	58.2 $\pm$ 4.0 (7)
DJ 40 ratio		2.5 $\pm$ 0.9 (8)	2.0 $\pm$ 0.9 (5)	1.6 $\pm$ 0.6 (8)
DJ 80 ratio		1.9 $\pm$ 0.4 (8)	1.8 $\pm$ 0.8 (5)	1.4 $\pm$ 0.5 (8)

^b Defenders significantly greater than forwards (p<0.05).

* p=0.06 Defenders compared to forwards

Table 5. Mean $\pm$ SD sprint, vertical jump, endurance and Yo Yo test results for player positions. The sample size is shown in brackets.

	Defenders	Forwards	Mid-fielders
10m time (s)	1.88 $\pm$ 0.07 (11)	1.93 $\pm$ 0.1 (8)	1.90 $\pm$ 0.06 (11)
Flying 30m time (s)*	3.49 $\pm$ 0.06 (11)	3.60 $\pm$ 0.15 (8)	3.48 $\pm$ 0.11 (11)
Vertical jump (cm)	63.4 $\pm$ 2.4 (11) ^b	58.4 $\pm$ 5.1 (7)	62.3 $\pm$ 3.7 (11)
Predicted $\dot{V} O_2$ max (ml.kg ⁻¹ .min ⁻¹)*	61.1 $\pm$ 3.5 (8)	57.8 $\pm$ 2.4 (7)	61.6 $\pm$ 3.5 (10)
Yo Yo (m)	743 $\pm$ 142 (7)	656 $\pm$ 128 (5)	747 $\pm$ 123 (6)

^b Defenders significantly greater than forwards (p<0.05)

* p=0.06 Defenders compared to mid-fielders