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Original research

Annual improvement in fitness test performance for elite junior Australian football cohorts

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ABSTRACT

Objectives: The study examined the change in fitness test performance of elite junior Australian football cohorts tested over the span of seven years.
Design: Annual cross-sectional observation study.
Methods: A total of 1714 elite junior male Australian football players were eligible for the study and completed annual late pre-season fitness testing between 2009 and 2015. The testing comprised anthropometric (height, mass, and skinfolds) and performance tests (standing vertical jump, left and right foot running vertical jumps, 5- and 20-m sprinting, agility, and shuttle run test). A linear regression analysed the performance change for each test over time for two analyses: (1) the entire cohort, and (2) a stratified analysis of 'high' (top 20% of players) and 'low' (bottom 20% of players) performers for each performance test.
Results: There was a moderate ($f^2 = 0.20$) improvement in the standing vertical jump for the entire cohort. Small ($f^2 \geq 0.03$) changes occurred for the right and left foot running vertical jumps, agility, and shuttle run, whilst trivial/small ($f^2 \leq 0.02$) changes were observed for skinfolds, 5- and 20-m sprinting for the entire cohort. The most notable difference in the stratified analysis was that the 'low' performance groups had a greater improvement in the shuttle run, and 5- and 20-m sprinting.
Conclusions: Findings indicate a small overall annual improvement in fitness test performance of elite junior cohorts over time that seems to permeate through both 'high' and 'low' performers for most tests. The results might suggest an increase in the professionalism of players and junior developmental pathways.

1. Introduction

The professional Australian Football League (AFL) is the pinnacle Australian football (AF) competition. Prospective players are most often drafted from high school between the ages of 17–20 y from elite junior clubs competing in state-based Under 18 (years) competitions. The continued rise in professionalism of AF at the elite senior level has contributed to a widening gap between the playing demands of junior and senior competition.[1] Burgess, Naughton, and Norton[1] demonstrated that senior AFL matches are distinguished by players covering more distance per min (134 vs 119 m/min), higher percentage of time spent sprinting (6.2 vs 3.8%), and a faster game speed (4.14 vs 3.28 m/s; as indicated by ball speed) than elite junior (Under 18) matches in 2009. The authors observed that the aforementioned variables increased between 2003 and 2009 to a greater extent in the senior competition.[1] This demonstrates a widening gap between the physical match demands of the senior and junior level, highlighting the rapid increase in game demands and professionalism at the elite senior level.[1]

Junior AF players undertake a battery of fitness tests for the purpose of evaluating their physical capacity prior to being drafted. These tests, namely the 20-m sprint, vertical jump, agility, and endurance shuttle run test have a small but important positive association with the career progression of AFL players.[2,3] The tests have somewhat potential to distinguish draft status,[2,4] and junior player selection and quality.[5–7] In unison with match physical performance data,[1,3] these tests may provide an indication of the readiness of junior players for the transition into the elite senior competition that is characterised by a faster game speed[1] and higher injury incidence.[8,9] It might be expected that the fitness capacity of junior cohorts improve over time in response to the recent substantial increases in the physical requirements at the

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elite senior level. Otherwise, players may be underprepared to tolerate higher-intensity competition at the senior level.[1]

Little research has been undertaken to assess the change in fitness of AF players over time. Pyne et al.[10] monitored the change in six cohorts of elite junior AF players (total of 495 players) attending the national AFL draft meeting between 1999 and 2004. The authors observed a 'moderate' change in height and a 'small' change in 20-m sprint over the time period.[10] It is important to recognize that 'small' statistical changes may still present some practical value. The study by Pyne et al.[10] occurred during an era when game speed was similar between elite junior and senior matches.[1] Therefore, examination of the recent fitness test performance of large elite junior cohorts is warranted at a time in which there is an acceleration in movement activity during senior matches, the greatest demand for new players in the AFL, and debate concerning the physical readiness of players in relation to the minimum draft age.[11]

The primary aim of the current study was to examine the change in performance for each fitness test performed by annual elite junior cohorts tested in the late pre-season phase between 2009 and 2015. It was hypothesised that a small linear increase in physical fitness test (vertical jump, sprinting, agility, and endurance) scores would occur during the study period as a consequence of greater selection pressure generated by the substantial increases in the physical requirements at the elite senior level. The secondary aim was examine a sub-group stratified analysis of 'high' and 'low' performers to identify whether certain sub-groups of players are changing over time.

2. Methods

Each South Australian National Football League (SANFL) Under 18 club ($n=9$ [2009–2014], $n=8$ [2015]) was invited to supply approximately 50 male players on a yearly basis for fitness testing. Players were eligible to attend testing on multiple years. A total of 2565 physical performance assessments were undertaken, including players who were tested on multiple occasions. Only the most senior year (oldest age) of results were included if a player completed yearly testing on multiple occasions, therefore, 1714 assessments were eligible for the study. An athlete was included if they completed at least one physical fitness test (vertical jump, sprint, agility, or multi-stage shuttle run) at a meeting between 2009 and 2015. The study was approved by the University of South Australia Human Ethics Committee.

The yearly testing was conducted in an indoor gymnasium during the late pre-season phase (February). All data were mined and not directly collected by the research team. Representatives from the SANFL and South Australian Sport Institute collected the testing and reliability data (Intraclass correlation coefficient [ICC]; reliability data for the agility and shuttle run test were not available) during the study period. Warm-up activities were organised by the fitness staff of each individual team. Players were assigned into groups for a circuit of testing, therefore, tests were completed in varying order for different players. Mass (ICC 0.991) and height (ICC 0.967) were recorded to the nearest 0.1 kg and 0.1 cm, respectively. The sum of seven skinfolds (ICC 0.997) was calculated according to the International Society for the Advancement of Kinanthropometry,[12] using the triceps, biceps, subscapular, supraspinale, abdominal, medial calf, and front thigh sites. Measurements were recorded to the nearest 0.1 mm. Vertical jump height was measured using a 'jump and reach' technique from both standing (ICC 0.879), and running jumps (within 5 m) from the left (ICC 0.930) and right (ICC 0.862) foot. The jump height was measured to the closest 1 cm using a Vertec yardstick device (Swift performance equipment, New South Wales, Australia). Players were allowed three attempts at each jump and the best score was recorded as the final result. Acceleration from a stationary start was tested over both 5- (ICC 0.617) and 20-m (ICC 0.780) distances. A dual beam electronic timing system (Swift performance equipment, New South Wales, Australia) monitored players to the closest 0.01 s. Players were allowed three attempts, with the best score recorded. Planned agility was tested using the 'AFL agility test', a test that consists of a series of five pre-planned changes of direction that are each greater than 90° and marked by a flexible pole.[2] Players began from a stationary start and performance was measured to the closest 0.01 s using a dual beam electronic timing system (Swift performance equipment, New South Wales, Australia). Players were allowed three attempts, with the best score recorded. The rest periods between each attempt during the vertical jumping, sprinting, and agility tests were determined by the administrator of each testing station. Aerobic endurance was measured using the 20-m multi stage shuttle run test.[2] Players were allowed one attempt at the test and the final number of shuttles was recorded as the score.

The process of retaining only the results from a player's most senior year of participation created a bias for older players during the first six years of data collection, and for a much larger sample size during the final year of data collection (2015). Therefore, players aged ≤15 were removed from the 2015 database. Means and standard deviations are reported for all fitness test results. Data were organised into two analyses: (1) the entire cohort, and (2) a sub-group stratified analysis of 'high' (top 20% of players; i.e. highest vertical jump height and shuttle run scores, and fastest sprinting and agility times) and 'low' (bottom 20% of players; i.e. lowest vertical jump height and shuttle run scores, and slowest sprinting and agility times) performers on physical performance tests for each yearly testing period. The results from each performance test were independently divided into these sub-groups. A linear regression analysed the change in fitness test results for the entire cohort, and 'high' and 'low' performance groups over the course of the seven years. A group × time interaction compared the change in 'high' and 'low' performance groups for each test. The annual coefficient (coef) of change is reported in the raw measurement units and as a percentage. The percentage change was determined by dividing the coefficient of change (as determined by the linear regression) of each fitness test by the mean score from the first year (2009) of results. It was determined that the data did not need to be transformed for the variables that were not normally distributed due to the large study sample size. Effect sizes were determined using Cohen's f^2, using the descriptive terms of 'small' ($f^2=0.02$), 'medium (moderate)' ($f^2=0.15$), and 'large' ($f^2=0.35$). The interpretation of results was primarily based upon the effect size outcomes due to the biased effect of a large sample size on the probability of statistical significance. Effect sizes describing the change in performance tests are not compared between the entire cohort and sub-group analyses because the homogeneity and low variability of the stratified sub-group data influences the determination and comparison of effect sizes. Statistical significance was set at $p<0.05$ and 95% confidence intervals are reported.

3. Results

First, the change in the entire cohort was examined. The yearly scores for each fitness test are detailed in Table 1. Height (coef: 0.12 [−0.05 to 0.28]; 0.1%; $p=0.159$; $f^2=0.00$) and mass (coef: −0.11 [−0.31 to 0.08]; 0.1%; $p=0.261$; $f^2=0.00$) did not change over the study period. The sum of seven skinfolds had a small decrease over the seven years (coef: −1.20 [−1.58 to −0.83]; 2.0%; $p<0.001$; $f^2=0.02$). There was a moderate improvement in the standing vertical jump (coef: 1.35 [1.20–1.49]; 2.3%; $p<0.001$;