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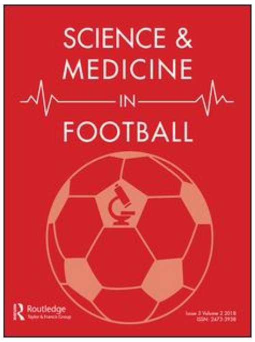

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Sprint acceleration force-velocity-power characteristics in drafted vs non-drafted junior Australian football players: Preliminary results

Running Title: Horizontal Force-Velocity-Power Profiles of Elite Junior AF players

Submission Type: Short Communication

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ABSTRACT

This investigation aimed to compare the maximal sprint acceleration profiles of drafted and non-drafted elite junior Australian football (AF) players. Nineteen players (10 drafted and 9 non-drafted) from an elite junior AF state team participated in this study. Instantaneous velocity was measured via radar gun during maximal 30 m sprints. The velocity-time data were analysed to derive individual force-velocity-power characteristics and sprint times. No significant differences existed between groups, however drafted players reached moderately faster maximum velocity (Hedges' g = 0.70 [-0.08; 1.48] and theoretical maximum velocity (g = 0.65 [-0.13; 1.42]) than non-drafted players indicating a superior ability to apply higher amounts of force at increasing sprinting velocity. Further, drafted players produced moderately higher absolute theoretical maximum force (g = 0.72 [-0.06; 1.50]) and absolute maximum power (g = 0.83 [0.04; 1.62]) which reflects their moderately higher body mass (g = 0.61[-0.16;1.38]). Although not significant, in this sample of elite junior AF players, those drafted into the AFL displayed greater absolute sprint acceleration characteristics and maximal velocity capabilities than their non-drafted counterparts (moderate effect size). Whether force-velocity-power characteristics can be more beneficial in differentiating sprint performance of elite junior Australian footballers compared to the traditional sprint time approach warrants further investigation with a larger sample size.

Keywords: talent identification, kinetics, kinematics, youth, profiling

INTRODUCTION

Talent identification and selection in professional sports is a multi-million dollar business as teams aim to identify and select talented athletes with the best potential for success [1]. The Australian Football League (AFL) holds an annual draft combine that provides an opportunity for standardised testing of physical, psychological, medical, and skill-based activities for highly rated draft prospects from all states and territories. Draft combine testing data assists the AFL talent scouts in their decision-making process when choosing which players to draft.

At the AFL draft combine, a player's sprinting ability is assessed using a maximal 20 m sprint with sprint times at 5 m, 10 m, and 20 m [1, 2]. Previously, researchers have identified that superior sprint performance at the draft combine over all 3 distances was associated with increased likelihood for draft selection into the AFL and playing more games within a 5 year period [1, 3], highlighting the importance of sprinting ability. However, maximal sprint velocity occurs between 20 – 40 metres in team sport athletes [4]. Therefore, a limitation of the 20 m sprint test conducted at the AFL draft combine is that it only measures a player's acceleration capacity [5]. Whilst acceleration over shorter distances and times occur more frequently in competition, the assessment and prescription of maximum velocity sprinting should not be ignored as acceleration and maximum velocity capacities are independent attributes that contribute to overall sprinting performance [6] and should be considered in respect to talent identification and selection. Secondly, measuring sprinting performance through sprint times only provides the performance outcome of the sprint and not the underlying mechanistic factors that contribute to the sprint. Recently, a practical approach using radar gun technology was developed to further understand the mechanistic factors that reflect the neuromuscular system's ability to apply force and power during maximal sprint acceleration [7]. Specifically, this macroscopic approach is known as "sprint acceleration profiling" uses inverse dynamics to estimate the step-averaged ground reaction force during a maximal sprint acceleration using only spatiotemporal and anthropometric data [7].

Whilst previous research has shown that faster sprint times can increase the likelihood of AFL draft selection [1, 8] no previous research has investigated whether sprint acceleration characteristics differ between drafted and non-drafted players. Identifying these characteristics can provide talent scouts a more thorough assessment of an individual's sprinting capacities and can guide coaches individual training prescription when attempting to improve sprinting performance [9]. Therefore, this study aimed to identify differences in sprint acceleration force-velocity-power characteristics between drafted and non-drafted elite junior Australian football (AF) players using a macroscopic approach of sprint acceleration profiling.

METHODS

Design

This investigation was a cross sectional analysis of elite junior AF players representing their state at the AFL Under 18 National Championships. Sprint performance data was collected on a single occasion during the season as part of the training schedule set by the West Australian State Under 18 AF academy, twelve days since their last competitive game and 24 hours after their last training session. Subjects had to be a member of the West Australian State Under 18 AF academy and be free from injury or illness in order to participate in the study. Testing occurred on an outdoor grassed surface with the participants wearing their normal football boots.

Subjects

19 elite junior male AF players were recruited from a State talent program competing at the AFL Under 18 National Championships. Following the 2019 National Draft, 10 players were drafted into the AFL, whilst 9 players were not drafted. All participating athletes were free from any musculoskeletal or neuromuscular injuries that would have affected their ability to perform the required test. This research was approved by the Human Research Ethics Committee at The University of Notre Dame Australia, Fremantle Campus.

Procedures

After a standardised warmup that included low intensity running and plyometrics, joint mobility exercises, and athletic drills each athlete performed two maximal 30 m sprint accelerations from a two-point stance based on the AFL National Draft Combine testing protocols. Verbal encouragement and instantaneous feedback of recorded maximum speed was provided to each player facilitating competition amongst players. A Stalker Acceleration Testing System II radar device (Applied Concepts, Dallas, TX, USA) was positioned 10 m behind the starting line on a tripod 1 m above the ground corresponding approximately to the participant's centre of mass and was used to record instantaneous velocity-time data of each trial.

The raw instantaneous velocity-time data was collected and manually processed in a commercially available software package (STATS; Stalker ATS II Version 5.0.2.1; Applied Concepts, Dallas, TX, USA) according to the procedures of Simperingham et al. [10] by: (a) deleting all data prior to the start and after the finish of each sprint; (b) naming all trials to be 'acceleration runs' forcing the start of the velocity-time curve through the zero point; and (c) removal of high and low data points on the velocity-time curve likely caused by segmental movements while sprinting. The processed data file for each sprint acceleration was used to derive all sprint times (5m, 10m, 15m, 20m, 25m, 30m) and sprint acceleration force-velocity-power characteristics including maximum theoretical force (F0), maximal theoretical velocity (V0), maximal power (Pmax), maximal ratio of force (RFmax), decrease in the ratio of force (Drf) and the slope of the force-velocity relationship (Sfv) in a custom-made Microsoft Excel spreadsheet, consistent with procedures developed by Samozino et al. [7].

All sprint acceleration characteristics have been shown to produce acceptable intra-day and inter-day reliability (CV < 10%) in similar aged and competition level rugby union players [10]. Further, the average of all sprint acceleration characteristics and sprint times of the two maximal sprint trials from each participant was used for statistical analysis based on recommendations of Simperingham et al. [10] to reduce measurement variability.

Statistical Analysis

Mean and standard deviations (SD) of all athlete characteristics, force-velocity-power sprint characteristics, and sprint times were calculated for the drafted and non-drafted groups. A Shapiro-Wilk test of normality confirmed all variables were normally distributed. An independent samples t-test and Hedge's g effect sizes (90% confidence intervals) was used to identify if any significant differences in force-velocity-power characteristics and sprint times existed between the drafted and non-drafted groups with statistical significance set at $p < 0.05$. Effect size values of 0.2, 0.6, 1.2, 2.0, and 4.0 were used to represent trivial, small, moderate, large, very large, and extremely large effects, respectively [11].

****** INSERT TABLE 1 HERE ******

RESULTS

Means and standard deviations for all athlete characteristics, sprint acceleration variables and sprint times are outlined in Table 1. There were significant moderate differences in height (g = -0.93) between drafted and non-drafted players with drafted players being younger than their counterparts. Moderate and trivial non-significant differences were found in body mass (g = 0.61) and height (g = 0.16) between groups (Table 1).

There were no significant differences in any sprint acceleration variables between drafted and non-drafted players. However, moderate effect size differences were found in absolute F_0 (g = 0.72), absolute P_{max} (g = 0.83), and V_0 (g = 0.65). Small effects were also detected in relative P_{max} (g = 0.30), absolute S_{fv} (g = -0.56), and RF_{max} (g = 0.29) whilst all other differences in sprint acceleration variables were trivial (Table 1).

There were no significant differences in sprint times or V_{max} between drafted and non-drafted players. However, there were moderate effect size differences in V_{max} (g = 0.70) with drafted players faster than non-drafted players. Small effect size differences were found between groups for all sprint times, increasing from shorter to longer distances (5 – 30m; g = 0.25 to 0.52) (Table 1).

DISCUSSION

To our knowledge this is the first study to examine the force-velocity-power profiles of maximal sprint acceleration in elite junior AF players and compare between players drafted and non-drafted to the professional AFL. Whilst no clear differences in any variables existed between drafted and non-drafted players, moderate effect size differences suggest that drafted players were younger (g = -0.93 [-1.73; -0.14], p = 0.05), heavier in body mass (g = 0.61 [-0.16; 1.38], p = 0.18), produced higher absolute F_0 (g = 0.72 [-0.06; 1.50], p = 0.12) and P_{max} (g = 0.83 [0.04; 1.62], p = 0.08), and had greater maximum velocity capabilities with higher V0 (g = 0.65 [-0.13; 1.42], p = 0.16) and Vmax (g = 0.70 [-0.08; 1.48], p = 0.13) than non-drafted players.

Studies measuring sprint performance in AF have typically used dual beamed timing gates at set distances of 5 to 20 m [2, 3]. The current study included additional longer sprint distances of 25 and 30 m to ensure players reached maximal velocity that allowed acceleration and maximum velocity capacities to be assessed. Importantly, whilst the current study did not find any clear differences in sprint acceleration force-velocity-power characteristics between drafted and non-drafted players, moderate effect sizes existed in several variables. Given the sprint performances (sprint times) were similar between groups, the moderately higher absolute F_0 and absolute P_{max} in drafted players reflects the moderate differences in body mass. The trivial, small, and moderate effect size differences in relative F_0, relative P_{max}, and V_0 respectively, suggest that drafted and non-drafted players have similar ability to apply relative force during the early acceleration phase however drafted players have a greater ability to apply higher amounts force at increasing sprinting velocities. Together, these results suggests that heavier athletes that can produce higher absolute and similar relative accelerative capacities will possess a higher momentum (P = m x v) than lighter athletes which may provide them an advantage in contested passages and situations in games [12].

Another important finding of the current study that aligns with previous research using timing gates [1, 8] was that effect size differences in sprint times increased from shorter to longer distances (g: 0.25 – 0.52; p: 0.25 – 0.58) with drafted players faster than non-drafted players. Drafted players also produced moderately faster V_{max} than non-drafted players. Both findings are likely due to drafted player's greater ability to apply higher amounts force at increasing sprinting velocities, subsequently resulting in higher relative P_{max}.

It is important to note the limitations of this study and their implications when interpreting the results of this study, specifically the small sample size and timing of the sprint acceleration testing. Firstly, all participants were recruited from one State talent academy and it was not feasible to include more elite junior AF players from other State talent academies. The small sample size (10 drafted, 9 non-drafted) has likely influenced statistical significance and effect size confidence intervals of the between group analysis resulting in uncertainty. Secondly, although the timing of sprint acceleration testing post the last training exposure (24 hours) may have impacted on sprint performance, we do not believe this impacted the data as showcased by a similar research design [13]. Controlling for previous training load, recovery and fatigue, and increasing the sample size might yield more significant findings and should be considered for future research.

CONCLUSION & FUTURE DIRECTION

Drafted players did not show any significant differences in any sprint acceleration force-velocity-power characteristics. However, moderate effect size differences existed between drafted and non-drafted elite junior AF players in absolute F_0, absolute P_{max}, V_0 and V_{max} suggesting that drafted players produce higher amounts of relative force at increasing sprinting velocity compared to their non-drafted counterparts. Given that only small, non-significant difference in sprint performance (sprint times) existed between groups the higher absolute F_0 and absolute P_{max} reflects the moderately higher body mass observed in drafted players. In summary, players drafted into the AFL displayed greater absolute sprint acceleration characteristics and maximal velocity capabilities than their non-drafted counterparts (moderate effect size). Whether sprint acceleration force-velocity-power characteristics can be more beneficial for practitioners to differentiate between drafted and non-drafted players compared to the traditional sprint time approach warrants further investigation with a larger sample size.

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	Drafted	Non-Drafted	Hedges' g (90% CI)	p value
Athlete Characteristics				

List of Tables and Figures:

Age (y)	17.4 ± 0.5	18.0 ± 0.7	-0.93 (-1.73; -0.14)	0.05
Height (cm)	185.9 ± 6.6	184.3 ± 11.5	0.16 (-0.60; 0.92)	0.72
Mass (kg)	80.2 ± 8.1	74.2 ± 10.5	0.61 (-0.16; 1.38)	0.18
Force-Velocity-Power Characteristics				
Absolute F_0 (N)	644.8 ± 92.6	585.7 ± 58.6	0.72 (-0.06; 1.50)	0.12
Relative F_0 (N/kg)	8.03 ± 0.67	7.96 ± 0.74	0.09 (-0.66; 0.85)	0.83
Absolute P_{max} (W)	1446.3 ± 222.0	1286.2 ± 128.1	0.83 (0.04; 1.62)	0.08
Relative P_{max} (W/kg)	18.0 ± 1.7	17.5 ± 1.6	0.30 (-0.46; 1.06)	0.50
V_0 (m/s)	8.97 ± 0.17	8.79 ± 0.33	0.65 (-0.13; 1.42)	0.16
Absolute S_{fv}	-71.9 ± 9.8	-66.8 ± 7.5	-0.56 (-1.33; 0.21)	0.22
Relative S_{fv}	-0.90 ± 0.07	-0.91 ± 0.10	0.14 (-0.62; 0.89)	0.76
RF_{max} (%)	45.7 ± 1.7	45.1 ± 1.9	0.29 (-0.47; 1.05)	0.51
D_{RF} (%)	-8.24 ± 0.56	-8.38 ± 0.91	0.18 (-0.57; 0.95)	0.68
Maximum Velocity (V_{max}) and Sprint Times				
5 m (s)	1.32 ± 0.05	1.33 ± 0.05	0.25 (-0.51; 1.01)	0.58
10 m (s)	2.06 ± 0.06	2.08 ± 0.07	0.30 (-0.46; 1.06)	0.50
15 m (s)	2.71 ± 0.08	2.74 ± 0.09	0.37 (-0.39; 1.14)	0.41
20 m (s)	3.33 ± 0.09	3.37 ± 0.10	0.43 (-0.34; 1.19)	0.34
25 m (s)	3.93 ± 0.10	3.99 ± 0.11	0.47 (-0.29; 1.24)	0.30
30 m (s)	4.53 ± 0.11	4.59 ± 0.12	0.52 (-0.25; 1.29)	0.25
V_{max} (m/s)	8.45 ± 0.17	8.29 ± 0.26	0.70 (-0.08; 1.48)	0.13

Table 1. Comparison of maximal sprint acceleration force–velocity-power profiles between drafted and non-drafted elite junior Australian football players