The Influence of Age, Playing Position, Anthropometry and Fitness on Career Attainment Outcomes in Rugby League

Running Head: Influences of Career Attainment in Rugby League

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Abstract

This study evaluated the influence of annual-age category, relative age, playing position, anthropometry and fitness on the career attainment outcomes of junior rugby league players originally selected to a talent identification and development (TID) programme. Junior rugby league players (*N*=580) were grouped retrospectively according to their career attainment level (i.e., amateur, academy and professional). Anthropometric (height, sitting height, body mass, sum of four skinfolds), maturational (age at peak height velocity) and fitness (power, speed, change of direction speed, estimated $\dot{V}O_{2max}$) characteristics were assessed at the Under 13s, 14s and 15s annual-age categories. Relative age (Q2=8.5% vs. Q4=25.5%) and playing position (Pivots=19.5% vs. Props=5.8%) influenced the percentage of players attaining professional status. Anthropometry and fitness had a significant effect on career attainment at the Under 14 (p=0.002, η^2=0.16) and 15 (p=0.01, η^2=0.12) annual-age categories. Findings at the Under 14s showed future professional players were significantly later maturing compared to academy and amateur players. Findings suggest that relative age, playing position, anthropometry and fitness can influence the career attainment of junior rugby league players. TID programmes within rugby league, and other related team sports, should be aware and acknowledge the factors influencing long-term career attainment, and not delimit development opportunities during early adolescence.

Introduction

In youth sport, national governing bodies and professional clubs utilise talent identification and development (TID) programmes in the hope of identifying and nurturing future professional players (Cobley, Baker & Schorer, 2012; Williams & Reilly, 2000). Most TID research to date, has compared adolescent players of differing standards (e.g., elite vs non-elite handball players; Mohamed et al., 2009) to identify important characteristics for performance. A common problem with TID research (and practice) is that it assumes that an individual's current performance during adolescent stages can help predict future performance and subsequent success in adulthood (Vaeyens, Lenoir, Williams, & Philippaerts, 2008). However, limited research is available (Le Gall, Carling, Williams & Reilly; Till et al., 2014a) that tracks the career progression of players selected to a TID programme during adolescence into adult professional sport. Therefore, understanding the factors associated with future success would seem valuable to improve TID practices within youth sport.

Rugby League is a collision sport played worldwide from local recreation to professional levels across a range of junior to senior age groups (Johnston, Gabbett & Jenkins, 2014). The game requires players to perform frequent bouts of high-intensity activities (e.g., tackling, ball carrying) separated by periods of low-intensity activity (e.g., repositioning; Gabbett, King & Jenkins, 2008; Johnston et al., 2014). Due to the physically demanding nature of rugby league, players are required to have highly developed physiological capacities of muscular strength, power, speed, agility and endurance alongside increased lean mass (Gabbett & Seibold, 2013; Johnston et al., 2014). Like many sports, TID research within rugby league has predominantly compared the abilities of players of differing playing levels (i.e., elite vs. sub-elite), showing anthropometric and fitness characteristics increase with playing level within junior players (Gabbett, 2009; Gabbett, Jenkins & Abernethy, 2010; Till et al., 2011). In addition, further research (Till, Cobley, O'Hara, Chapman & Cooke, 2010a; Till, Cobley, O'Hara, Chapman & Cooke, 2010b; Till, Cobley, O'Hara, Chapman & Cooke, 2014b) has also suggested that there are a number of independent factors (i.e., annual-age category, relative age, maturation and playing position) that influence the selection of players to TID programmes within youth rugby.

Recently, a research study in rugby league (Till et al., 2014a) retrospectively examined the long-term career progression of players selected to the United Kingdom's Rugby Football League's (RFL's) TID programme (the Player Performance Pathway; PPP; see Till, Chapman, Cobley, O'Hara & Cooke, 2012; for more information) between 13 and 15 years of age. Specifically, this research investigated whether players selected to the PPP ultimately went on to play at the amateur, academy, or professional level. Findings demonstrated that 57.1% and 12.1% of players selected successfully progressed to academy and professional levels, respectively. In addition, it was found that sum of four skinfolds and advanced fitness characteristics (i.e., vertical jump, speed, agility and estimated $\dot{V}O_{2max}$) at 13-15 years contributed to long-term career progression. Although, this study began to explore the long-term career outcomes using longitudinal tracking of junior rugby league players, a number of factors (i.e., annual-age category, relative age and playing position) were not considered but warrant further investigation into whether and how these factors may impact upon long-term career attainment and influence TID processes during adolescent ages.

Therefore, the aims of the current study were considered in two parts. Part 1, aimed to evaluate the influence of annual-age category, relative age and playing position on the long-term career attainment (i.e., amateur, academy and professional) of junior rugby league players originally selected to the PPP. Part 2 aimed to investigate whether differences in anthropometric and fitness characteristics in junior rugby league players according to annual-age category (i.e., Under 13s, 14s & 15s) affected career attainment outcomes.

Methods

Participants

A total of 580 junior rugby league players selected to the RFL's PPP between 2005 and 2007 at the Under 13 (*n*=95), 14 (*n*=195) and 15 (*n*=290) annual-age categories were longitudinally tracked in July 2008 and August 2014. By 2008, players selected to the PPP were either: (a) no longer participating in rugby league; (b) continued to play amateur rugby league; or (c) were selected to join a professional rugby league club's academy. By 2014, players were then potentially able to progress into playing professional rugby league within the European Super League through continued involvement within an academy programme. So, consistent with prior investigations (Till et al., 2014a), players were divided into three long-term career attainment outcomes for comparison, (1) not selected to an academy squad and classed as 'amateur'; (2) selected to a professional 'academy' but did not play Super League, and (3) played 'professional' Super League rugby league. Players were identified as professional if they had played 5 or more Super League games.

Procedures

All players selected to the original PPP undertook annual anthropometric and fitness assessments in July each year, with all protocols receiving institutional ethics approval and assent/consent provided by players and parents/guardians. The protocol included standard anthropometry (height, sitting height, body mass, sum of 4 skinfolds), maturation (age at peak height velocity; PHV) and fitness (lower and upper body power, speed, change of direction speed, estimated $\dot{V}O_{2max}$) assessments. Intra-class correlation coefficients and typical error measurements for each measure are presented in previous research (Till et al., 2010a; 2011) and all measurement reliability conformed to published expectations (Hopkins, 2000). In addition, to answer the research question, the relative age and playing position of each player was collected.

Relative Age

To determine relative age, player's birth-dates were coded to reflect their birth quartile (Q) in accordance to dates used by the RFL for creating annual-age groups. September 1st was the annual cut-off date and players were categorized into quartiles (Q) commensurate with prior research (Cobley, Baker, Wattie & McKenna, 2009; Sherar, Baxter-Jones, Faulkner & Russell, 2007). That is, Quartile 1 (Q1) = birth dates between September and November; Q2 = December–February; Q3 = March–May; and, Q4 = June–August.

Playing Position

Playing position was classified into four sub-groups, as used in previous research (Till et al., 2010a). These were 'Outside-Backs' (Fullback, Wing, Centre; *n*=184), 'Pivots' (Stand-Off, Scrum-Half, Hooker; n=149), 'Props' (n=104), and 'Backrow' (Second-Row, Loose-Forward; n=143).

Anthropometry & Maturation

Anthropometric characteristics were collected in the morning in a fasted state with participants wearing only shorts. Height and sitting height were measured to the nearest 0.1cm using a Seca Alpha stadiometer (Seca, Birmingham, UK). Body mass was measured to the nearest 0.1kg using calibrated Seca alpha (model 770, Seca, Birmingham, UK) scales. The sum of four skinfold thickness was determined using calibrated Harpenden skinfold callipers (British Indicators, West Sussex, UK) with procedures in accordance with Hawes & Martin (2001). To measure maturity status, an age at PHV prediction equation was used (Mirwald, Baxter-Jones, Bailey & Beunen, 2002). Years from PHV was calculated for each participant by subtracting age at PHV from chronological age.

Fitness

A standardized warm up was conducted prior to fitness testing with tests performed in the following order. Speed was assessed at 10 m, 20 m, 30 m and 60 m using timing gates

(Brower Timing Systems, IR Emit, USA). The shortest time recorded to the nearest 0.01s during three trials, separated by 3 minutes rest, was used. Change of direction speed was assessed using the agility 505 test (Gabbett & Herzig, 2004). Participants were positioned 15 m from a turning point with timing gates positioned 10 m from the start point. Players accelerated from the starting point, through the timing gates, turned on the 15 m line and ran back through the gates. The shortest time was recorded to the nearest 0.01s during three attempts on each foot. A countermovement vertical jump was used to assess lower body power, using a Takei vertical jump metre (Takei Scientific Instruments Co. Ltd, Japan). Jump height was measured to the nearest cm, with hands positioned on the hips. Vertical jump score was the highest value recorded during three trials, separated by 30 s rest (Hunter & Marhsall, 2002). The 2 kg medicine ball (Max Grip, China) chest throw was used to measure upper body power (Stockbrugger & Haennel, 2003). Participants were seated and were instructed to throw the ball horizontally as far as possible. Distance was measured to the nearest 0.1 m from the wall to where the ball landed with the furthest of three trials used as the score. Maximal oxygen uptake ($\dot{V}O_{2max}$) was estimated using the multistage fitness test (Ramsbottom, Brewer & Williams, 1988). Players were required to shuttle run 20 m repeatedly, whilst keeping in time to a series of beeps, on a pre-recorded multistage fitness test compact disc. Player's running speed (i.e. frequency of the beeps) increased progressively until they reached volitional exhaustion. Regression equations were used to estimate $\dot{V}O_{2max}$ from the level attained during the multistage fitness test.

Statistical Analysis

For part 1, the number and percentage of players attaining academy and professional status from the PPP were examined according to annual-age category, relative age and playing position. Then, Odds ratios (OR) and 95% Confidence Intervals (CI) compared annual-age categories (e.g., Under 13s vs. Under 14s), relative age quartiles (e.g., Q1 vs. Q4) and playing positions (e.g., Pivots vs. Props) for player attainment from the PPP to academy, PPP to professional and academy to professional levels. The findings of Till et al., (2014a) of 57.1% (PPP to academy) and 12.1% (academy to professional) were used as the referent percentages values throughout for OR comparisons.

For part 2, mean and standard deviation (SD) scores were calculated for all dependant variables by career attainment level at each annual-age category. A multivariate analysis of variance (MANOVA) test was conducted at each annual-age category (Under 13s, 14s & 15s), with career level as the fixed factor. Bonferroni pairwise comparisons were conducted to examine univariate effects between each dependent variable. Significance was set at $p<0.05$, and partial eta squared (η^2) effect sizes were interpreted as 0.01 = small, 0.06 = medium and 0.14 = large (Cohen, 1988). All analyses were conducted with SPSS version 19.0.

Results

Part 1

Table 1 shows the number and percentage of players attaining amateur, academy and professional levels from the PPP according to annual-age category, relative age quartile and playing position. For annual-age category, no significant ORs were found, even though the number of players attaining academy status increased with age category. However, a similar pattern was not evident for attainment at the professional level with a greater percentage of players selected to the PPP at the Under 13s attaining professional status.

For relative age quartile, significant ORs were identified in attainment between the PPP and professional (OR: 3.00, 95% CI: 1.00-9.13) and academy and professional (OR: 2.48, 95% CI: 1.05-5.89) levels for Q4 vs. Q2 players. A significantly greater proportion of Q4 players achieved professional status compared to Q2 players. No significant ORs were found for any other quartiles, although Q4 players demonstrated the greatest percentage of players to attain academy and professional status.

For playing position, significant ORs were identified in attainment between the PPP and professional (OR: 3.36, 95% CI: 1.00-11.40) and academy and professional (OR: 2.97, 95% CI: 1.21-7.30) levels for Pivots vs. Props. This demonstrated that a significantly greater proportion of Pivots achieved professional status compared to Props. No significant ORs were found for any other playing positions.

Insert Table 1 near here

Part 2

Table 2 presents the mean and SD for the anthropometric and fitness characteristics of players at each annual-age category according to their career attainment level. At the Under 13s, MANOVA identified no significant overall effect for the anthropometric and fitness characteristics on career attainment. At Under 14s, an overall significant effect for career attainment level ($F_{30, 3184}$=1.98, p=0.002, η^2=0.16) was observed. Univariate analysis demonstrated moderate effects for age at PHV ($F_{2, 194}$=4.58, p=0.012, η^2=0.05), years from PHV ($F_{2, 194}$=6.63, p=0.002, η^2=0.07), sitting height ($F_{2, 194}$=4.45, p=0.013, η^2=0.05), body mass ($F_{2, 194}$=4.80, p=0.009, η^2=0.05), sum of four skinfolds ($F_{2, 194}$=4.50, p=0.013, η^2=0.05), med ball throw ($F_{2, 194}$=5.10, p=0.007, η^2=0.06), 10m sprint ($F_{2, 194}$=3.27, p=0.040, η^2=0.04), agility 505 left ($F_{2, 194}$=6.82, p=0.001, η^2=0.08), agility 505 right ($F_{2, 194}$=5.50, p=0.005, η^2=0.06) and estimated $\dot{V}O_{2max}$ ($F_{2, 194}$=3.28, p=0.004, η^2=0.04). Professional players were significantly later maturing, with lower body mass, and reduced upper body power compared to amateur and academy players. For sum of four skinfolds, 10m sprint, agility 505 and estimated $\dot{V}O_{2max}$, professional players outperformed amateur players but not academy players.

At Under 15s, an overall significant effect for career attainment level ($F_{30, 3184}$=1.69, p=0.01, η^2=0.12) was also evident. Univariate analysis demonstrated small to moderate significant effects for sum of four skinfolds ($F_{2, 289}$=3.21, p=0.04, η^2=0.03), agility 505 right ($F_{2, 289}$=3.72, p=0.03, η^2=0.03) and estimated $\dot{V}O_{2max}$ ($F_{2, 289}$=4.66, p=0.01, η^2=0.04). Professional players outperformed amateur players for sum of four skinfold scores and agility 505 right, and both academy and professional players outperformed amateur players for estimated $\dot{V}O_{2max}$.

Insert Table 2 near here

Discussion

The current study; (1) evaluated the influence of annual-age category, relative age and playing position on the long-term career attainment of junior rugby league players originally selected to the PPP and (2) investigated whether differences in anthropometric and fitness characteristics in junior rugby league players, according to annual-age category (i.e., Under 13s, 14s and 15s), affected career attainment. This study advanced previous retrospective evaluations of TID programmes in rugby league (Till et al., 2014a) by considering how additional factors (i.e., age category, relative age and playing position) can impact upon long-term athlete development.

When annual-age category was considered, no significant ORs were identified, although the percentage of players attaining academy level from the PPP increased with age (i.e., Under 13s = 47.4%; 14s = 52.8%; 15s = 63.1%). This suggests that delayed selection during adolescence may be more accurate in determining onward selection into academy squads, as suggested by Vaeyens et al., (2008) due to the many factors that change over time. However, such a notion is not supported at the professional level (i.e., Under 13s = 13.7%; 14s = 9.2%; 15s = 13.4%) and early TID system retention with prolonged TID involvement, may have helped increase player preparation and development for adult professional status.

When relative age was considered, ORs identified a significantly greater proportion of Q4 vs. Q2 players attained professional status and although not significant, a greater proportion of Q4 players progressed across all levels. This is consistent with recent findings in ice-hockey (Deaner, Lowen & Cobley, 2013) and rugby union (McCarthy & Collins, 2014) and supports reductions in relative age biases into adult professional rugby league

(Till et al., 2010b). This suggests that relative age advantages, common in youth sport (Cobley et al., 2009), may not be advantageous for long-term performance. A possible explanation for this finding is that the relatively younger individual, selected to a TID programme, may overcome maturational and physical fitness disadvantages and develop heightened technical, tactical and psychological skills to progress in the longer-term if they can persist within developmental programmes (Cobley et al., 2009; Deaner et al., 2013; McCarthy & Collins, 2014).

For playing position, significant ORs were found between the Pivots and Props, with Pivots approximately three times more likely to attain professional status. This finding supports previous research (Till et al., 2010a; Till, Cobley, O'Hara, Chapman & Cooke, 2013) questioning whether 'Props' at 13-15 years, due to their advanced maturation and typical underperformance on a range of fitness assessments, are less likely to attain professional status due to the increasing game demands (e.g., speed) at higher playing levels (Gabbett, 2012). Physiologically speaking, the lower progression rates of 'Props' questions the validity of early TID in this position, and suggest that coaching interventions at younger age categories should aim to develop a range of generic capabilities rather than being position specific.

When anthropometric and fitness characteristics were compared according to career attainment outcomes, results identified overall significant effects for anthropometric and fitness characteristics at the Under 14s and 15s annual-age categories but not at the Under 13s. This suggests that advanced anthropometry and fitness may be advantageous for future career attainment at the Under 14s and 15s annual-age groups. Specifically, professional players at Under 14 and 15 significantly outperformed amateur players on sum of four skinfolds, speed, change of direction speed and estimated $\dot{V}O_{2max}$. These findings are supported by previous retrospective analyses in rugby league (Till et al., 2014a) and soccer (Le Gall et al., 2010), where increased anthropometric and fitness characteristics were associated with higher performance levels and implicate the benefit of such advanced characteristics in adolescence for long-term career attainment. However, it should be highlighted that only examining anthropometric and fitness characteristics is a limitation of the study and a more holistic identification protocol, including technical tactical and psychological measures, would have been more appropriate (Vaeyens et al., 2008).

Interesting findings were also evident at Under 14s, where players who attained professional status were significantly (η^2=moderate) more likely to be later maturing, with lower body mass and reduced upper body power compared to amateur and academy players. This is supported by data in soccer (Le Gall et al., 2010; Ostojic et al., 2014), where youth soccer players who progressed to professional levels were also later maturing compared to amateurs. This may be explained by the fact that although these players were later maturing, their fitness performance was at least matched or superior to earlier maturing players. Other data has also shown that earlier maturing players were often the worst performing on fitness measures (Till et al., 2010a), and highlights how they may have less potential for improvement or adaptability of such characteristics over time (Till et al., 2014b). Alternatively, playing position and skill speciality demand from teams may also be influential, assisting the trend for later-maturers to progress. For instance, pivots are often comparatively lower in body size and upper body power (Till et al., 2013; 2014b), but need to be quick in terms of speed, suggesting benefits for the later maturing junior pivots. Overall, findings highlight that advanced maturation status does not necessarily translate to greater opportunities for career attainment in rugby league with more meticulous longitudinal tracking, monitoring and evaluation needed.

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Conclusion

This present study identified that the career attainment of junior rugby league players selected to a TID programme (i.e., PPP) is influenced by annual-age category, relative age and playing position. Q4 players and Pivots demonstrated the greatest likelihood of attainment at professional levels, which was approximately three times more likely than Q2 players and Props, respectively. Anthropometry (i.e., sum of four skinfolds) and fitness (i.e., speed, change of direction speed and estimated $\dot{V}O_{2max}$) were significantly greater in future professional compared to amateur players at the Under 14 and 15 age categories. However, advanced size and early maturation in the early years of a TID programme did not contribute to career attainment. In fact, later maturing players with lower body mass were more likely to attain professional status. These findings, question the over reliance on early (de)selection policies common in TID programmes, where players are selected within annual-age groups often by playing position speciality, usually resulting in physical size, maturational, and relative age biases. TID programmes within rugby league, and other related team sports, should acknowledge the factors influencing long-term career attainment, and not allow these factors to delimit development opportunities during early adolescence.

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Table 1. Player career attainment outcomes by annual-age category, relative age quartile and playing position

	PPP	Amateur	Academy	Professional
Annual-Age Category				
Under 13s	95	50 (52.6%)	45 (47.4%)	13 (13.7% / 28.9%)
Under 14s	195	92 (47.2%)	103 (52.8%)	18 (9.2% / 17.5%)
Under 15s	290	107 (36.9%)	183 (63.1%)	39 (13.4% / 21.3%)
Relative Age				
Q1	275	120 (43.6%)	155 (56.4%)	33 (12.0% / 21.3%)
Q2	141	56 (39.7%)	85 (60.3%)	12 (8.5% / 14.1%)
Q3	109	58 (53.2%)	51 (46.8%)	11 (10.1% / 21.6%)
Q4	55	15 (27.3%)	40 (72.7%)	14 (25.5% / 35.0%)
Playing Position				
Outside-Backs	184	88 (47.8%)	96 (52.2%)	18 (9.8% / 18.8%)
Pivots	149	64 (43.0%)	85 (57.0%)	29 (19.5% / 34.1%)
Props	104	52 (50.0%)	52 (50.0%)	6 (5.8% / 11.5%)
Backrow	143	46 (32.2%)	97 (67.8%)	17 (11.9% / 17.5%)

Note: Professional shows percentage from PPP / percentage from academy

Table 2: Anthropometric and fitness characteristics at Under 13s, 14s and 15s years of age by career attainment level (i.e., amateur, academy and professional).

	Under 13s			Under 14s			Under 15s		
	Amateur (n=50)	**Academy (n=32)**	**Professional (n=13)**	**Amateur (n=92)**	**Academy (n=85)**	**Professional (n=18)**	**Amateur (n=107)**	**Academy (n=144)**	**Professional (n=39)**
Age (Years)	13.56±0.27	13.63±0.23	13.57±0.34	14.58±0.27	14.58±0.27	14.46±0.32	15.59±0.25	15.57±0.29	15.54±0.30
Age at PHV (Years)	13.50±0.58	13.44±0.58	13.79±0.82	13.52±0.48	13.58±0.56	13.97±0.77 [a, b]	13.72±0.57	13.74±0.56	13.65±0.54
YPHV	0.06±0.62	0.19±0.55	-0.23±0.87	1.06±0.55	1.00±0.55	0.49±0.75[a, b]	1.88±0.60	1.83±0.56	1.88±0.52
Height (cm)	169.0±7.5	170.5±5.9	166.8±10.4	174.9±6.2	174.8±6.3	171.9±9.0	177.1±6.4	177.7±6.3	179.5±5.8
Sitting Height (cm)	85.8±4.1	86.6±4.2	83.5±5.5	89.0±3.3	88.6±3.7	86.0±5.4 [a, b]	90.9±3.6	90.7±3.6	91.4±3.3
Body Mass (kg)	61.2±11.6	61.5±7.7	57.2±12.2	71.1±11.8	70.0±10.7	61.7±9.2 [a, b]	76.1±12.4	75.3±10.4	76.2±8.5
Sum 4 Skinfolds (mm)	36.9±17.0	33.3±13.2	32.0±6.8	41.2±18.7	37.4±13.8	28.5±9.2 [a]	43.5±17.0	40.4±16.4	37.3±10.8 [a]
Vertical Jump (cm)	41.4±4.8	40.9±6.2	42.8±7.9	39.0±4.8	40.5±5.1	39.6±6.6	38.8±4.8	39.6±5.5	41.3±7.1
MBT (m)	5.6±1.1	5.7±1.2	5.7±0.9	5.8±0.9	5.8±0.8	5.0±1.7 [a, b]	5.8±0.8	5.7±0.8	5.9±1.0
10m (s)	1.92±0.13	1.88±0.09	1.87±0.08	1.93±0.10	1.90±0.10	1.86±0.09 [a]	1.87±0.16	1.87±0.15	1.82±0.14
20m (s)	3.37±0.21	3.29±0.14	3.32±0.14	3.32±0.15	3.28±0.15	3.24±0.13	3.21±0.19	3.20±0.18	3.14±0.15
30m (s)	4.78±0.28	4.66±0.20	4.70±0.19	4.63±0.23	4.58±0.20	4.52±0.17	4.47±0.24	4.46±0.24	4.38±0.17
60m (s)	9.07±0.60	8.74±0.44	8.84±0.36	8.61±0.48	8.49±0.44	8.39±0.37	8.28±0.42	8.23±0.41	8.10±0.30
Agility 505 L (s)	2.58±0.15	2.48±0.13	2.50±0.15	2.52±0.16	2.46±0.13	2.38±0.09 [a]	2.49±0.16	2.47±0.15	2.42±0.13
Agility 505 R (s)	2.58±0.16	2.49±0.15	2.56±0.15	2.54±0.17	2.49±0.15	2.42±0.09 [a]	2.52±0.13	2.50±0.14	2.45±0.11[a]
Estimated $\dot{V}O_{2max}$	45.1±4.8	47.3±5.9	47.0±4.6	47.0±5.8	49.1±5.0	49.3±4.4 [a]	49.5±5.1	51.2±4.5	51.9±3.8 [a, b]

(ml.kg^{-1}.min^{-1})

[a]Sig different to amateur (p<0.05); [b] Sig different to academy (p<0.05)

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