Retrospective analysis of anthropometric and fitness characteristics associated with long-term career progression in Rugby League

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Abstract

Objectives: The current study retrospectively investigated the differences in anthropometric and fitness characteristics of junior rugby league players selected onto a talent identification and development (TID) programme between long-term career progression levels (i.e., amateur, academy, professional).

Design: Retrospective design

Method: Former junior rugby league players (N=580) selected to a TID programme were grouped according to their career progression level. Anthropometric (height, sitting height, body mass and sum of four skinfolds), maturational and fitness (power, speed, change of direction speed and estimated $\dot{V}O_{2max}$) assessments were conducted at 13-15 years. Multivariate analysis of covariance (MANCOVA) analysed differences between career progression levels controlling for chronological age.

Results: 57.1% and 12.1% of players selected to the TID programme progressed to academy and professional levels in rugby league, respectively. Sum of four skinfolds (η^2=0.03), vertical jump (η^2=0.02), 10m (η^2=0.02), 20m (η^2=0.02), 30m (η^2=0.02), and 60m (η^2=0.03) speed, agility 505 left (η^2=0.06), agility 505 right (η^2=0.05) and estimated $\dot{V}O_{2max}$ (η^2=0.03) were superior within junior players who progressed to professional compared to amateur levels. No significant differences were identified between future academy and professional players for any measure.

Conclusions: Findings suggest that lower sum of four skinfolds and advanced fitness characteristics within junior (13-15 years) rugby league players may partially contribute to long-term career progression. Therefore, TID programmes within rugby league should aim to assess and develop body composition and fitness characteristics, especially change of direction speed. However, TID programmes should also consider technical, tactical and psycho-social characteristics of junior rugby league players that may be important for long-term career progression.

Key Words: Talent identification, talent development, adolescence

Introduction

In recent years, the emphasis on identifying and developing young talented athletes in the pursuit of sporting excellence has led to national governing bodies and professional clubs investing considerable resources into the process of talent identification and development (TID).[1,2] Traditionally, TID research studies within youth sport (e.g., volleyball,[3] soccer[4]) have identified anthropometric and fitness characteristics that distinguish between junior elite and sub-elite players. These studies (and practice) work on the assumption that current performance capabilities and discrepancies between selection levels in junior populations can help predict potential success in adulthood.[5] However, the effectiveness of such TID programmes at adolescent stages is questionable with limited data available that monitors the career progression of athletes through TID programmes into professional sport.[5] To advance our understanding of the effectiveness of TID programmes and the factors that may contribute to adult performance it would seem more valuable to prospectively track players, or retrospectively trace their long-term career progression.[5,6]

Recent research in soccer[7,8] has retrospectively compared the anthropometric and fitness characteristics of adolescent soccer players in relation to a player's attained career level (i.e., amateur, professional or international). For example, Le Gall et al.[7] identified that junior soccer players aged 14-16 years who only attained amateur status were more mature than those who progressed to professional and international levels. However, significant differences were observed for vertical jump and 40m sprint performance that favoured the future professional and international compared to amateur players. This research begins to suggest that fitness testing in adolescent athletes can provide useful information in terms of predicting future career progression. However, similar investigations retrospectively examining adolescent populations and related characteristics with long term career progression in other sport contexts are limited, with no study available within rugby league.

Rugby league is a collision sport played at junior and senior levels around the world with game popularity most established in Great Britain, France, Australia and New Zealand.[9] The sport involves frequent periods of high intensity activity (e.g., sprinting, tackling) separated by lower intensity activity (e.g., jogging).[9] Therefore, players are required to have highly developed strength, speed, power, agility and aerobic fitness. [10] Previous research in the UK[11,12,13] and Australia[14,15,16] has identified advanced anthropometric and fitness characteristics within junior players compared to the normative population; between annual-age categories (i.e., Under 13, 14s, etc.); and according to playing level (i.e., Regional and National players). Yet determining the relative importance and influence that these characteristics have on future career progression has not been identified, which would be informative for TID programmes within rugby league.

The UK's national governing body, the Rugby Football League (RFL), used a TID programme named the Player Performance Pathway (PPP; see[17] for a detailed description) between 2005 and 2007 for players aged 13 and 15 years. All players selected to the PPP undertook an annual anthropometric and fitness assessment each year, which allowed a retrospective analysis (in 2013) of the career progression of players selected to the PPP. Therefore, the aims of the current study were (1) examine the career progression levels of junior rugby league players originally selected to the PPP and (2) investigate the differences in anthropometric and fitness characteristics in 13-15 year old rugby league players between long-term career progression levels, notably whether the player's highest level of performance attained was amateur, academy or professional. It was hypothesized that anthropometric and fitness characteristics would be advanced in junior rugby league players that progressed to higher career progression levels.

Methods

Former representative junior rugby league players (N=580) selected to the RFL's PPP between 2005 and 2007 participated in the study. Of these participants, 95, 195 and 290 players were selected onto the PPP at the Under 13, 14 and 15 age categories, respectively. By July 2008, PPP players were either: (a) selected to join a professional rugby league club's academy; (b) continued to play amateur rugby league; or (c) no longer participate in the game. Through continued involvement at a professional academy, players were then potentially able to progress into playing professional rugby league within the European Super League. For the purposes of this study, players were divided into three career progression levels 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' rugby league by the end of the 2013 Super League season. Players were identified as professional if they had played 5 or more Super League games.

All PPP players undertook an annual anthropometric and fitness assessment in July of the respective junior years, with all protocols receiving institutional ethics approval with consent provided by both players and parents/guardians. All assessments were conducted by Leeds Metropolitan University sport science support team but were decided by the RFL. 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 for each participant. Intra-class correlation coefficients and typical error measurements for each measure are presented in previous research[11,12] and all measurement reliability and objectivity conformed to published expectations.[18]

Anthropometric characteristics were collected prior to breakfast with participants wearing only shorts. Participants' height and sitting height were measured using a Seca Alpha stadiometer, to the nearest 0.1cm. Body mass was measured using calibrated Seca alpha (model 770) scales, to the nearest 0.1kg. The sum of four skinfold thickness was determined using calibrated Harpenden skinfold callipers (British Indicators, UK) with procedures in accordance with Hawes and Martin.[19] To measure maturity status, an age at PHV prediction equation was used.[20] The 95% confidence interval associated with this equation for boys is ±1.18 years.[20] Years from PHV were calculated for each participant by subtracting age at PHV from chronological age.

Prior to fitness testing, a standardized warm-up was conducted, and all the players received full instructions of the tests. The fitness tests were conducted in the order described. Running speed was assessed over 10m, 20m and 30m and speed endurance was assessed over 60m using timing gates (Brower Timing Systems, IR Emit, USA).[12] Times were recorded to the nearest 0.01s, with the shortest time recorded during 3 trials, separated by 3 minutes rest, used for the sprint measurement. Change of direction speed was assessed using the agility 505 test.[21] Participants were positioned 15m from a turning point with timing gates positioned 10m from the start point. Players accelerated from the starting point, through the timing gates, turned on the 15m line and ran as quickly as possible back through the gates. Three attempts were performed on each foot, separated by 3 minutes rest, with times recorded to the nearest 0.01s. To assess lower body power a vertical jump was measured using a Takei vertical jump metre (Takei Scientific Instruments Co. Ltd, Japan). A counter-movement jump with hands positioned on hips was used, with jump height measured to the nearest cm.[22] The vertical jump score was the highest value recorded during three trials with 30s rest between jumps. The 2kg medicine ball (Max Grip, China) chest throw was used to measure upper body power.[23] Participants were seated with their backs against a wall and were instructed to throw the ball horizontally as far as possible. Distance was measured to the nearest 0.1cm 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.[24] Keeping in time with a series of beeps, on a pre-recorded multistage fitness test compact disc, players were required to shuttle run 20m. 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 reached during the multistage fitness test.

Mean and standard deviation (SD) scores were calculated for all dependant variables according to career progression level (i.e., amateur, academy, professional). To examine the differences in anthropometric and fitness characteristics according to career progression level, a multivariate analysis of covariance (MANCOVA) test was applied, with career progression level used as the fixed factor and chronological age applied as the covariate. Chronological age was applied as a covariate to control for the greater proportion of players at the older age categories (i.e., Under 13 = 95; 14s = 195; 15s = 290). Bonferroni pairwise comparisons were conducted to examine univariate effects between each dependent variable. Partial eta squared (η^2) effect sizes were also calculated and interpreted as 0.01 = small, 0.06 = medium and 0.14 = large according to Cohen.[25] All analyses were conducted with SPSS version 19.0 with significance levels set at $p<0.05$.

Results

From the 580 players originally selected onto the PPP between 2005 and 2007, 249 (42.9%) players were classed as amateur, and 331 (57.1%) of players were academy players in July 2008 (i.e., when players were 16 years of age). From the 331 academy players, 70 players attained professional status by the end of the 2013 Super League season demonstrating that 21.1% of academy players, and 12.1% of the players originally selected to the PPP progressed to a professional level.

Table 1 presents the mean and SD for the anthropometric and fitness characteristics of junior rugby league players selected to the PPP according to amateur, academy and professional career progression levels. MANCOVA analyses identified that chronological age, applied as a covariate, had a confounding effect on all variables except medicine ball throw. MANCOVA analyses between career progression levels revealed a significant overall difference ($F_{32, 1128}$=3.48, p<0.001, η^2=0.11) demonstrating a medium-large effect size. Univariate analyses demonstrated significant effects for career progression level on sum of four skinfolds, vertical jump, 10m, 20m, 30m and 60m sprint, agility 505 left, agility 505 right and estimated $\dot{V}O_{2max}$. Medium effect sizes were identified for agility 505 left (η^2=0.06) and agility 505 right (η^2=0.05), with all other effect sizes classified as small. Professional players significantly outperformed amateur players for the sum of four skinfolds, vertical jump, 10m, 20m, 30m and 60m sprint, agility 505 left, agility 505 right and estimated $\dot{V}O_{2max}$. Academy players outperformed amateur players for 60m sprint, agility 505 left, agility 505 right and estimated $\dot{V}O_{2max}$. No significant differences were identified between professional and academy players for any dependant variable.

Insert Table 1 near here

Discussion

The present study examined the career progression levels of junior rugby league players originally selected to a TID programme (i.e., PPP) and investigated the differences in anthropometric and fitness characteristics of a large sample of junior rugby league players in relation to long-term career progression level (i.e., amateur, academy or professional). Few studies have been able to monitor the progress of athletes in talent development systems, which may be important to understand the effectiveness and advance our understanding of the factors that contribute to future adult performance.[5,6] This study begins to address these concerns and develops upon previous TID research in rugby league.[12,15]

Overall, findings showed that 57.1% of players selected to the PPP progressed into a professional club's academy system at 16 years and 12.1% went on to play professional rugby league. These results suggest a low-moderate success ratio; similar to those reported within Russian and German TID squads.[26] This suggests a large proportion of players selected to the PPP did not progress to academy or professional level, questioning the efficacy surrounding TID programmes.[1,5,26] That said, it is worth considering that the PPP context involved a large number of player selections per year (i.e., total = 300, 100 at Under 13s, 14s, 15s) and that opportunities for all players to progress to a professional level will never likely be feasible, when many sports employ pyramidal models of talent development.[1] Further consideration of players not selected to the PPP, but yet who go on to progress to play at professional levels would be particularly insightful, allowing comparisons between TID programme and potentially alternative development pathways.

Overall significant effects were identified for career progression level between anthropometric and fitness characteristics of junior rugby league players, demonstrating a medium-large effect size (η^2=0.11). This suggests that advanced anthropometric and fitness characteristics within junior rugby league players aged 13-15 years may be advantageous for future long-term career progression. These findings are similar to research comparing current performance level within junior samples in rugby league,[12,15,21] and other sports (e.g., volleyball,[3] soccer[4]) whereby anthropometric and fitness characteristics improve with selection level. These findings suggest that advanced anthropometric and fitness characteristics can differentiate between selection levels within junior populations and long-term career progression levels.

For anthropometric and maturational characteristics, only sum of four skinfolds significantly differed between career progression levels. No significant differences in height, body mass or age at PHV suggest that size or maturation at 13-15 years did not influence career progression. No differences in size or maturation have been found in other studies comparing TID junior samples in rugby league[12,16,21] and other sports (e.g., volleyball[3]), with authors suggesting the sample had already become relatively homogenous, due to performance demands at such levels. Although not directly adhering to Le Gall et al.[7] whereby 'later maturers' progressed to professional and international levels, current descriptive patterns do suggest that professional players (age at PHV = 13.80±0.72 years; body mass = 67.1±12.8 kg) were 'less mature' and 'lighter' than future amateur players (age at PHV = 13.60±0.55 years; body mass = 70.7±13.5kg) at 13-15 years. This suggests that advanced size and maturation status may not necessarily translate into higher levels of career progression in rugby league. For sum of four skinfolds, professional players were significantly lower than amateur players between 13 and 15 years. Although significance was demonstrated, effect sizes were small-medium (η^2=0.03), suggesting that although lower skinfolds contribute to future career progression the effect is minimal. However, sum of skinfolds could be used as an identification measure in rugby league with players encouraged to achieve lower sum of skinfolds due to the relationship between lower body fat with performance (e.g., speed, agility, power).[11]

All fitness measures, with the exception of medicine ball throw, showed significant effects between career progression levels. Junior players who progressed to professional levels outperformed those who progressed to amateur levels for vertical jump, 10m, 20m and 30m sprint with future academy and professional players outperforming amateur players for the 60m sprint, agility 505 left, agility 505 right and estimated $\dot{V}O_{2max}$. These findings are consistent with previous evaluations of current performance by selection level in rugby league[12,16] and studies that track career progression in soccer.[7,8] However, the magnitude of effect sizes was small for most variables other than change of direction speed (i.e., Agility 505 left, η^2=0.06; right, η^2=0.05), which demonstrated the greatest effect size. This suggests that change of direction speed may be the most discriminating physical characteristic of junior players in determining career progression. A possible explanation for this may be the demands of rugby league match-play involving constant accelerations and change of direction due to the defensive line retreat required within rugby league match play.[9] Interestingly, no significant fitness differences were identified between academy and professional players, consistent with findings between future soccer international and professional players.[7] Although descriptive data suggests some improved performance in future professional compared to academy players (e.g., vertical jump – academy = 39.9 ±5.6, professional = 41.2 v 7.2cm) the lack of statistical significance demonstrates that anthropometric and fitness characteristics may not be able to distinguish between players at 13-15 years who progress to academy and professional levels. This suggests that as playing level increases it may be more difficult to identify distinguishing variables between more homogenous samples.[7,12,27] However, the absence of assessments of specific rugby league fitness attributes (i.e., repeated sprint ability), recently suggested as important for rugby league performance, [28] may be more sensitive to differentiate between career progression levels (i.e., academy and professional). Therefore, although fitness characteristics may contribute to long-term career progression and playing success in rugby league, the small effect sizes and lack of differences between academy and professional players suggest that fitness attributes combined with technical skills, tactical knowledge and psycho-social development are important for future career progression as a professional rugby league player.[12]

The present study is not without limitations. Firstly, the PPP ceased at the Under 15s age category and therefore anthropometric and fitness data was not available beyond this point. This may have been informative in distinguishing variables that affect future career progression post 16 years. It would have been more appropriate to measure maturation and fitness capacities (e.g., $\dot{V}O_{2max}$) more directly than using estimation methods. The 60m sprint may not be the most appropriate assessment within youth sport athletes with distances at a maximum distance of 40m commonly used. [29]Finally, the lack of multi-disciplinary assessments, including technical, tactical and psychological attributes, is a further limitation and broader challenge for research in this area. Integrating such measures may provide additional and a more holistic insight into the characteristics of junior rugby league players required for career success.

Conclusion

This study identified that 57% and 12% of players selected to the TID programme in junior (Under 13 – 15) rugby league progressed to academy and professional levels respectively. No differences were identified between career progression levels for maturation or size suggesting these characteristics did not differentiate between future career progressions within an already identified group of talented junior rugby players. Lower sum of four skinfolds and advanced lower body power, speed, change of direction speed and estimated $\dot{V}O_{2max}$ at junior age categories contributed towards long-term career progression level, as evidenced by increased characteristics within academy and professional players when compared to amateurs. Therefore, considering these characteristics, especially change of direction speed, is important for TID in rugby league, However, the small-medium effect sizes and no significant differences between academy and professional level players suggest that fitness characteristics only partially contribute towards academy and professional level attainment and should be considered as part of a holistic approach to TID.

Practical Implications

- Rugby league practitioners should assess and develop body composition, speed, lower body power, estimated $\dot{V}O_{2max}$ and in particular change of direction speed within junior rugby league players for future career development.
- Height, body mass, maturation and upper body power at 13-15 years do not seem to contribute towards long-term career progression in rugby league.
- Fitness characteristics only partially account for long-term career progression and TID programmes should also consider technical, tactical and psycho-social characteristics of junior rugby league players.

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References

1. Cobley S, Baker J, Schorer J. Identification and development of sport talent: A brief introduction to a growing field of research and practice, Chapter 1, in *Talent identification & development in sport: International perspectives*, Baker J, Cobley S, Schorer J editors, London, Routledge, 2012.
2. Williams AM, Reilly T. Talent identification and development in soccer. *J Sports Sci* 2000;18(9):657-667.
3. Gabbett TJ, Georgieff B, Domrow N. The use of physiological, anthropometric and skill data to predict selection in a talent-identified junior volleyball squad. *J Sports Sci* 2007;25:1337-1344.
4. Gil S, Ruiz F, Irazusta A, et al. Selection of young soccer players in terms of anthropometric and physiological factors. *J Sports Med Phys Fitness* 2007;47(1):25-32.
5. Vaeyens R, Lenoir M, Williams AM, et al. Talent identification and development programmes in sport: Current models and future directions. *Sports Med* 2008;38(9):703-714.
6. Kannekens R, Elferink-Gemser MT, Visscher C. Positioning and deciding: key factors for talent development in soccer. Scand J Med Sci Sports 2011;21(6):846-852.
7. Le Gall F, Carling C, Williams M, et al. Anthropometric and fitness characteristics of international, professional and amateur male graduate soccer players from an elite youth academy. *J Sci Med Sport*, 2010;13(1):90-95.
8. Gonaus C, Muller, E. Using physiological data to predict future career progression in 14- to 17-year-old Austrian soccer academy players. *J Sports Sci* 2012;30(15):1673-1682.
9. Gabbett TJ, King T, Jenkins D. Applied Physiology of Rugby League. *Sports Med* 2008;38:119-138.
10. Baker DG, Newton RU. Comparison of lower body strength, power, acceleration, speed, agility, and sprint momentum to describe and compare playing rank among professional rugby league players. *J Strength Cond Res* 2008;22:153-158.
11. Till K, Cobley S, O'Hara J, et al. Anthropometric, physiological and selection characteristics in high performance UK junior Rugby League players. *Talent Dev Excellence* 2010;2(2):193-207.
12. Till K, Cobley S, O'Hara J, et al. Using Anthropometric and Performance Characteristics to Predict Selection in Junior UK Rugby League Players. *J Sci Med Sport* 2011:14(3):264-269.

13. Till K, Cobley S, O'Hara J, et al. A Longitudinal Evaluation of Anthropometric and Fitness Characteristics in Junior Rugby League Players. *J Sci Med Sport* 2013;16(5):438-443.
14. Gabbett TJ. A comparison of physiological and anthropometric characteristics among playing positions in junior rugby league players. *Br J Sports Med* 2005;39(9):675-680.
15. Gabbett TJ. Physiological and anthropometric characteristics of starters and non-starters in junior rugby league players, aged 13-17 years. *J Sports Med Phys Fitness* 2009;49(3):233-239.
16. Gabbett TJ, Kelly J, Ralph S, et al. Physiological and anthropometric characteristics of junior elite and sub-elite rugby league players, with special reference to starters and non starters. *J Sci Med Sport* 2009:12(1):215-222.
17. Till K, Cobley S, O'Hara J, et al. Talent Identification, Selection and Development in UK Junior Rugby League: An Evolving Process, chapter 9, in *Talent Identification and Development in Sport: International Perspectives*. Baker J, Cobley S, Schorer J editors, London, Routledge, 2012
18. Hopkins WG. Measures of reliability in sports medicine and science. *Sports Med* 2000;30:1-15.
19. Hawes MR, Martin AD. Human Body Composition, Chapter 1 in *Kinanthropometry and exercise physiology laboratory manual: Tests, procedures and data second edition. Volume 1: Anthropometry*. London, Routledge, 2001.
20. Mirwald RL, Baxter-Jones ADG, Bailey DA, et al. An assessment of maturity from anthropometric measurements. *Med Sci Sport Exerc* 2002;34:689-694.
21. Gabbett TJ, Herzig PJ. Physiological characteristics of junior elite and sub-elite rugby league players. *Strength Cond Coach* 2004;12:19–24.
22. Hunter JP, Marshall, RN. Effects of power and flexibility training on vertical jump technique. *Med Sci Sports Exerc* 2002;34(3):478-486.
23. Stockbrugger BA, Haennel RG. Contributing factors to performance of a medicine ball explosive power test: a comparison between jump and non jump athletes. *J Strength Cond Res* 2003;17:768-774.
24. Ramsbottom R, Brewer J, Williams C. A progressive shuttle run test to estimate maximal oxygen uptake. *Br J Sports Med* 1988;22:141–144.

25. Cohen, J. *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum. 1988.
26. Vaeyens R, Güllich A, Warr CR, et al. Talent identification and promotion programmes of Olympic athletes. *J Sports Sci* 2009;27(13):1367-80.
27. Franks A, Williams AM, Reilly T, et al. Talent identification in elite youth soccer: Physical and physiological characteristics. *J Sports Sci* 1998;17:812.
28. Johnston RD, Gabbett TJ, Jenkins, DJ. Applied sport science of rugby league. *Sports Med* 2014;DOI 10.1007/s40279-014-0190-x
29. Rumpf MC, Cronin JB, Oliver JL, et al. Assessing youth sprint ability – methodological issues, reliability and performance data. *Pediatr Exerc Sci* 2011;23:442-467.

Table 1. Anthropometric and fitness characteristics of junior rugby league players by career progression level

	Amateur (n=249)	Academy (n=261)	Professional (n=70)	Covariate Age	MANCOVA P	η^2
Age at PHV (Years)	13.60 ± 0.55	13.64 ± 0.58	13.80 ± 0.72	***		
YPHV	1.11 ± 0.88	1.22 ± 0.81	0.94 ± 1.14	***		
Height (cm)	174.2 ± 7.1	175.2 ± 6.8	174.1 ± 9.7	***		
Sitting Height (cm)	88.9 ± 4.0	89.1 ± 4.0	87.8 ± 5.8	***		
Body Mass (kg)	70.7 ± 13.5	70.9 ± 11.1	67.1 ± 12.8	***		
Sum 4 Skinfolds (mm)	41.6 ± 18.2	38.4 ± 15.5	33.4 ± 9.8 [a]	***	**	0.03
Vertical Jump (cm)	39.2 ± 4.9	39.9 ± 5.6	41.2 ± 7.2 [a]	**	**	0.02
Medicine Ball Throw (m)	5.7 ± 0.9	5.7 ± 0.9	5.8 ± 1.0			
10m (s)	1.90 ± 0.14	1.88 ± 0.13	1.85 ± 0.12 [a]	**	*	0.02
20m (s)	3.29 ± 0.19	3.25 ± 0.17	3.21 ± 0.16 [a]	***	**	0.02
30m (s)	4.61 ± 0.27	4.54 ± 0.23	4.51 ± 0.22 [a]	***	*	0.02
60m (s)	8.60 ± 0.56	8.43 ± 0.45 [a]	8.36 ± 0.49 [a]	***	**	0.03
Agility 505 L (s)	2.52 ± 0.16	2.47 ± 0.13 [a]	2.42 ± 0.12 [a]	***	***	0.06
Agility 505 R (s)	2.54 ± 0.15	2.48 ± 0.14 [a]	2.46 ± 0.12 [a]	***	***	0.05
Estimated $\dot{V}O_{2max}$ (ml.kg^{-1}.min^{-1})	47.6 ± 5.6	49.6 ± 4.9 [a]	49.8 ± 4.6 [a]	***	**	0.03

[a]Pairwise comparison, significantly different to Amateur; *P<0.05; **P<0.01; ***P<0.001