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Using Anthropometric and Performance Characteristics to Predict Selection in Junior UK Rugby League Players

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Abstract

Objectives. Research examining the factors influencing selection within talented junior Rugby League players is limited. The aims of this study were firstly to determine whether differences existed for anthropometric and performance characteristics between regional and national selection in high performance UK junior Rugby League players, and secondly to identify variables that discriminated between these selection levels. *Method.* Regional representative (n=1,172) selected junior players (aged 13-16 years) undertook an anthropometric and fitness testing battery with players split according to selection level (i.e., national, regional). *Results.* MANCOVA analyses, with age and maturation controlled, identified national players as having lower sum of 4 skinfolds scores compared to regional players, and also performed significantly better on all physical tests. Stepwise discriminant analysis identified that estimated maximum oxygen uptake ($\dot{V}O_{2max}$), chronological age, body mass, 20m sprint, height, sum of 4 skinfolds and sitting height discriminated between selection levels, accounting for 28.7% of the variance. This discriminant analysis corresponded to an overall predictive accuracy of 63.3% for all players. *Conclusions.* These results indicate that performance characteristics differed between selection levels in junior Rugby League players. However, the small magnitude of difference between selection levels suggests that physical qualities only partially explain higher representative selection. The monitoring and evaluation of such variables, alongside game related performance characteristics, provides greater knowledge and understanding about the processes and consequences of selection, training and performance in youth sport.

Key Words: Talent; Maturation; Identification; Homogenous

Introduction

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[1,2]. The game involves frequent periods of high-intensity activities (e.g. tackling, ball carrying) separated by bouts of low intensity activity (e.g. jogging; [3,4]). Due to the physically demanding nature of the game, players are required to have highly developed physiological capacities of muscular strength, power, speed, agility and aerobic power [2,5,6].

In the UK, the Rugby Football League (RFL) used a player performance pathway for the selection of high performance junior players (See Till et al., [7] for a more detailed description of the pathway). The major purpose of the pathway was to assist in the development of the most talented junior players with regional and national representative selection key components of this development model. Regional selection (i.e., County standard – Yorkshire, North-West, Cumbria in the UK) resulted in 100 players being selected at under 13, 14 and 15 annual-age categories each year in which players attended a week long training camp to undertake specialised coaching and training. Following performances at regional level, players were then selected for national level (n=40 at Under 13s; n=24 at under 14 and 15 each year) where they received further support and development from the RFL. Therefore, the RFL identified 100 talented players at each annual-age group each year to regional level with the best of this group of players selected to respective national squads.

Previous research in junior Rugby League players [3,8-11] has shown that anthropometric and physiological characteristics increase and develop across annual-age groups and playing level. For instance, Gabbett [8] showed improved capacities as age increased from under 13 to senior aged players, while further studies [10,11] found body mass, vertical jump, speed, agility and estimated aerobic power to differentiate between elite (Australian National Rugby League club development program) and sub-elite (club standard) juniors. Recent research in other youth sports contexts, such as field hockey [12] and volleyball [13] has begun to assess whether anthropometric, physiological and skill data also discriminate between junior players within a similar age and stage of development. For example, in volleyball [13], no differences in anthropometric and physiological characteristics were found between selected (n=19) and non-selected (n=9) players to a Queensland Academy of Sport Talent Search Program. Instead results found that passing accuracy, passing technique and spiking technique were the discriminating factors. However, in junior handball players [14], findings identified that body mass, arm length, standing long jump, vertical jump and shuttle speed were able to distinguish between elite and non-elite players.

Unlike heterogeneous samples (i.e., different ages, stages of development and skill levels) where anthropometric and physiological differences may be more striking, it is difficult based on research to date, to consistently assume which variables are able to discriminate between more homogenous (i.e., similar age and skill levels) samples in a given sport context. Although studies have compared characteristics across age-categories and skill levels in youth sport, no study has directly examined how anthropometric and performance characteristics contribute to regional or national selection within a developmental and representative group of junior Rugby League players. Thus using a large sample with data collected over a number of years from the RFL player performance pathway, the initial purpose of this study was to determine if differences existed for anthropometric and performance characteristics between regional and nationally selected players, whilst controlling for chronological age and maturation. The secondary purpose was to identify potential variables which discriminated between the selection levels and were able predict the likelihood of being a national compared to regional representative junior player.

Methods

Participants: A total of 1,172 regional representative selected junior rugby league players participated in the study. The data were separated by selection level (regional n=870; national n= 302) and by annual-age category (Under 13 regional n=255, national n=130; Under 14 regional n=309, national n=86; Under 15 regional n=306, national n=86). All players undertook an anthropometric and fitness assessment, in which all protocols received institutional ethics approval with parental and/or guardian consent provided.

Procedures: Fitness testing results from the 2005 to 2008 RFL's Regional representative squads were collected in July each year. All assessments were carried out by Leeds Metropolitan Sport Science Support Team, however all tests were decided by the RFL. Standard anthropometry (height, sitting height, body mass, sum of 4 skinfolds), maturation (age at peak height velocity; PHV) and performance characteristics (lower and upper body power, speed, agility, estimated maximum oxygen uptake) were collected for each participant during the regional camp.

Anthropometry: Height and sitting height were measured using a Seca Alpha stand, 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 [15]. Intraclass correlation coefficients and typical error measurements for reliability of skinfold measurements were r=0.954 ($p<0.001$) and 3.2% respectively, indicating acceptable reliability based on established criteria (i.e., > .80; [16]).

Maturation (Age at PHV): To measure maturity status, an age at PHV prediction equation was used [17]. The 95% confidence interval associated with this equation for boys is ±1.18 years [17]. Years from PHV was calculated by subtracting age at PHV from chronological age.

Performance Characteristics: To assess lower body power a vertical jump was measured using a Takei vertical jump metre (Takei Scientific Instruments Co. Ltd, Japan). A countermovement jump with hands positioned on hips was used, with jump height measured to the nearest cm. The vertical jump score was the highest value recorded during three trials [18]. The intraclass correlation coefficient and typical error measurement for the vertical jump was r=0.903 (p<0.001) and 2.9%, respectively.

The 2kg medicine ball (Max Grip, China) chest throw was used to measure upper body power [19]. 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. The intraclass correlation coefficient and typical error measurement for the medicine ball chest throw was r=0.965 (p<0.001) and 0.6%, respectively.

Running speed was assessed over 10m, 20m, 30m and 60m using timing gates (Brower Timing Systems, IR Emit, USA). Times were recorded to the nearest 0.01s, with the shortest time recorded during 3 trials used for the sprint measurement. Intraclass correlation coefficients and typical error measurements of the 10m, 20m, 30m and 60m sprints were r=0.788 (p<0.001), r=0.852 (p<0.001), r=0.899 (p<0.001)and r=0.924 (p<0.001), and 8.4%, 4.5%, 3.3% and 2.3% respectively.

Change of direction speed was assessed using the agility 505 test [20]. 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 [10]. Three attempts were performed on each foot with times recorded to the nearest 0.01s. Intraclass correlation coefficients and typical error measurements for the agility 505 left and right were r=0.823 and r=0.844 (p<0.001), and 3.5% and 3.1% respectively.

Maximal oxygen uptake ($\dot{V}O_{2max}$) was estimated using the multistage fitness test [21]. 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 maximal oxygen uptake from the level reached during the multistage fitness test [21]. Intraclass correlation coefficients and typical error measurements for the multistage fitness test were 0.90 and 3.1%[11].

Data Analysis: Mean and standard deviation (SD) scores were calculated for all dependant variables with selection level acting as the independent variable. A multivariate analysis of covariance (MANCOVA) test was applied with selection level (regional vs national) as the fixed factor. Chronological age and maturity (Years from PHV) were entered as covariates to adjust for variations in age and maturation status. Partial eta squared effect sizes (η^2) were also calculated. For identifying discriminating variables between regional and national players, a stepwise discriminant analysis was applied with selection level used as the discrete outcome variable. SPSS version 15.0 was used for all analysis with significance set as $p<0.05$.

Results

Regional & National Characteristics: Table 1 presents the mean and SD of the anthropometric and performance measures across selection levels (i.e. regional and national). Results identified that chronological age had a confounding effect on all measures whilst maturation had a significant effect on all variables except vertical jump and 60m sprint. MANCOVA analyses between selection levels for all players revealed that national players significantly outperformed regional players for sum of skinfolds, vertical jump, medicine ball chest throw, 10m, 20m, 30m, 60m sprint, agility 505 left and right and estimated $\dot{V}O_{2max}$.

Insert Table 1 near here

Annual-age categories: Table 2 presents the means and standard deviations of characteristics across selection level by annual-age category (i.e. under 13s, 14s, 15s). MANCOVA analyses identified national player's outperformed Regional players at under 13 for sum of four skinfolds and all performance characteristics except agility 505 right. At the under 14 age category national players outperformed regional players on all performance characteristics, however at the under 15s age category a significant difference was only identified for the vertical jump performance. Therefore regional and national under 15 players were similar for anthropometric and all but one physical characteristic.

Insert Table 2 near here

Predictors of National Selection: The stepwise discriminant analysis predicted that a combination of seven variables would successfully discriminate between regional and national players. The variables (in order) were estimated $\dot{V}O_{2max}$ (0.980), chronological age (0.966), body mass (0.953), 20m sprint (0.939), height (0.934), sum of 4 skinfolds (0.923) and sitting height (0.917). The average squared canonical correlation was 0.287, showing that these seven variables, accounted for 28.7% of the overall variance in the data set. Cross-validation results were calculated to identify correct classification of Regional and National players based on the discriminant analysis. The discriminant analysis corresponded to an overall predictive accuracy of 63.3% for all players with an accuracy of 62.6% and 65.1% for Regional and National players respectively.

Discussion

The aims of the present study were to firstly determine if anthropometric and physical performance differences existed (whilst controlling for chronological age and maturational status) between regional and national selected UK junior Rugby League players. The second purpose was to identify potential variables which discriminated between the selection levels, and were able to predict the likelihood of being a national compared to regional representative junior player. To meet these purposes, a large relatively homogenous sample of high performance junior players was utilised. The study differs from previous research in Rugby League [8,10,11] and other sports contexts [14] where skill level comparisons have only been made between more heterogeneous groups of elite and non-elite players. Likewise, the study adds to present understanding by examining data obtained over four years of implementing a national governing body's talent identification and development pathway (i.e. RFL player performance pathway). Present findings demonstrated a significant main effect for chronological age, maturational status and selection level with both anthropometric and physical performance differences found between selection levels.

Findings suggest that biological growth and physical performance qualities contribute toward national selection level in UK junior Rugby League, even though the testing battery was not used as a basis for selection. Chronological age and maturational status (years from PHV), entered in the analyses as covariates to adjust for age and maturational variation, were consistent and strong influences upon dependent variables. Effect sizes identified strong relationships between chronological age and maturation with anthropometric characteristics (e.g. sitting height, body mass). These outcomes were expected as they are used in the prediction of age at PHV [17]. Effect sizes between covariates and physical performance measures were relatively smaller, with results consistent with the view that maturation is more strongly related to anthropometric than performance measures [14, 22] during periods of growth and development (i.e., puberty).

For anthropometric variables, the sum of four skinfolds produced a significant difference between selection levels, which differs from comparisons of body fat, when comparing elite and sub-elite Australian junior players [11] where no differences were found.

No differences were found for body mass in the current sample, which is consistent with Gabbett et al. [11], however, contrasts with Gabbett and Herzig's [10] whom identified significant differences in body mass. Research in field hockey [12] and volleyball [13] found no significant differences in anthropometric characteristics, with both studies examining a homogenous (junior elite v sub-elite) sample. In contrast, Mohamed and colleagues [14] did find significant differences in body mass, arm length, arm span and arm circumference in their elite and non-elite under 16 handball players, potentially highlighting the impact of sport demand, position and contextual variables upon the dependent variables in such studies.

For physical performance variables, national players outperformed regional players on all measures when controlling for chronological and maturational age. One possible explanation for the greater physical qualities amongst national players could be the significant difference in sum of four skinfolds. Previous research [23] has identified a negative relationship between body fat and performance (e.g. vertical jump) with possible reasons due to a reduction in power to body mass ratio [4] and an increase in thermoregulation demands [2]. Assuming all other things are equal, the increased body fat of regional players could have led to a decrease in vertical jump, speed, change of direction speed and estimated $\dot{V}O_{2max}$; thereby impacting the level of discrimination between regional and national levels.

Current findings for performance measures are consistent with previous findings [10,11] with advanced physical performance characteristics contributing toward the likelihood of national selection. However, although differences were evident, the magnitude of differences between regional and national level in the current sample were small, when assessed against differences between the Australian junior players (e.g., effect sizes for $\dot{V}O_{2max}$ was η^2=0.04 in the present analysis). A more descriptive example of this is the 0.02s difference in 10m sprint time between regional and national players in the current sample compared to 0.13s [11] and 0.34s [10] between playing levels in other studies. These data support the assertion that comparisons between groups that are substantially different in performance and/or skill level can be problematic, as they overstate the importance of physical qualities toward playing success [24]. The current sample of junior Rugby League players, who were all selected based on a broader basis of overall Rugby League performance, provides a more refined evaluation and discrimination between high performance playing levels than has been presented previously. The findings from this study identify that although physical qualities underpin playing success in Rugby League, the small differences in performance characteristics between regional and national players reported here, suggest that physical attributes combined with technical skills and tactical knowledge are all important for player selection at national junior level.

In similar research studies [12,13], where talented youngsters have been examined, technical characteristics (e.g. passing technique and accuracy in volleyball; [13]) have been shown to discriminate between selection levels. The lack of such assessments on technical and tactical skills amongst the current sample is a limitation of the present study. Although the current study only provides anthropometric and physical performance characteristics, coaches in the RFL pathway did provide an overall player evaluation, including attributes related to technical, tactical and attitude, which were measured subjectively. These may be useful indices in future studies.

The stepwise discriminant analysis determined that seven variables distinguished between regional and national players. These included (in order): estimated $\dot{V}O_{2max}$, chronological age, body mass, 20m sprint, height, sum of 4 skinfolds and sitting height, accounting for 28.7% of the overall variance. This means that seven anthropometric and physical performance measures accounted for 28.7% of those selected, with the remaining 71.3% likely to be made up from other variables associated with Rugby League performance (e.g. technical, tactical, psychological, etc.). Five of the seven variables were associated with age and anthropometric characteristics, demonstrating that in high performance junior groups, selection is affected and biased by particular factors and processes previously identified (e.g., relative age effects, [7,23]).

Conclusion

In summary, the present study examined differences in anthropometric and performance measures within a relatively homogenous high performing group of junior Rugby League players. Findings identified that national players outperformed their regionally selected counterparts on performance measures. However, due to the small magnitude in these differences, physical attributes may only partially contribute toward national selection in junior Rugby League. Instead, it seems more appropriate to consider a combination of physical, technical, tactical and psychological variables as more able to identify high performing players for a given context and stage of development. Thus, in talent identification research, it is important that future studies consider carefully, the sport context, age and skill level of participants, as well as the nature of referent groups used for comparison.

Practical Implications

- Junior Rugby League coaches should consider chronological age and maturational status in player assessments.
- Junior coaches should highlight the importance of low body fat to physical performance.
- Player selection should consider physical, technical, tactical and psychological variables.
- The sport context, participant characteristics (e.g. age, skill level) and levels of comparison should be considered when examining selection within junior sport.

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Table 1. Selection Level (regional v national) characteristics of UK junior Rugby League players.

			Covariates			
	Regional	National	Age	Years PHV	MANCOVA	η^2
Age (years)	14.62 ± 0.84	14.47 ± 0.84				
Age at PHV (years)	13.64 ± 0.58	13.54 ± 0.54				
Years from PHV	0.98 ± 0.95	0.93 ± 0.90				
Height (cm)	174.4 ± 7.8	174.4 ± 7.4	***	**		
Body Mass (kg)	69.7 ± 12.3	69.8 ± 10.9	***	**		
Sum of skinfolds (mm)	40.0 ± 16.3	36.6 ± 13.1	***	**	***	0.01
Vertical Jump (cm)	40.4 ± 5.5	41.3 ± 5.3	***		***	0.01
MB Chest Throw (m)	5.8 ± 0.8	5.9 ± 0.8	*	*	*	0.01
10m (seconds)	1.90 ± 0.12	1.88 ± 0.12	***	**	***	0.02
20m (seconds)	3.27 ± 0.19	3.23 ± 0.16	***	**	***	0.03
30m (seconds)	4.57 ± 0.26	4.52 ± 0.24	***	*	***	0.03
60m (seconds)	8.49 ± 0.55	8.37 ± 0.49	***		***	0.03
Agility 505 L (s)	2.51 ± 0.15	2.49 ± 0.14	***	***	***	0.01
Agility 505 R (s)	2.53 ± 0.15	2.51± 0.14	***	**	**	0.01
$\dot{V}O_{2max}$ (ml.kg^{-1}.min^{-1})	48.7 ± 5.2	50.3 ± 3.8	***	***	***	0.04

**P<0.05; **P<0.01; ***P<0.001.*

Table 2. Selection level and age category characteristics of UK junior Rugby League players.

	Under 13s			Under 14s			Under 15s		
	Regional	National	η^2	Regional	National	η^2	Regional	National	η^2
Age (years)	13.57±0.27	13.65±0.22		14.58±0.26	14.61±0.25		15.56±0.29	15.57±0.27	
Age at PHV (years)	13.58±0.68	13.44±0.51		13.59±0.55	13.53±0.52		13.75±0.53	13.68±0.57	
Years from PHV	-0.01±0.69	0.21±0.55		0.99±0.57	1.07±0.59		1.81±0.58	1.88±0.58	
Height (cm)	169.6±8.4	171.0±7.1		175.0±6.5	175.3±6.5		177.8±6.3	178.3±6.4	
Body Mass (kg)	62.4±11.4	63.7±9.0		70.2±10.8	71.1±9.3		75.8±10.9	77.6±9.7	
Sum of skinfolds (mm)	38.6±16.4	34.9±12.3**	0.03	40.1±17.1	35.8±12.2		41.1±15.8	39.9±14.5	
Vertical Jump (cm)	38.2±5.1	39.6±5.0*	0.02	40.3±5.3	41.9±5.1*	0.01	42.5±5.4	43.5±5.0*	0.02
MB Chest Throw (m)	5.1±0.7	5.4±0.6*	0.01	5.8±0.7	6.0±0.5*	0.02	6.4±0.7	6.5±0.6	
10m (seconds)	1.95±0.12	1.91±0.12**	0.03	1.91±0.09	1.87±0.10***	0.03	1.86±0.14	1.85±0.14	
20m (seconds)	3.38±0.20	3.29±0.14***	0.04	3.29±0.25	3.21±0.15***	0.04	3.19±0.17	3.17±0.17	
30m (seconds)	4.75±0.26	4.61±0.22***	0.05	4.58±0.22	4.50±0.21**	0.02	4.43±0.22	4.40±0.23	
60m (seconds)	8.89±0.56	8.59±0.47***	0.05	8.49±0.46	8.32±0.44**	0.02	8.17±0.41	8.10±0.43	
Agility 505 L (s)	2.59±0.14	2.55±0.13*	0.01	2.49±0.14	2.44±0.12***	0.04	2.46±0.14	2.45±0.16	
Agility 505 R (s)	2.61±0.14	2.57±0.14		2.51±0.15	2.46±0.11**	0.02	2.48±0.13	2.47±0.14	
$\dot{V}O_{2max}$ (ml.kg^{-1}.min^{-1})	46.35±4.66	49.46±3.74***	0.11	48.7±5.3	50.9±3.9**	0.03	50.6±4.8	51.1±3.6	

**P<0.05; **P<0.01; ***P<0.001.*