Abstract

Purpose: To assess a standardised testing battery's ability to differentiate anthropometric and physical qualities between youth, academy and senior rugby league players, and determine the discriminant validity of the battery.

Methods: A total of 729 rugby league players from multiple clubs within England categorised as youth (*n* = 235), academy (*n* = 362) and senior (*n* = 132) players completed a standardised testing battery that included the assessment of anthropometric and physical characteristics during preseason. Data was analysed using magnitude-based inferences and discriminant analysis.

Results: Academy players were most likely taller and heavier than youth players (effect size (ES) = 0.64 to 1.21), with possibly to most likely superior CMJ, medicine ball throw and prone Yo-Yo IR1 performance (ES = 0.23 to 1.00). Senior players were likely to most likely taller and heavier (ES = 0.32 to 1.84), with possibly to most likely superior 10 and 20 m sprint times, CMJ, CoD, medicine ball throw and prone Yo-Yo IR1 compared to youth and academy (ES = -0.60 to 2.06). The magnitude of difference appeared to be influenced by playing position. For the most part, the battery possessed discriminant validity with an accuracy of 72.2%.

Conclusion: The standardised testing battery differentiates anthropometric and physical qualities of youth, academy and senior players as a group and, in most instances, within positional groups. Furthermore, the battery is able to discriminate between playing standards with good accuracy and might be included in future assessments and rugby league talent identification.

Key words: talent identification; team sport; playing position; fitness; profiling

Introduction

In an attempt to improve sporting success at both club and national standards, governing bodies such as the Rugby Football League (England), have resourced Talent Identification and Development (TID) programmes to aid selection and training processes for young 'talented' players.[1] Clubs are also encouraged to develop young players, with financial incentives offered by the governing body that lifts salary restrictions on players eligible for both academy and senior rugby. This, in theory, offers young players a pathway into senior rugby league while allowing financially inferior teams to supplement their squad with "home grown" talent.[2] In rugby league, the majority of professional clubs run a TID programme, whereby players aged 14 and 15 and those aged 16 and 18 years are contracted to scholarship and academy teams, respectively.[3] Such programmes are designed to recognise players with potential, enabling them to excel early in their development[4-6] via appropriate coaching, welfare, and sport science provision.[5,7]

Entry onto a TID programme is multidimensional and typically includes physical, technical, tactical, social and perceptual skills[5,6,8] as well as considering maturation.[2,4,8] The anthropometric and physical characteristics of rugby league players appear important and can discriminate between playing standards,[9-11] positions,[12,13] those selected and not-selected onto a TID programme[14] and age categories.[15] For example, Tredrea et al.[14] observed that those players selected onto a TID programme were faster and more powerful than non-selected players. Till et al.[4] also reported that a combination of anthropometric and physical characteristics accurately discriminated between amateur and professional status in rugby league (sensitivity > 83%). Collectively, these studies indicate anthropometric and physical characteristics can be used to make informed decisions on a player's progression and development as well as identifying 'talent'; albeit, the need for reliable measures of anthropometric and physical characteristics that can discriminate between standards (i.e. discriminant validity) are required.[2,3]

The majority of studies to date examining the anthropometric and physical characteristics of rugby league players have collected data from a single club with relatively small sample sizes.[11,14,16] These limitations could be addressed with a national standardised testing battery that provides normative data on physical qualities for youth, academy and senior rugby league players from multiple clubs. To this end, a reliable testing battery was recently introduced that allowed youth, academy and senior players to be assessed efficiently using the same procedures with minimal cost.[17] What remains unclear is how the specific components of this battery differentiate between performance standards in male rugby league players and the discriminant validity of the testing battery as a whole. Accordingly, this study aimed to investigate differences in anthropometric and physical qualities between youth, academy and senior rugby league players across multiple clubs and thus establish the discriminant validity of a standardised testing battery.

Methods

Participants and Design

With institutional ethics approval, 729 male youth (*n* = 235), academy (*n* = 362) and senior (*n* = 132) rugby league players from 12 individual clubs participated in the study (Table 1). Youth players were affiliated with a scholarship programme and academy players were contracted to a professional club. Senior players were professional and had competed at least one full competitive season in the European Super League. Players at each standard were classified as back row forwards, props, hookers, halves, centres and fullback/winger and was based on the position they played most often.[13]

During the first two weeks of the Super League preseason, participants first completed measures of stature to the nearest 0.1 cm (Seca, Leicester Height Measure, Hamburg, Germany) and body mass to the nearest 0.1 kg (Seca, 813, Hamburg, Germany) wearing minimal clothing and no footwear before commencing the testing battery.[17] All testing, which took place at the club's own training ground on artificial turf, was preceded by 48 hours of no leisure- or club-based physical activity and participants were instructed to arrive in a fed and hydrated state. Participants were divided into two groups with group one completing the sprint and countermovement jump test whilst group two completed the change of direction test and medicine ball throw. The groups then swapped and came together to complete the prone Yo-Yo IR1. All measures were conducted by the same researcher in a standardised order and with no verbal encouragement provided. All participants were familiar with the procedures having completed these tests before as part of routine club monitoring activities.

Procedures

Sprint performance was measured using electronic timing gates (Brower, Speedtrap 2, Brower, Utah, USA) positioned at 0, 10 and 20 m, 150 cm apart and at a height of 90 cm. Participants began each sprint from a two-point athletic stance 30 cm behind the start line. Two maximal 20 m sprints were recorded to the nearest 0.01 s with two minutes between each attempt and the best 10 and 20 m sprint times used for analysis possessing a coefficient of variation (CV) of 4.2 and 3.6%, respectively.[17]

Participants completed two countermovement jumps (CMJ) with 2-minutes passive recovery between each attempt. Participants placed their hands on their hips and started upright before flexing at the knee to a self-selected depth and extending up for maximal height, keeping their legs straight throughout. Jumps that did not meet the criteria were not recorded, and participants were asked to complete an additional jump. Jump height was recorded using a jump mat (Just Jump System, Probotics, Huntsville, Alabama, USA) and corrected before peak height was used for analysis,[18] with a CV of 5.9%.[17]

Change of direction (CoD) performance was measured using electronic timing gates (Brower, Speedtrap 2, Brower, Utah, USA) placed at the start/finish line 150 cm apart and at a height of 90 cm. The test consisted of different cutting manoeuvres over a 20 x 5 m course (see Ref 17) with each effort interspersed by 2-minutes passive recovery. Participants started in two-point athletic stance 30 cm behind the start line and completed one trial on the left; the timing gates were then moved, and a second trial was performed on the right in a standardised order before the times were combined (CV = 2.5%).[17] Failure to place both feet around each cone resulted in disqualification and the trial being repeated.

To assess whole-body muscle function, participants began standing upright with a medicine ball (dimensions: 4 kg, 21.5 cm diameter) above their head before lowering the ball towards their chest whilst squatting down to a self-selected depth. With their feet shoulder width apart, in contact with the ground and behind a line that determined the start of the measurement, they were then instructed to extend up pushing the ball forwards striving for maximum distance. Distance was measured to the nearest centimetre using a tape measure from the back of the start line to the rear of the ball's initial landing imprint on the artificial surface. Participants completed two trials interspersed by 2-minutes recovery, with the maximum distance used (CV = 9.0%).[17]

The prone Yo-Yo IR1 required participants to start each 40 m shuttle in a prone position with their head behind the start line, legs straight and chest in contact with the ground. Shuttle speed was dictated by an audio signal commencing at 10 $km\cdot h^{-1}$ and increasing 0.5 $km\cdot h^{-1}$ approximately every 60 s to the point at which the participants could no longer maintain the required running speed. The final distance achieved was recorded after the second failed attempt to meet the start/finish line in the allocated time. The reliability (CV% = 9.9%)[17] and concurrent validity of this test have been reported.[19]

Statistical analysis

Data are presented as mean ± SD. Magnitude-based inferences and effect sizes (ES) with 90% confidence limits were used, with ES calculated as the difference between trials divided by the pooled SD. Threshold values for effect sizes were: 0.0-0.2, *trivial*; 0.21-0.6, *small*; 0.61-1.2, *moderate*; 1.21-2.0, *large*; >2.01, *very large*.[20] Threshold probabilities for a mechanistic effect based on the 90% confidence limits were: 25-75% possibly, 75-95% likely, 95-99% very likely and > 99.5 most likely.[21] Effects with confidence limits spanning a likely small positive or negative change were classified as unclear. Interpretation about the magnitude of difference was also assessed with reference to the 'required change' (typical error + smallest worthwhile change) for each test.[17] Statistical analysis was conducted using a predesigned spreadsheet for independent groups.[22] To identify which measures included in the standardised testing battery discriminate between youth, academy and senior players, a stepwise discriminant analysis was applied with playing standard included as the dependent variable and performance tests as predictor variables. Analysis was performed using SPSS version 25 with alpha set at 0.05.

Results

Analysis revealed *trivial* to *very large* differences between playing standards in several anthropometric and physical qualities (Table 1). Compared to youth players, academy and senior players were most likely taller and heavier, with senior players likely taller and most likely heavier than academy players. Differences in 10 and 20 m sprint times were likely trivial between youth and academy players but were possibly to very likely lower for senior players compared to youth (20 m only) and academy players. Countermovement jump height was most likely higher for academy players compared to youth, and most likely higher for senior players compared to youth and academy players. Differences in CoD time were likely trivial between youth and academy, and most likely faster for senior players. Medicine ball throw distance for senior was most likely higher compared to youth and academy, and most likely higher for academy compared to youth players. Prone Yo-Yo IR1 distance was most likely higher for senior players compared to youth and academy players, with distance possibly higher for academy compared to youth.

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

Normative data for each playing position at youth, academy and senior standard are presented in Table 2, with the magnitude of differences presented in Figure 1. Within-positional group differences ranged from *trivial* to *very large*, and for the most part, indicated that the differences between senior and academy players was smaller than between senior and youth players.

****INSERT TABLE 2 HERE****

****INSERT FIGURE 1 HERE****

Stepwise discriminant analysis identified that a combination of seven predictor variables would successfully and significantly discriminate between youth, academy and senior players ($P < 0.000$). The variables were 20 m sprint time ($\wedge = 0.976$), change of direction time ($\wedge = 0.942$), prone Yo-Yo IR1 distance ($\wedge = 0.931$), stature ($\wedge = 0.872$), countermovement jump height ($\wedge = 0.792$), body mass ($\wedge = 0.651$) and power pass ($\wedge = 0.631$). The squared canonical correlation was 0.560 meaning these eight performance measures combined accounted for 56.0% of the overall variance in the data set. Cross-validation classification indicated that the discriminant analysis corresponded with an accuracy of 72.2% overall, equating to 68.9% (162/235) of youth players, 79.0% (286/362) for academy players and 59.1% (78/132) for senior players.

Discussion

This study assesses the ability of a reliable testing battery to differentiate anthropometric and physical characteristics between youth, academy and senior rugby league players and explores how these tests discriminate between playing standards. Results revealed different anthropometric and physical profiles at senior compared to youth and academy standards, and that all but 10 m sprint time were able to discriminate between youth, academy and senior players. The proposed testing battery is sensitive and can differentiate anthropometric and physical profiles within positional groups between youth, academy and senior rugby league players.

Anthropometric characteristics differentiated between playing standards reaffirming their importance in rugby league.[13,15,16] The difference observed between youth and academy players is expected and likely reflects maturation[15] as well as the greater training volume and physical demands of senior compared to academy match-play. For example, the relative number of defensive tackles (forwards: 0.47 ± 0.23 *cf.* 0.34 ± 0.13 $n \cdot \text{min}^{-1}$; backs: 0.16 ± 0.11 *cf.* 0.13 ± 0.08 $n \cdot \text{min}^{-1}$ for senior and academy, respectively) and offensive carries (forwards: 0.20 ± 0.10 *cf.* 0.12 ± 0.06 $n \cdot \text{min}^{-1}$; backs: 0.15 ± 0.08 *cf.* 0.06 ± 0.04 $n \cdot \text{min}^{-1}$ for senior and academy, respectively)[23] likely explains the requirement of greater body mass in senior players. In agreement with Morehen et al.[13] for senior players but also for youth and academy, we observed large positional variation in stature and body mass. Differences in stature between youth and senior players ranged from *moderate* to *large*, whereas between academy and senior players, the magnitude was lower. *Large* differences in body mass were observed within positional groups between youth and academy players but was reduced to *moderate* when comparing academy to senior players. These results demonstrate that stature and body mass can discriminate between playing standards and should be included as part of a TID programme in rugby league.

Whilst smaller scale studies have inferred sprint speed differentiates between performance standards in rugby league,[11,14,16] this study observed *trivial* differences in 10 m and 20 m sprint times between youth and academy players. This might be explained by the large increase in body mass[24] as players progress from youth to academy, meaning an impaired technical capacity[25] and players needing to overcome a greater inertia when sprinting from a stationary start. Despite senior players being heavier than both youth and academy, they possess similar or faster sprint times that suggests they could generate greater force and power during the sprints.[25] These observations reaffirm the importance of senior players possessing both high speed and high body mass in order to generate momentum into collisions,[26] though it should be noted that 10 m sprint times were excluded during the stepwise discriminate analysis. The within-position difference between playing standards revealed differences in 10 and 20 m sprint times between academy and senior wingers, halves, props and backrow forwards but not centres or hookers; albeit, few of these differences in sprint performance exceeded the 'required change'.[17] We propose that 10 m sprint times *per se* might not discriminate between youth and academy players regardless of playing position but that 20 m sprints times can discriminate between playing standards.

Senior players possessed most likely faster CoD time compared to youth and academy players, with the mean difference exceeding the 'required change' (0.76 *cf.* 0.67 s).[17] However, similar to previous findings,[11] there was no meaningful difference in CoD between youth and academy players. Again, the faster CoD times for senior players is likely explained by increased exposure to specific training practices that enable greater muscle power contributing to change of direction ability.[27] Whilst only *trivial* differences existed between youth and academy mean CoD times, a *small* difference was observed for hookers and props, though did not exceed the 'required change'.[17] The CoD test was able to differentiate senior wingers/fullbacks, hookers and back row forwards from academy and youth players. The similarity between youth and academy players could be explained by the *trivial* differences in 10 and 20 m sprint times as well as the potentially varied exposure to accelerating, decelerating and cutting mechanics during training (i.e. 1 to 3 years). Discriminant analysis revealed that CoD is a significant predictor and should be include in future testing batteries for the purpose of TID.

A *moderate* difference in CMJ was observed between youth and academy players, and academy and senior players, with the mean differences exceeding the 'required change' (2.9 cm).[17] Similar observations for the medicine ball throw revealed *moderate* differences between youth and academy, and academy and senior, all that exceeded the 'required change' of 0.7 m.[17] Further, discriminant analysis revealed both CMJ and medicine ball throw as predictors of playing standard, though it is also important to recognise the within-position difference between groups. For example, differences in CMJ between youth and academy players ranged from *small* to *moderate* and were greater than the 'required change' for all positions. Differences in CMJ between academy and senior players were in agreement with previous research,[9,28] ranging from *small* to *large* and were greater than 2.9 cm. Positional differences in the distance achieved during the medicine ball throw between youth and academy players ranged from *small* and *large,* exceeding 0.7 m for all positions except props. Positional differences in medicine ball throw between academy and senior players were more varied ranging from *small* to *large.* The *large* effect for CMJ and medicine ball throw between academy and senior props might suggest that this position becomes specialised as players progress through to senior rugby and are required to develop power to a greater extent than other playing positions.

Small differences that did not exceed the 'required change' (48 *cf.* 120 m) suggest the prone Yo-Yo IR1 was unable to differentiate between youth and academy players. However, when combined with the six additional variables, the stepwise discriminant analysis revealed the prone Yo-Yo IR1 as a significant predictor of playing standard. The *large* increase in body mass (ES = 1.21) from youth to academy probably impacts negatively on the older player's ability to get up from the prone position and perform intermittent shuttle running.[29] While academy coaches might focus on increasing body mass to aid running momentum and impact forces during the collision[3] as players progress from youth rugby, they should be mindful of the detrimental trade-off on rugby-specific high intensity running. In contrast, *moderate* differences exceeding 120 m were observed between younger (i.e. youth and academy) and senior players. Whilst senior players also possess greater body mass, they seemingly tolerate this better during the prone Yo-Yo IR1 probably because of the smaller increases in body mass from academy to senior rugby (ES = 0.70) and greater emphasis on specific high intensity training. Collectively, the ability to get up from the prone position, accelerate and perform repeated intermittent running, while also maintaining a high body mass, is important for elite rugby league players. Positional differences for the prone Yo-Yo IR1 between youth and academy halves were *trivial* whereas all other positional differences were *small*. A *trivial* difference was also observed when comparing academy and senior halves; *small* for wingers/fullbacks and centres; *moderate* for hookers and back row forwards; and *large* for props. These observations might reflect differences in position-specific training as players progress from academy to senior rugby and that based on the discriminant analysis should be incorporated into future assessments of a player's high-intensity intermittent running ability.

Discriminate analysis determined, that seven of the eight performance measures included in the battery (i.e. stature, body mass, 20 m sprint times, CMJ height, CoD time, medicine ball throw distance and prone Yo-Yo IR1 distance) discriminated between youth, academy and senior players. These accounted for 56% of the variance between youth, academy and senior players, with the remaining 44% accounted for by other variables associated with sporting performance (e.g. technical, tactical, social and psychological skills). Overall, the analysis possessed a predictive accuracy of 72.2%, which equated to 68.9% for youth players, 79.0% for academy players and 59.1% for senior players. These results suggest that a combination of seven performance measures were able to place youth and academy players to a greater degree of accuracy compared to senior players where a large (41.1%) proportion of players were incorrectly placed into the academy group. Furthermore, a third (31.1%) of youth players were incorrectly identified as academy players while 12.4% and 8.6% of academy players were incorrectly placed within the youth and senior groups, respectively. Our results indicate a degree of overlap in the physical characteristics between youth and academy, and senior and academy players, suggesting that additional factors beyond physical characteristics also play an important role in talent progression and identification. Nonetheless, the high degree of predictive accuracy suggests that practitioners can use this testing battery to discriminate between performance standards in rugby league.

Whilst this study provides data on elite rugby league players across multiple clubs, inherent limitations exist. All data was collected at the start of the preseason period and might not reflect the 'optimal' anthropometric and physical characteristics of players.[30] We also acknowledge no measure of muscle strength within the battery, although recent work has reported the construct validity of mid-thigh pull dynamometer for discriminating between youth and senior rugby league players[10] that could be included in the standardised battery.

Practical Applications

The standardised testing battery is able to differentiate between playing standards and, excluding 10 m sprint time, possesses discriminant validity. The testing battery can also, for the most part, be used to differentiate within playing positions between youth, academy and senior standards. Finally, the data represents normative data for UK-based youth, academy and senior rugby league players. As such, practitioners in rugby league can use this battery and the data presented to monitor players and support the decision-making process concerning a player's development or progression through performance standards in rugby league.

Conclusion

This study demonstrates the discriminant validity of a standardised testing battery for assessing anthropometric and physical qualities between youth, academy and senior rugby league players. Our results revealed that, for the most part, senior players possessed superior anthropometric and physical characteristics compared to youth and academy players, with fewer clear differences between youth and academy players. Furthermore, playing position influenced the magnitude of difference between performance standards and should be considered when assessing the anthropometric and physical characteristics to inform talent identification and monitor player development in rugby league.

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Table 1. Anthropometric and physical characteristics for youth, academy and senior rugby league players.

Characteristic	Performance standard: Youth (*n* = 235)	Academy (*n* = 365)	Senior (*n* = 132)	Effect size ± 90% CI: Youth *cf.* Academy	Youth *cf.* Senior	Academy *cf.* Senior
Age (years)	15.1 ± 0.8	17.5 ± 2.0	23.7 ± 4.3	2.65 ± 0.17 *Most likely* ↑	8.11 ± 0.48 *Most likely* ↑	3.60 ± 0.32 *Most likely* ↑
Stature (cm)	172.6 ± 6.9	180.7 ± 6.4	182.7 ± 5.8	0.64 ± 0.13 *Most likely* ↑	0.92 ± 0.16 *Most likely* ↑	0.32 ± 0.15 *Likely* ↑
Body mass (kg)	73.6 ± 10.6	87.5 ± 11.7	95.6 ± 10.0	1.21 ± 0.13 *Most likely* ↑	1.84 ± 0.15 *Most likely* ↑	0.70 ± 0.14 *Most likely* ↑
10 m sprint (s)	1.83 ± 0.11	1.84 ± 0.11	1.82 ± 0.09	0.14 ± 0.13 *Likely trivial*	-0.06 ± 0.16 *Likely trivial*	-0.21 ± 0.15 *Possibly* ↓
20 m sprint (s)	3.16 ± 0.16	3.15 ± 0.16	3.09 ± 0.12	-0.06 ± 0.14 *Likely trivial*	-0.42 ± 0.16 *Very likely* ↓	-0.35 ± 0.14 *Very likely* ↓
CMJ height (cm)	33.3 ± 6.8	38.1 ± 6.3	42.5 ± 5.2	0.63 ± 0.12 *Most likely* ↑	1.12 ± 0.12 *Most likely* ↑	0.70 ± 0.14 *Most likely* ↑
Change of direction (s)	20.31 ± 1.22	20.44 ± 1.30	19.68 ± 0.84	0.10 ± 0.13 *Likely trivial*	-0.46 ± 0.14 *Most likely* ↓	-0.60 ± 0.13 *Most likely* ↓
Medicine ball throw (m)	6.3 ± 0.9	7.1 ± 0.8	8.1 ± 0.8	1.00 ± 0.14 *Most likely* ↑	2.06 ± 0.16 *Most likely* ↑	1.12 ± 0.15 *Most likely* ↑
Prone Yo-Yo IR1 (m)	727 ± 252	775 ± 233	930 ± 277	0.23 ± 0.13 *Possibly* ↑	0.74 ± 0.16 *Most likely* ↑	0.61 ± 0.17 *Most likely* ↑

Data are presented as mean ± SD, with effect sizes and magnitude-based inference based on the difference between groups. ↓ and ↑ represents less than and greater than, respectively.

Table 2. Position-specific anthropometric and physical qualities

		Winger/Fullback	Centres	Halves	Hooker	Prop	Back Row Forwards
Youth	Stature (cm)	174.6 ± 5.9	177.1 ± 5.2	172.9 ± 8.4	171.6 ± 7.2	178.4 ± 5.1	179.2 ± 6.2
	Body mass (kg)	69.3 ± 9.7	72.6 ± 7.5	66.4 ± 8.1	68.7 ± 10.5	85.3 ± 9.4	77.3 ± 8.3
	10 m sprint (s)	1.82 ± 0.09	1.81 ± 0.12	1.83 ± 0.13	1.85 ± 0.10	1.87 ± 0.11	1.82 ± 0.11
	20 m sprint (s)	3.12 ± 0.14	3.13 ± 0.15	3.19 ± 0.18	3.21 ± 0.17	3.22 ± 0.15	3.15 ± 0.16
	CMJ height (cm)	33.3 ± 6.7	34.1 ± 6.8	34.0 ± 6.4	34.6 ± 6.5	30.1 ± 7.3	33.7 ± 6.9
	Medicine ball throw (m)	6.4 ± 0.7	6.1 ± 1.2	5.9 ± 0.8	6.0 ± 0.8	6.8 ± 0.8	6.4 ± 0.6
	Change of direction (s)	19.78 ± 1.63	20.19 ± 0.96	20.36 ± 0.88	20.49 ± 1.10	20.81 ± 1.27	20.44 ± 1.04
	Prone Yo-Yo IR1 (m)	756 ± 248	742 ± 252	808 ± 232	776.8 ± 335	591.2 ± 249	702.2 ± 216
Academy	Stature (cm)	180.9 ± 6.5	181.4 ± 5.4	176.4 ± 5.0	173.8 ± 6.2	183.0 ± 6.1	183.0 ± 4.9
	Body mass (kg)	82.2 ± 9.5	85.3 ± 6.7	78.1 ± 6.8	78.1 ± 8.7	99.7 ± 11.7	90.9 ± 8.4
	10 m sprint (s)	1.80 ± 0.09	1.81 ± 0.09	1.83 ± 0.09	1.83 ± 0.09	1.91 ± 0.10	1.85 ± 0.12
	20 m sprint (s)	3.08 ± 0.15	3.10 ± 0.13	3.12 ± 0.14	3.11 ± 0.16	3.28 ± 0.15	3.16 ± 0.15
	CMJ height (cm)	41.9 ± 7.3	39.8 ± 5.8	38.3 ± 6.0	38.7 ± 5.3	34.2 ± 5.0	37.2 ± 5.3
	Medicine ball throw (m)	7.2 ± 0.9	7.3 ± 0.8	6.8 ± 0.8	6.8 ± 0.8	7.2 ± 0.8	7.3 ± 0.7
	Change of direction (s)	19.95 ± 1.27	20.11 ± 1.11	20.21 ± 1.06	20.08 ± 0.98	21.31 ± 1.46	20.54 ± 1.21
	Prone Yo-Yo IR1 (m)	773 ± 241	799 ± 226	871 ± 206	960 ± 256	615 ± 147	769 ± 215
Senior	Stature (cm)	180.4 ± 3.7	185.5 ± 5.8	178.3 ± 5.3	177.8 ± 4.1	187.4 ± 4.8	183.8 ± 4.7
	Body mass (kg)	90.3 ± 7.5	91.9 ± 8.1	90.2 ± 8.4	88.7 ± 6.3	107.7 ± 4.6	97.8 ± 8.9
	10 m sprint (s)	1.77 ± 0.08	1.83 ± 0.09	1.84 ± 0.07	1.82 ± 0.10	1.85 ± 0.10	1.82 ± 0.08
	20 m sprint (s)	3.01 ± 0.11	3.08 ± 0.10	3.14 ± 0.08	3.11 ± 0.11	3.13 ± 0.14	3.10 ± 0.12
	CMJ height (cm)	45.2 ± 4.8	43.0 ± 5.4	41.9 ± 4.0	44.3 ± 5.2	40.9 ± 4.5	41.0 ± 5.6
	Medicine ball throw (m)	8.0 ± 0.8	8.1 ± 0.6	7.8 ± 0.8	7.7 ± 0.7	8.5 ± 0.8	8.1 ± 0.9
	Change of direction (s)	19.09 ± 0.65	20.01 ± 1.06	19.65 ± 0.72	19.32 ± 0.67	20.15 ± 0.81	19.75 ± 0.70
	Prone Yo-Yo IR1 (m)	889 ± 224	885 ± 211	914 ± 255	1160 ± 275	834 ± 286	979 ± 307

Data are presented as mean ± SD. Youth - winger/fullback, centre, halves, hooker, prop and back row forwards; *n* = 48, 34, 38, 19, 33 and 63, respectively. Academy – winger/fullback, centre, halves, hooker, prop and back row forward; *n* = 60, 56, 46, 33, 70 and 97, respectively. Senior – winger/fullback, centre, halves, hooker, prop and back row forward; *n* = 26, 16, 19, 12, 26 and 33, respectively.

Figure 1. Within position comparisons for anthropometric and physical characteristics between youth, academy and senior players. Data expressed as an effect size ± 90% confidence limits. Magnitude-based inferences are included to demonstrate the certainly in difference between groups using the following qualitative descriptors: *possibly* *, *likely* **, *very likely* ***, *most likely* ****.