Fitness Profiles of Elite Adolescent Irish Rugby Union Players

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Abstract

Wood, DJ, Coughlan, GF, and Delahunt, E. Fitness profiles of elite adolescent Irish rugby union players. *J Strength Cond Res* 32(1): 105–112, 2018—Rugby unions throughout the world are implementing player development models to prepare young players to meet the demands of professional rugby union. An example of this is the Irish Rugby Football Union Long Term Player Development model. The purpose of this study was to provide normative data relating to the physical fitness of elite adolescent Irish rugby union players and determine the differences in the physical capacities between players in the forward and back units as well as to provide descriptive data for the position categorizations within these units for this unique population. Players in the forward unit were significantly taller and heavier than players in the back unit (1.85 ± 0.06 m and 96.88 ± 9.00 kg vs. 1.79 ± 0.05 m and 81.97 ± 7.09 kg, respectively). Forwards (38.37 ± 4.00 cm) had a significantly lower countermovement jump height than backs (41.31 ± 4.44 cm). Forwards had a significantly lower triple hop for the distance score on their right (5.78 ± 0.52 m) and left (5.78 ± 0.55 m) legs compared with backs (6.26 ± 0.42 m and 6.33 ± 0.45 m, respectively). Forwards (1.85 ± 0.07 seconds) had a significantly higher 10-m sprint time than backs (1.77 ± 0.06 seconds). Furthermore, forwards (675.90 ± 82.46 m) had a significantly lower 150-m shuttle test score than backs (711.71 ± 27.46 m). The results of this study provide normative data for players who currently possess underage international potential and could be used by strength and conditioning coaches to guide the selection of players through talent identification processes.

Key Words assessment, performance, team sport

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32(1)/105–112

Journal of Strength and Conditioning Research

Introduction

Rugby union is a field-based team sport characterized by intermittent bouts of high-intensity tasks (e.g., sprinting, tackling, collisions) interspersed by lower-intensity activity or rest (e.g., walking and jogging) (13). Considering these varied physiological demands, rugby union players require muscular strength and power, speed, agility, in addition to well-developed aerobic and anaerobic capacity (1). Players are grouped into 2 distinct units (forwards and backs) with each player assigned a designated number that represents a specific position within each unit (28). Each of the positional units' physical characteristics, technical skills, and physical demands during the game are well documented. Differences in the anthropometric and physiological profiles of the position units are typically related to the specific game demands of each unit. The contrasting roles between forward and back units suggest that specific physical capacities are required to perform game tasks safely and effectively. Furthermore, because unique positional categorizations within the forward and back units are required to perform specific tasks, it is probable that each unique positional categorization within the forward and back units is characterized by different anthropometric and physiological profiles.

Considering that rugby union is a highly demanding physical, tactical, and skill-based sport (10), it is important to develop and maintain physical fitness in players from an early age to withstand the physical demands of the game but also to reduce the risk of injury and prolong their playing careers (9). With this in mind, rugby unions throughout the world are implementing player development models to prepare young players to meet the demands of professional rugby union. An example of this is the Irish Rugby Football Union (IRFU) Long Term Player Development (LTPD) model (29), which is a framework to guide the development of the technical, tactical, physical, and psychological capacities required for the game. The IRFU LTPD is a 6-stage model, designed to serve participants from juveniles through to professional international players (29). The integrated framework is designed to facilitate the progression of rugby union players at all levels of participation and experience by ensuring that the standard of training and competition is always appropriate for the development stage of the players. Within the LTPD model, specific characteristics pertaining to each stage are based on the particular capacities of players at each stage of development. For example, the Train-to-Compete stage of the IRFU LTPD model (29) is designed for players who have committed themselves to rugby union as their primary sport and are willing to invest a significant amount of time and energy to develop themselves as positional specialists to undertake their positional roles. To accommodate for this, there is the deliberate inclusion of a comprehensive monitoring and testing system within the LTPD model that examines several current and potential physical and physiological characteristics (21). Such a monitoring and testing system allows coaches to continually assess players, allowing for the identification of the strongest and weakest link in the players' overall development as a rugby union player (4).

The IRFU National Talent squads are part of the IRFU's High Performance pathway. The squads consist of under-18 and under-19 elite junior players who have been identified at this point in their developmental progression as potential future senior international representatives. The goal of the National Talent squad is to identify and develop rugby talent with a long-term vision of channeling these players into elite professional setups and eventually the national senior squad. Regarding the LTPD model, these players reflect the Train-to-Compete stage of their rugby union development.

At present, there are a limited number of studies describing the anthropometrics and physical characteristics of adolescent rugby union players competing at an international level. The results of this study will provide normative data and unique information relating to the fitness profiles of elite adolescent Irish rugby union players at the Train-to-Compete stage of the LTPD model competing at an international level. Thus, the purpose of this study was to determine the differences in the physical capacities between players in the forward and back units of elite adolescent Irish rugby union players, as well as providing descriptive data for the position categorizations within these units. Based on the specific game demands of each unit position, we hypothesized that significant differences would exist in lower limb strength and power, linear speed, and anaerobic fitness between the forward and back units.

Methods

Experimental Approach to the Problem

The study was designed to determine the fitness profiles of elite adolescent international rugby union players at the Train-to-Compete stage of the IRFU LTPD model. Specifically, the study sought to provide normative data relating to the physical capacities for this unique population, to determine the differences in physical fitness between players in the forward and back units, and also to provide descriptive data for the position categorizations within the forward and back units. To answer these questions, each player underwent a battery of physical fitness tests, including indirect quantification of lower limb strength and power, as well as linear speed and anaerobic fitness. These assessments are commonly performed in rugby union populations, with all tests used previously shown to be valid and reliable.

Subjects

Eighty-nine male (18.66 ± 0.58 years) elite adolescent international rugby union players (age range, 17–20 years) participated in the study. All players were members of the IRFU under-18 and under-19 international teams and were participating at a training camp that included a specific fitness screening section. Players were categorized into forward ($n = 52$) and back ($n = 37$) position units. Players were also subcategorized into 8 designated on-field positions as follows: (a) prop ($n = 16$), (b) hooker ($n = 5$), (c) second row ($n = 12$), (d) back row ($n = 19$), (e) scrum half ($n = 5$), (f) out half ($n = 7$), (g) center ($n = 8$), and (h) back three ($n = 17$). The Institutional Review Board of the University College Dublin (U.C.D) approved the methods used in this study a priori. All subjects were informed of the methodology and they gave their written consent to participate. Individual written informed consent was received from all players aged above 18 years, whereas for players younger than 18 years, parental or guardian written informed consent was obtained with individual player ascent being assumed when a player presented for a prearranged testing session.

Procedures

Before each physical fitness test, each player partook in a supervised warm-up that consisted of 5 minutes of submaximal cycling followed by light jogging with active dynamic warm-ups and movement preparation of all major lower limb musculature.

Anthropometric Profile

Height and body mass were assessed using a Harpenden stadiometer (Holtain Ltd., Crymych, United Kingdom) and weighing scales (Holtain Ltd.).

Countermovement Jump Height

Countermovement jump (CMJ) height was measured using a jump mat (Just Jump System, Probiotics Inc., Huntsville, USA). Players began with their hands on their hips, and they were instructed to squat to a self-selected depth and immediately jump as high as possible. This protocol is similar to that used in previous investigations of CMJ performance (13). Previous findings have shown jump mats to be a reliable ($r = 0.877$) (25) and valid measure of the CMJ height ($r = 0.967$) (15). Each player was allowed 5 submaximal practice jumps before completing 3 maximal CMJs; with the highest jump height recorded (in centimeters) being used for analysis.

Triple Hop Jump for Distance

The triple hop jump for distance was used as an applied indirect quantification of lower limb strength and power of both legs (12). Previous findings have shown the triple hop jump for distance to be a reliable (intraclass correlation coefficient = 0.95–0.97) and valid measure to predict lower limb strength and power output in athletes (18). A standard fixed cloth tape measure was adhered to the ground, perpendicular to a starting line. Participants stood on the designated testing leg, with the great toe behind the starting line, and hopped twice on this leg before landing on both legs. Arm swing was permitted. All participants were allowed 1–3 practice attempts on each leg and then completed 1 test trial per leg. The investigator measured the distance hopped from the starting line to the point where the posterior aspect of the heel struck the ground upon completing the third hop (1).

10-m Sprint Time

The 10-m sprint was applied to assess the player's time to maximally run this distance from a standing start. Electronic timing gates (Brower Timing Systems, Draper, UT, USA) were placed 20 cm away from the lane width on each side at a height of 95 cm above ground level. Before testing, each athlete had to complete a standardized warm-up and performed submaximal efforts over 30 m at 50–60%, 70–80%, and 90% of their maximal effort. Adequate resting times were given before testing. Participants performed 2 maximum effort trials separated by a 5-minute rest interval to allow full recovery. Participants began at a fixed starting point 0.7 m behind the electronic timing gates. The athletes decided themselves when to start the test from a static position, with the time being recorded from when the participants intercepted the photocell beam. The fastest time (to 100th of a second) recorded by each player was used for analysis.

150-m Shuttle Test

The 150-m shuttle run test, also known as the 5-m multiple shuttle test, was selected to assess the anaerobic fitness of the participants. Previous findings have shown the 150-m shuttle run test to be a reliable measure (ICC = 0.86–0.98) (2) and have high direct validity ($r = 0.92$) (compared with high-speed distances covered in field sports) (3). The purpose of this test is to assess players' multisprint capacity. The multidirectional anaerobic endurance capacity of the test requires the athletes to accelerate, decelerate, and change direction frequently. The test involves running to shuttles marked at 5, 10, 15, 20, and 25 m. Participants had 30 seconds to complete as many shuttles as possible. The score for each run was calculated by recording the last cone touched before the 30-second time limit. Successful completion of all the shuttle runs would score 150 m. A rest interval of 30 seconds followed each run, and the procedure was repeated 6 times. A maximum score is 900 m.

Statistical Analyses

Position Units. A multivariate analysis of covariance test was conducted with position unit (forward vs. back) as the independent variable and age as the covariate. The dependent variables were height, body mass, CMJ, right-leg triple hop jump for distance, left-leg triple hop jump for distance, 10-m sprint time, and 150-m shuttle test distance. The level of statistical significance was set at $p \leq 0.05$. Furthermore, the relationship between the dependent variables for each position unit was investigated using Pearson's product-moment correlation coefficient. The strength of the correlations was evaluated according to the recommendations of Cohen (5) as

Table 1. Estimated marginal means for the forward ($n = 52$) and back ($n = 37$) units.

Dependent variable	Position unit	Mean	SD	95% CI	*p*	Effect size (partial eta squared)
Age (y)	Forward	18.70	0.57	19.85 to 20.17	=0.51	0.00
	Back	18.60	0.60	19.74 to 20.11		
Height	Forward	1.85	0.06	1.83 to 1.87	<0.01	0.22
	Back	1.79	0.05	1.77 to 1.81		
Body mass (kg)	Forward	96.88	9.00	94.58 to 99.17	<0.01	0.45
	Back	81.97	7.09	79.31 to 84.63		
Countermovement jump height (cm)	Forward	38.37	4.00	37.20 to 39.54	<0.01	0.10
	Back	41.31	4.44	39.96 to 42.66		
Right-leg triple hop for distance (m)	Forward	5.78	0.52	5.64 to 5.91	<0.01	0.20
	Back	6.26	0.42	6.10 to 6.42		
Left-leg triple hop for distance (m)	Forward	5.78	0.55	5.64 to 5.92	<0.01	0.22
	Back	6.33	0.45	6.17 to 6.50		
10-m sprint time (s)	Forward	1.85	0.07	1.83 to 1.87	<0.01	0.24
	Back	1.77	0.06	1.75 to 1.79		
150-m shuttle test (m)	Forward	675.90	82.46	657.80 to 694.00	=0.01	0.07
	Back	711.71	27.46	690.74 to 732.67		

CI = confidence interval.

TABLE 2. Correlation analysis for the forward unit ($n = 52$).

	Height (m)	Body mass (kg)	Countermovement jump height (cm)	Right-leg triple hop for distance (m)	Left-leg triple hop for distance (m)	10-m sprint time (s)	150-m shuttle test (m)
Height (m)	1	0.3 $p = 0.0$	0.2 $p = 0.1$	0.1 $p = 0.3$	0.2 $p = 0.2$	−0.1 $p = 0.4$	−0.2 $p = 0.3$
Body mass (kg)	0.3 $p = 0.0$	1	−0.1 $p = 0.5$	−0.4 $p = 0.0$	−0.4 $p = 0.0$	0.1 $p = 0.3$	−0.2 $p = 0.2$
Countermovement jump height (cm)	0.2 $p = 0.1$	−0.1 $p = 0.5$	1	0.5 $p = 0.0$	0.4 $p = 0.0$	−0.6 $p = 0.0$	0.00 $p = 1.0$
Right-leg triple hop for distance (m)	0.1 $p = 0.3$	−0.4 $p = 0.0$	0.5 $p = 0.0$	1	0.8 $p = 0.0$	−0.4 $p = 0.0$	−0.1 $p = 0.6$
Left-leg triple hop for distance (m)	0.2 $p = 0.2$	−0.4 $p = 0.0$	0.4 $p = 0.0$	0.8 $p = 0.0$	1	−0.4 $p = 0.0$	0.0 $p = 0.8$
10-m sprint time (s)	−0.1 $p = 0.4$	0.1 $p = 0.3$	−0.6 $p = 0.0$	−0.4 $p = 0.0$	−0.4 $p = 0.0$	1	−0.1 $p = 0.3$
150-m shuttle test (m)	−0.2 $p = 0.3$	−0.2 $p = 0.2$	0.0 $p = 1.0$	−0.1 $p = 0.6$	0.0 $p = 0.8$	−0.1 $p = 0.3$	1

follows: small $r = 0.10–0.29$; medium $r = 0.30–0.49$; large $r = 0.50–1.0$. The coefficient of determination (r^2) was calculated to interpret the level of variance that is shared between 2 variables (25). Statistical analyses were conducted in IBM SPSS Statistics 20 (IBM Ireland Ltd., Dublin, Ireland).

Position Categorizations. No formal statistical hypothesis testing was undertaken for the positional categorizations. Instead, mean and SD values for each of the tests were calculated for each of the following positions: (a) prop ($n = 16$), (b) hooker ($n = 5$), (c) second row ($n = 12$), (d) back row ($n = 19$), (e) scrum half ($n = 5$), (f) out half ($n = 7$), (g) center ($n = 8$), and (h) back three ($n = 17$). Mean and SD values were computed using IBM SPSS Statistics 20 (IBM Ireland Ltd.).

RESULTS

Position Units

Preliminary checks were conducted to ensure that there were no violations of the assumptions of linearity, homogeneity of variances, and homogeneity of regression slopes.

TABLE 3. Correlation analysis for the back unit ($n = 37$).

	Height (m)	Body mass (kg)	Countermovement jump height (cm)	Right-leg triple hop for distance (m)	Left-leg triple hop for distance (m)	10-m sprint time (s)	150-m shuttle test (m)
Height (m)	1	0.6 $p = 0.0$	0.0 $p = 0.1$	0.2 $p = 0.2$	0.2 $p = 0.1$	−0.2 $p = 0.3$	0.0 $p = 0.9$
Body mass (kg)	0.6 $p = 0.0$	1	0.0 $p = 0.1$	0.1 $p = 0.6$	0.0 $p = 1.0$	0.2 $p = 0.2$	−0.4 $p = 0.0$
Countermovement jump height (cm)	0.0 $p = 1.0$	0.0 $p = 1.0$	1	0.5 $p = 0.0$	0.5 $p = 0.0$	−0.5 $p = 0.0$	0.2 $p = 0.3$
Right-leg triple hop for distance (m)	0.2 $p = 0.2$	0.1 $p = 0.6$	0.5 $p = 0.0$	1	0.9 $p = 0.0$	−0.3 $p = 0.1$	−0.2 $p = 0.9$
Left-leg triple hop for distance (m)	0.2 $p = 0.1$	0.0 $p = 1$	0.5 $p = 0.0$	0.9 $p = 0.0$	1	−0.3 $p = 0.1$	0.0 $p = 0.8$
10-m sprint time (s)	−0.2 $p = 0.3$	0.2 $p = 0.2$	−0.5 $p = 0.0$	−0.3 $p = 0.1$	−0.3 $p = 0.1$	1	−0.3 $p = 0.1$
150-m shuttle test (m)	0.0 $p = 0.9$	0.4 $p = 0.0$	0.2 $p = 0.3$	−0.2 $p = 0.9$	0.0 $p = 0.8$	−0.3 $p = 0.1$	1

Table 4. Means values for position categorizations ($n = 89$).

Dependent variable	Prop ($n = 16$)	Hooker ($n = 5$)	Second row ($n = 12$)	Back row ($n = 19$)	Scrum half ($n = 5$)	Out half ($n = 7$)	Center ($n = 8$)	Back three ($n = 17$)
Age (y)	18.8 ± 0.6	18.7 ± 0.6	18.7 ± 0.5	18.6 ± 0.6	18.7 ± 0.7	18.4 ± 0.7	18.8 ± 0.6	18.6 ± 0.6
Height (m)	1.8 ± 0.0	1.8 ± 0.00	1.9 ± 0.0	1.8 ± 0.0	1.7 ± 0.0	1.8 ± 0.0	1.8 ± 0.1	1.8 ± 0.0
Body mass (kg)	103.2 ± 9.1	94.6 ± 4.1	99.2 ± 4.4	90.1 ± 7.8	75.2 ± 8.5	80.4 ± 5.7	84.7 ± 8.1	83.1 ± 6.0
Countermovement jump height (cm)	37.3 ± 3.8	35.7 ± 5.0	38.8 ± 3.3	39.7 ± 3.9	40.0 ± 1.9	37.3 ± 1.9	42.0 ± 2.8	42.2 ± 4.4
Right-leg triple hop for distance (m)	5.5 ± 0.6	5.6 ± 0.7	5.9 ± 0.5	6.1 ± 0.3	6.0 ± 0.4	6.1 ± 0.2	6.4 ± 0.4	6.4 ± 0.5
Left-leg triple hop jump for distance (m)	5.5 ± 0.5	5.5 ± 0.9	5.9 ± 0.6	6.1 ± 0.4	6.0 ± 0.4	6.2 ± 0.3	6.4 ± 0.4	6.4 ± 0.5
10-m sprint time (s)	1.9 ± 0.1	1.9 ± 0.1	1.9 ± 0.1	1.8 ± 0.1	1.8 ± 0.1	1.8 ± 0.0	1.8 ± 0.0	1.8 ± 0.1
150-m shuttle test (m)	665.7 ± 19.7	686.0 ± 8.2	644.2 ± 164.9	702.6 ± 19.9	719.0 ± 28.8	705.0 ± 13.5	716.3 ± 21.0	708.8 ± 34.4

Levene's test of equality of error variances was not violated for any of the dependent variables. There was a significant difference between the forward and back units on the combined dependent variables, $F(7, 80) = 14.22$, $p < 0.01$; Wilk's lambda = 0.44; partial eta squared = 0.55. The estimated marginal means of the dependent variables for players in the forward and back units are described in Table 1. The results of the Pearson's product-moment correlation analysis for the forward and back units are presented in Table 2 and 3, respectively.

Position Categorizations

Mean and SD values for each of the tests for the position categorizations are presented in Table 4.

Discussion

The aim of this study was to describe and contrast the physical capacities and fitness profiles of elite adolescent Irish rugby union players. We hypothesized that significant differences would exist between the forward and back units. The results of this study confirmed our primary hypothesis.

Players in the forward unit were significantly heavier and taller than players in the back unit. This difference in body mass and height between forward and back units has also been observed at underage representative (8,15,26), professional (24), and senior international levels (23). These anthropometric distinctions were observed by Lombard et al. (15) in a group of elite under-20 South African international representatives who were preparing for the 2010 junior world championships. The average body mass for a forward in the present study was 96.88 ± 9.00 kg, whereas the average body mass for a player in the back unit was 81.97 ± 7.09 kg. The average body mass of the forward and back units in the present study differ substantially from those observed by Lombard et al. (15), in which the average body mass for a forward was 106.89 ± 12.61 kg, whereas the average body mass for a player in the back unit was 87.93 ± 13.56 kg. The average height for a forward in the present study was 1.85 ± 0.06 m, whereas the average height for a player in the back unit was 1.79 ± 0.05 m. These results do not differ substantially from those observed by Lombard et al. (15), in which the average height for a forward was 1.87 ± 0.09 m, whereas the average height for a player in the back unit was 1.79 ± 0.10. The anthropometric profile of the forward unit in the study by Lombard et al. (15) may represent a more beneficial game-specific profile compared with the findings of the present study. It has been proposed that a larger anthropometric profile (i.e., increased body mass and height) of players in the forward unit may provide a competitive advantage with respect to scrummaging, lineout jumps, mauls, rucks, and tackling (7,10,20,22).

The CMJ height and the triple hop jump for distance were selected as an indirect quantification of lower limb strength and power. Countermovement jump performance requires a significant amount of impulse to be produced vertically by the lower limb musculature to achieve a maximal jump height. Similarly, the triple hop for distance performance is dependent on the amount of impulse produced by the lower limb musculature in a horizontal direction. To our knowledge, no previous authors have assessed CMJ flight time with rugby union players of a similar age to the players include in this study. Previous studies (14,26) have selected the vertical jump to assess lower limb strength and power; however, we decided to select the CMJ because it has been shown to be a greater predictor of lower limb strength and power. A study by Markovic and colleagues (16) reported that CMJ flight time had a stronger relationship with lower limb power ($r = 0.87$) and also greater reliability (Cronbach's a = 0.98) than vertical jump flight time. The protocol for the CMJ requires subjects to place their hands on hips during the jump, thus minimizing arm action, in contrast, the vertical jump allows for arm action, and this may enhance flight time. Thus, by selecting the CMJ instead of the vertical jump, it allows us to more accurately predict lower limb strength and power in relation to CMJ flight time.

The results of this study showed that players in the forward unit had a significantly lower average CMJ height (38.37 ± 4.00 cm) compared with the average CMJ height (41.31 ± 4.44 cm) of the players in back unit. The average triple hop jump for distance (the mean score for both the right and left legs) for a forward in this study was 5.78 ± 0.53 m, whereas the average triple hop jump for distance (the mean score for both the right and left leg) for a back was 6.29 ± 0.43 m.

The findings of this study relative to the differences in CMJ height and triple hop jump for distance between the forward and back units are not unexpected. Players in the forward unit require high levels of muscular strength and power for successful completion of game tasks, particularly in scrums, rucks, and mauls (19). During competition, forwards spend ~70% of their high-intensity activity involved in static exertions, and therefore, the ability to produce substantial force in close-contact situations is crucial. In contrast, players in the back unit only spend ~25% of their game time in static exertions. However, players in the back unit require substantial muscular strength and power to optimize their running speed, and their ability to change direction, to beat the opposition and also achieve higher speeds in both attack and defense (23). This may explain the observed significant difference in CMJ and triple hop for jump distance performances between the forward and back units.

The average 10-m sprint time for a forward in this study was 1.85 ± 0.07 seconds, whereas the average 10-m sprint time for the backs was 1.77 ± 0.06 seconds. These differences between forward and back units have also been observed at underage representative (15,26) and professional (24) levels. The results of this study differ from those observed in a similarly aged cohort by Lombard et al. (15), in which the average 10-m sprint time for a forward was 1.76 ± 0.13 seconds, whereas the average 10-m sprint time for a back was 1.69 ± 0.15 seconds. The 10-m sprint time of the forward and back units in the study by Lombard et al. (15) would represent a considerable advantage to the findings of the present as speed has been shown to be a fundamental physical capacity related to success in competitive rugby union (11). Previous studies (24,27) have found that faster players will break tackles, evade opposing players, score tries more frequently, and arrive at the defensive line quicker. The differences in 10-m sprint times observed by Lombard et al. (15) compared with this study may be attributable to several factors. The players who participated in the Lombard et al. (15) study were members of the under-20 South African junior world championships team, whereas the participants in this study were involved with the under-18 and under-19 national teams. The greater training age of the players involved in the study by Lombard et al. (15) would give them more time to develop themselves anthropometrically and to improve their physical capacities to adhere to the physical demands of rugby union.

Although the ability to produce a high-power output for a short period is essential for rugby union players, it is the reproduction of these briefs bouts of high-intensity exercise that is important (20). Based on these observations, the 150-m shuttle test was selected to assess the players' anaerobic performance by evaluating their multisprint capacity. The results of this study show that players in the forward unit had a significantly lower mean 150-m shuttle test score (675.90 ± 82.46 m) than the average 150-m shuttle test score (711.71 ± 27.46 m) for players in the back unit. From our observations, this study is the first of its kind to use the 150-m shuttle test to assess the anaerobic capacity of rugby union players, and therefore this pilot work can be used by future studies to assess and compare similar-aged elite rugby union players.

Within the forward and back units, players are required to perform different game-specific tasks, which result in a further subdivision of players into specific positional categorizations. In this study, players within the forward and back units were subcategorized into 8 designated on-field positions. One of the aims of this study was to provide descriptive data for the specific position categorizations within the forward and back units, which are presented in Table 4. Considering the data presented in Table 4, we believe that our observations confirm the functionally distinct roles of players within the forward and back units, whereby anthropometric and fitness profiles relate to game-specific tasks of the positional subcategorizations.

Pearson's product-moment correlation analysis for the forward and back units was conducted to measure the degree of linear dependence across several physical variables that are necessary to meet the physiological demands of rugby union. Multiple relationships were observed between the physical characteristics derived from the fitness tests. Height was shown to be strongly significantly correlated with the back units body mass ($r = 0.61$, $p < 0.01$) and moderately correlated with the forward units body mass ($r = 0.31$, $p = 0.01$). The moderate to strong relationship between height and body mass is not unexpected as the higher stature of a player will be associated with increased levels of muscle and/or fat, and therefore a greater body mass. A larger body size correlates significantly with scrummaging force and competitive success (22). Although the correlations between height and body mass for the forward and back units are moderate to large, r^2 ranges from 10 to 37%. The fact that the 2 anthropometic characteristics are not more strongly associated may help to justify how other variables such as lean body mass may account for the unexplained common variance.

Significant moderate inverse correlations between body mass and right-leg triple hop jump for distance ($r = -0.45$, $p < 0.01$) and left-leg triple hop jump for distance ($r = -0.39$, $p < 0.01$) were found only in the forward unit, with r^2 ranging from 15 to 20%. The small association between the variables may help to explain why the body mass of players in the forward unit may be negatively associated with lower limb strength and power. Several observations from previous studies (7,24) have shown that players in the forward unit possess greater body mass and body fat percentage than players in the back unit to accommodate for the higher levels of forces that occur in close-contact situations. It may be postulated that the extra body mass of the players in the forward unit may consist of fat mass rather than lean tissue mass, which would reduce their power-to-weight ratio, and thus, their horizontal acceleration performance in the triple hop jump for distance would diminish. It is also interesting to note that players in the back unit had a significant moderate inverse correlation between body mass and 150-m shuttle test ($r = -0.38$, $p = 0.01$). However, only 14% of the common variance is explained between the 2 tests and other variables such as aerobic and anaerobic fitness, muscle fiber composition, and neuromuscular characteristics may contribute to the relationship. It may be postulated that players in the back unit were undertaking training regimens to induce hypertrophy or enhance their strength and power to adhere to the game demands of their specific positions, and as a consequence, their repeated sprint ability diminished. This underlies the importance of sport nutritionists and strength and conditioning coaches to ensure that players are under strict guidance regarding their dietary needs and training regimens to induce adaptations across all physical performance variables.

The 10-m sprint time was the most consistently correlated physical variable with other physical characteristics, specifically showing small to strong correlations with right-leg triple hop jump for distance ($r = -0.29$ to -0.42, $r^2 = 8$–18%), left-leg triple hop jump for distance ($r = -0.30$ to -0.37, $r^2 = 9$–14%), and CMJ performance ($r = -0.47$ to -0.58, $r^2 = 22$–34%) between the forward and back units. The negative relationship between unilateral triple hop jump for distance, CMJ performance, and 10-m sprint times was not unexpected. Each test is a derivative of lower limb strength and power, and these physical components are considered to be essential physical characteristics that underpin acceleration in rugby union players (6,7,17,20). However, the small to moderate associations between 10-m sprint time, CMJ performance, and unilateral triple hop for distance (r^2 ranges from 8 to 34%) indicate that other variables such as physiology, lean body mass, and relative strength and power have a considerable contribution regarding the relationships between speed, vertical, and horizontal jumping ability.

This study is the first of its kind to investigate the physical capacities of elite adolescent rugby union players in the Train-to-Compete stage of the IRFU's LTPD model. The results of this study provide normative data for this unique population and also for adolescent rugby union players competing at an international level. In addition, the results of this study indicate that players in the forward and back units possess distinct physical capacities and fitness profiles, which are likely contingent upon the specific functional roles of these positional units. The descriptive data provided for the positional categorizations confirmed the distinct roles of the players within the forward and back units.

Practical Applications

The Train-to-Compete stage of the IRFU's LTPD model is a crucial phase for adolescent players as they begin to develop as positional specialists. From a practical perspective, it is vital that coaches continuously assess and monitor the physical capacities of the players to allow for the identification of the strongest and weakest link in the players' overall development as a rugby union player (4). Based on the findings described in the present study, coaches and fitness staff can set specific training goals to adhere to the distinct functional roles of the players involved in the IRFU National Talent squad. Furthermore, from the unique sample group used, the study provides normative data for players who currently possess underage international potential and could also be used by strength and conditioning coaches to guide the selection of players through talent identification processes. The future sustainability of international success should remain a top priority for all sporting bodies within rugby union.

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