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Physical fitness profiles of elite women's rugby union players

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Abstract

Rugby union is a contact sport in which players require high levels of physical fitness, which is a composite of aerobic and anaerobic endurance, muscle strength and power, speed, agility and body composition. The aim of this study was to assess the physical fitness characteristics of elite female rugby union players. Thirty two elite female rugby players who were members of the South African Rugby Union High Performance Squad were assessed during the pre-season. The players were sub-divided into two positional categories consisting of 17 forwards and 15 backs. The players underwent a comprehensive physical fitness testing (height, body mass and sum of seven skinfolds, sit-and-reach, vertical jump, 10m and 40m speed, 1 RM bench press, pull-ups, one minute push-ups and multi-stage shuttle run test). Analysis of variance was used to examine the difference between forwards and back-line players with regards to physical fitness. There were statistical differences ($p < 0.01$) between positional groups, as forward players had a greater body mass, sum of skinfolds and body fat percentage than back-line players. In terms of explosive leg power, speed, muscular endurance, back-line players demonstrated superior performances. In contrast, no significant differences were detected between forward and back-line players in terms of flexibility, upper body strength (1 RM bench press and pull-ups) and estimated maximal aerobic power. These findings provide the coaches with a good understanding of the physical fitness of elite female rugby union players.

Keywords: Fitness, rugby, performance, positional groups.

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Introduction

Since men's rugby union became professional in 1995, the science of examining the sport has developed rapidly to meet the increased demand for knowledge on the requirements of the game and the physical fitness characteristics of players (Nicholas, 1997). It can be said that, as the men's game has developed, so too has the women's game (International Rugby Board, 2009). In 2000, when South African Rugby Union (SARU) accepted women's rugby into the rugby fraternity, there were less than 10 clubs playing on a social basis. At present, rugby is being played in 143 clubs throughout South Africa, involving 15129 female rugby players comprising 7167 senior female players, 4143 teen female

players and 3819 pre-teen female players within towns, suburbs and rural districts (International Rugby Board, 2009).

Competitive success in rugby union is related to anthropometric profiles (Duthie, Pyne, Hopkins, Livingstone, & Hooper, 2006b) and physical capacities of players such as strength (Mayes & Nutall, 1995; Quarrie & Wilson, 2000), speed (Quarrie et al., 1995; Duthie, Pyne & Hooper, 2003), muscular power (Deutsch, Kearney, & Rehrer, 2002) and aerobic fitness (Scott, Roe, Coats & Piepoli, 2003). Rugby union players have a diverse range of physical attributes, and a distinct physique will naturally orientate a player towards a particular position over others (Duthie et al., 2003). Back-line players, for whom sprinting ability is important for attacking and cover defending, have a lean physique, unlike forward players who are heavier, taller, and have a greater proportion of body fat as the physique is more suitable for dominating scrums, tackles, rucks and mauls (Rienzi, Reilly & Malkin, 1999). In addition, forward players also demonstrate greater absolute power and strength so as to defend as well as retain turn over possession (Argus et al., 2009).

Prior to the first sanctioned IRB Women's Rugby World Cup in 1998, a number of studies investigated the physical fitness characteristics of sub-elite and elite female rugby union players (Kirby & Reilly, 1993; Quarrie et al., 1995). There is, however, presently a dearth of information on the characteristics on contemporary elite female rugby union players. With this in mind, the purpose of present study was to investigate the physical fitness characteristics of elite female rugby union players.

Methodology

Research Design and Sample

Thirty two female rugby players selected from the South African Rugby Union High Performance Squad for the 2010 Women's Rugby World Cup participated in this study. The players were grouped according to playing positions: forward players (five props, two hookers, four locks, six loose forwards) and back-line players (nine inside backs and six outside backs). The players' ages ranged from 19 to 37 years. Prior to fitness testing, all players completed an informed consent. Ethical clearance was obtained from the Faculty of Community and Health Sciences and Senate Research Committees of the University of the Western Cape.

Testing Procedure

The subjects were assessed during the pre-season of the 2009 competition season. On arrival at the training camp, the sports physician and physiotherapist

conducted a full medical examination and musculo-skeletal screening on each player. Players with a medical condition or injuries were excluded from participating in the physical fitness assessment. The fitness testing protocol was then specifically completed in the following order:

Stature: The stature of each player was measured to the nearest 0.1cm using a stadiometer (Seca Model 708, Seca Germany) (Norton et al., 2000).
Body Mass: Body mass was measured using a calibrated scale (Seca Model 708, Seca Hamburg, Germany) with accuracy to the nearest 0.1 kg.

Skinfolds: Skinfold thickness was measured at seven sites (biceps, triceps, suprailiac, abdominal, subscapular, front thigh and medial calf) using a Harpenden skinfold calipers (Ross & Marfell-Jones, 1991). Thereafter, body fat was estimated as the sum of seven skinfolds (mm) and as a percentage of body mass according to Durnin and Womersley (1994). Body fat determination from skinfolds has a reliability ranging between 0.70 and 0.90 (American College of Sports Medicine, 2006).

Sit-and-reach: Flexibility was measured using the sit-and-reach test (Ellis et al., 2000). The sit-and-reach test has a test-retest reliability of 0.89 (Johnson & Nelson, 2000).

Vertical jump: Explosive leg power was tested using the Vertec Jump Tester (Sports Imports, Columbus, OH). Vertical jump height was measured as suggested by Logan, Fornasiero, Abernethy and Lynch (2000).

10 m and 40m speed: The acceleration and maximum velocity of players over 10m and 40m, respectively were evaluated using an electronic sprint timer with photo-electric sensors (Newtest Oy, Oulu, Finland). The speed test was measured as recommended by Durandt et al. (2006).

1 RM bench press: The 1RM bench press test, reflecting the maximum load that an individual could press once from the chest (Durandt et al., 2006), was used to assess strength. The final weight lifted successfully was recorded as the absolute 1RM in kilograms, and the relative bench press was calculated as 1RM/ (body weight). It has been demonstrated that the test-retest reliability of 1 RM measurements amongst experienced male and female lifters ranges from 0.92 to 0.98 (Logan et al., 2000).

Underhand pull-ups: The untimed pull-up test is widely used to assess body mass-related dynamic upper body muscular endurance. The underhand pull-up test was performed according to Durandt et al. (2006) with the maximal pull-ups

achieved being recorded as the subject's score. The reliability of the pull-up test is 0.95 (Vanderburgh & Edmonds, 1997).

Push-ups: The number of correctly performed push-ups in one minute was recorded for each player (Jackson, Fromme, Plitt, & Mercer, 1994).

Multistage shuttle run: The progressive multistage shuttle run was based on the protocol of Léger and Lambert (1982). The score was recorded as the number of the last completed lap and the maximal aerobic power was then predicted. The reliability and validity of the multistage fitness test protocol is 0.95 and 0.90, respectively (Léger & Lambert, 1982).

Statistical analysis

Analysis of the results was carried out using standard descriptive statistics (SAS version 9.0; SAS Institute Inc., Cary, NC, USA software). Analysis of variance (ANOVA) was used to examine the difference between forwards and backs with regards to physical fitness. Due to the large number of tests conducted, a more stringent level of significance of 0.01 was used rather than 0.05.

Results

The descriptive data for the two positional groups are contained in Table 1.

Table 1: Physical fitness data for the Elite Women's Rugby union players for forwards and backs

Variable	Forwards (n=16)	Backs (n=19)	p-value
Stature (cm)	165.20 ± 6.50	160.90 ± 6.40	0.0432
Body mass (kg)	78.94 ± 13.01	62.97 ± 5.96	0.0001 *
Sum of skinfolds (mm)	137.40 ± 30.08	106.66 ± 19.12	0.0003 *
Percent body fat (%)	30.81 ± 4.56	26.11 ± 3.81	0.0008 *
Sit-and-Reach (cm)	41.07 ± 5.30	39.91 ± 7.50	0.6423
Vertical Jump (cm)	37.50 ± 5.36	44.35 ± 5.06	0.0070 *
10m Speed (sec)	2.08 ± 0.08	1.90 ± 0.07	0.0002 *
40m speed (sec)	6.51 ± 0.31	5.96 ± 0.19	0.0001 *
1 RM Bench Press (kg)	63.57 ± 15.86	55.79 ± 9.17	0.3599
Ratio Scaled Strength (kg)	0.82 ± 0.17	0.90 ± 0.17	0.0418
Pull-ups (number per minute)	1.43 ± 3.20	2.74 ± 2.66	0.0566
Push-ups (number per minute)	16.46 ± 8.71	24.83 ± 9.47	0.0020 *
Estimated VO_2 max ($ml \cdot kg^{-1} \cdot min^{-1}$)	41.12 ± 9.28	46.49 ± 4.75	0.0276

*significant at $p < 0.01$

Forward players were found to have a greater body mass, higher sum of skinfolds and larger body fat percentage than back-line players ($p < 0.01$), whereas there was some evidence that forward players are taller, but the data did not show a significant difference. Back-line players produced a significantly ($p<0.01$) superior sprint (10 and 40m) and vertical jump performance than the forward players. In addition, back-line players completed a significantly ($p<0.01$) greater number of push-ups than forward players, however, no significant positional differences were detected in terms of flexibility, absolute and relative bench press strength, number of pull-ups and aerobic power.

Discussion

The results of this study show that forward players were significantly ($p<0.01$) heavier than back-line players. These current findings concur with previous observations on female rugby union players (Kirby & Reilly, 1993; Quarrie et al., 1995; Schick, Molloy & Wiley, 2008) and league players (Gabbett, 2007) at various playing levels. When the subjects positional body mass was compared with other players in relevant literature, the South African women's forward players had similar body mass compared to their international counterparts (Schick et al., 2008. However, the South African elite women's back-line players weighed less than the 2006 Women's Rugby World Cup players (Schick et al., 2008).

As expected the forward players had a higher percentage of body fat than back-line players. These values are higher than those reported for England's Female Rugby Union back-line players (21.2 ± 1.7 %) and forward players (26.11 ± 4.56 %) (Kirby & Reilly, 1993). Whilst excessive body fat may serve as a protective buffer in contact (Duthie, 2006), it acts as "dead weight" thus adversely affecting a player's work rate and speed (Duthie et al., 2003). This suggests that the South African female back-line players could benefit from loss of subscanteous fat, thereby improving their power and speed.

The results of this study indicated that the back-line players had significantly higher mean vertical jump values than the forward players. These results are similar to those reported in a previous study on New Zealand Senior Female Rugby Union forward players (Quarrie et al., 1995) where the back-line players produced a superior vertical jump performance compared with the forwards. However, it contrasts with results of studies by Kirby and Reilly (1993) and Gabbett (2007) conducted on elite women's Rugby Union and League players. In their studies no significant positional differences were found for the vertical jump test. Caution should be exercise in making any comparisons given the differences in vertical jump assessment technology over time (e.g. chalk board versus Vertec) (Duthie et al., 2003).

Speed is an integral requirement to successful performance in various contact football codes such as Australian Rules, Rugby League and Rugby Union (Baker & Nance, 1999; Sayers, 2000; Deutsch et al., 2002) as it is potentially decisive in determining the outcome of a game (Duthie, Pyne, Marsh & Hooper, 2006a). Both in 10m and 40m sprint, back-line players were significantly faster than forward players over 40m. The faster maximum sprint times are to be expected as back-line players perform a greater number of sprints during rugby games as they have greater space in which to run thus achieving higher speeds than forward players (Duthie et al., 2006a).

Forward players generally have higher levels of upper body strength when compared with the back-line players, as they are required to perform numerous strength-related activities during games, such as scrumming, rucking and mauling (Argus et al., 2009). Curiously, data from the present study revealed no statistical difference in 1RM bench press between forward and back-line players. This low level of strength amongst forwards suggests that the strength and conditioning coach should prescribe a more substantial strength training programme with an additional number of specific upper body sessions the forward players (Argus et al., 2009).

There were no significant differences in estimated maximum oxygen uptake values between forward and back-line players. This differs from previous research findings in which back line players possessed higher levels of endurance fitness than forward players (Quarrie et al., 1995; Gabbett, 2007). The values in this study were also lower than those of the senior female New Zealand Union forward and back-line players (44.75 and 54.48 $ml \cdot kg^{-1} \cdot min^{-1}$, respectively) (Quarrie et al., 1995). This suggests the need for the South African women rugby union players to develop their aerobic fitness.

Conclusion

In summary, the current data reinforces the substantial difference in physical fitness of rugby forward and back-line players. The forward players had a greater body mass, higher sum of skinfolds and larger body fat percentage whereas back-line players demonstrated superior leg power and speed. With forward and back-line players spending greater time in physical contact and sprinting during a game respectively, this lends credence to the concept of position-specific strength and conditioning programmes.

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