ORIGINAL RESEARCH ARTICLE

Physical and physiological profiles of Boland netball players

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Abstract

Objective. The primary aim of this study was to determine the physical and physiological profiles of 48 netball players (aged 18 - 24 years) playing in the super and first league in the Boland region. The secondary aim of the study was to compare the profiles of the Boland netball players with those of Australian under-21 players.

Design. The netball players were assessed for flexibility, speed, agility, power and aerobic endurance. Anthropometrical measurements were also taken. Descriptive statistics were calculated, after which Student s unpaired *t*-tests were used to compare results between the Boland and Australian under-21 netball players.

Results. The Boland players were statistically significantly faster over the first 5 m of a 20 m sprint; however, no significant differences were found at 10 m and 20 m between the 2 groups. The Australian players showed superior agility in both left and right feet, as well as vertical jump ability compared with the Boland players. The Boland players also had significantly lower aerobic endurance capacity compared with the Australian players. There were statistically significant differences in standing height and skinfold thickness between the two groups.

Conclusions. Our results indicate that Boland netball players, who can be considered representative of top-level players in South Africa, are not on the same physical fitness level as their Australian counterparts. The study also highlights the importance of similar and more comprehensive studies to obtain normative data for all levels of netball players.

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Introduction

It has been 10 years since the re-admission of South Africa to international sport. The South African national netball team played their first international tournament in 1994, and they are currently ranked fifth in the world. Upon re-admission it was apparent that our sports teams not only lacked specialised coaching and sportspecific skills, but also the physique and fitness that characterises elite sport. Over the past 10 years all of these components have been addressed, with a certain degree of success. This study is therefore an attempt to determine to what extent our netball players have developed into top-level players, by comparing their anthropometrical data and selected fitness test results with those of a group of elite-level Australian netball players.

Optimal performance in netball stems from a complex interaction of several factors, of which physical conditioning and technique are of utmost importance. Anne Miles[9] wrote: A netballer needs a strong, mobile body with plenty of stamina to last out an hour s hard play. Bloomfield *et al.*[3] described netball as an agility sport where the player must be extremely agile and able to jump . Netball, as a team sport, is an interval-type game played for 60 minutes, with predominantly high intensity, short bursts of movement and less intense recovery periods. It is a physically demanding game that requires a player to possess high levels of endurance, strength, speed, power, agility and flexibility.[10]

In the highly competitive environment of sport, the demands on players and coaches are always increasing. Selecting the players who will contribute to team success is one of the most important and difficult decisions a coach and team selectors will make at elite level. In order to achieve all-round improvement of players in the team or squad, the coach has to evaluate and assess the status and progress of the players on a regular basis.[4]

Players are being tested and measured, but this is often done randomly and informally and without profiles of the players being compiled. Profiling of the players in a squad has several important functions. General profiling can be done at the beginning of the season to identify strengths and weaknesses and to develop intervention programmes.[3] By repeating appropriate tests at regular intervals during the season, the effectiveness of a training programme can be evaluated. Feedback on test scores can also motivate the player to improve in a par-

ticular area.

Physiological and psychological tests, skill evaluation and physical capacity tests are used in athletic profiling. Foremost, individual results should be evaluated against those of the player s own teammates to ascertain the individual s status within the group. However, it is also useful to compare results with those of other high-level athletes or teams in the same sport to assess the standing of the individual or team on an international level.[3] Ellis and Smith[8] recommended some field tests as part of the test battery for use on the netball court at the training venue. These tests should focus on the major physical abilities required for playing netball, namely, speed and agility, acceleration, endurance, flexibility and explosive leg power, as well as anthropometrical measurements.

Netball is played on a daily basis in schools, clubs and at regional level. It has been reported that there are half a million players at school level (ages 16 - 19), with 9 700 adult players in South Africa. A national netball league is played on a weekly basis and the national netball team participates internationally on a regular basis.[12]

Despite the popularity of netball in South Africa, there is a lack of information on norms and standards for elite-level netball players. The aim of this study was, firstly, to obtain normative data on netball players in the Boland region. The Boland A team has won the South African netball championships for 3 successive years (2001 - 2003) and the under-21 team won the national U/21 tournament in 2004. Many players from the Boland region are regularly represented in national teams. The second aim of the study was to compare the physical characteristics and physical capacities of the Boland players with those of Australian under-21 players.

Methods

Participants

Forty-eight netball players from the Boland region participated in this research project. The group consisted of players from the super and first league and included provincial and national-level players. All players completed written, first-person informed consent forms.

Protocol

Testing took place on both outdoor and indoor courts. Participants were tested during May, i.e. in the midst of the competitive season. The first testing session included anthropometrical and power measurements, while the players were tested for speed, agility and aerobic endurance in the second session. Players had a warm-up period of 10 minutes prior to testing, consisting of running and stretching.

Anthropometry

Anthropometrical measurements were done according to the methods described by Norton *et al.*[11] Triceps, subscapular, biceps, supraspinal, abdominal, front thigh and medial calf skinfolds were measured using a Harpenden skinfold caliper with a constant pressure of 10 g/mm^2. Skinfolds were measured to the nearest 0.5 mm. Durnin and Womersley s[5] regression equation was used to predict body density from 4 skinfold measurements (sum of biceps, triceps, subscapula and supra-iliac). From body density, per cent fat was estimated using the Siri formula.[13]

A stadiometer with a perpendicular board and a hard, flat surface below were used to measure the players standing height, to the nearest 0.1 cm. Body weight was measured using a portable electronic scale, to the nearest 0.1 kg.

Flexibility

Flexibility around the hip joint was assessed using the sit-and-reach test.[7] Before the test, players were asked to stretch their hamstrings and lower back. Each player was instructed to sit on the floor with legs together, knees extended and with the soles of her feet against the box. She was then asked to lean forward as far as possible, with 1 hand on top of the other and palms facing down. The player was instructed to hold the full stretch for 2 seconds. The score (in cm) was noted as the most distant point on the box contacted by the fingertips. The best of 3 trials was recorded as the final score.

Power

The vertical jump test, using a wall-mounted board, was used to assess explosive leg power.[7] The player stood with either her left or right side against the wall, with feet flat on the floor. The player chalked her fingertips, elevated her shoulder, stretched out her arm and hand closest to the board, leaving a mark at the height of the full stretch. This was the first height recorded. From a stationary position, the player then took off, after a crouch, from both feet with no preliminary jumps. The player leapt up as high as possible to touch the board. Three attempts were allowed. Players rested between efforts. The distance between the initial mark and the highest jump was recorded as the test score.

Speed

The Swift speed light sport timing system (SL 9501 - 83) was used to measure the players sprint speed.[7] Timing gates were set at 0, 5, 10 and 20 m intervals. A start and finish line were marked with masking tape. The player started with the front foot up to the starting line. To eliminate reaction time, the player started the sprint when she was ready. The player sprinted as fast as possible through the finishing line. Players were asked not to slow down before the finish gate. Split times (at 5 m and 10 m) and final time (20 m) for 3 trials were recorded to the nearest 0.01 s. The best times were used as final result.

Agility

The 505 test was used to assess agility.[7] Timing lights were set up at 10 m from the starting line and 5 m from the turning point. The player assumed a standing starting position at the start line and could start the test when she was ready. The player was required to sprint from the starting line to the

turning point, where she had to turn and then accelerate off the line back through the light gates. Players had to perform 2 trials turning on the left foot and 2 trials turning on the right foot. Time to the nearest 0.01 s was recorded. The fastest time was recorded as the final score.

Aerobic endurance

Players were assessed through the use of the progressive multistage shuttle run (bleep test).[7] The test started at level 1. The tape emitted a single beep at the various intervals. The player had to place 1 foot on or behind the 20 m mark at the sound of each beep. Players who failed to reach the line at the sound of the beep received a warning that they would be eliminated if they were not at the opposite end of the 20 m track at the sound of the next beep. When players failed to reach the 20 m line twice in succession, the test was terminated. Their score was taken as the level and number of shuttles immediately prior to the bleep.

Statistical analysis

Descriptive data are presented as means – standard deviation (SD). Student s unpaired *t*-tests were used to compare results between the Boland and Australian under-21 netball players. Results were considered statistically significant if $p < 0.05$.

Results

The anthropometrical data for 48 elite Boland and 15 state-level Australian netball players are shown in Table I. Although the age details of the Australian players were not reported, they were classified as under-21 players.[8] According to age and level of competition, the 2 groups were therefore considered comparable.

The Boland players were statistically significantly shorter than the Australian players. Although there was no difference in weight between the 2 groups, the skinfold thickness (mean sum of 7 skinfolds) of the South African group was greater than that of their Australian counterparts. The Boland players were also significantly less flexible in their lower backs and hamstring muscles than the Australian players.

Fig. 1 depicts the results for the: (*i*) 20 m sprint; (*ii*) 505 agility; (*iii*) vertical jump; and (*iv*) 20 m shuttle run tests for the Boland and Australian netball players. The Boland players were faster over the first 5 m of a 20 m straight sprint (1.11 ± 0.05 seconds v. 1.15 – 0.07 seconds; $p < 0.05$); however, no differences were found at 10 m and 20 m between the 2 groups.

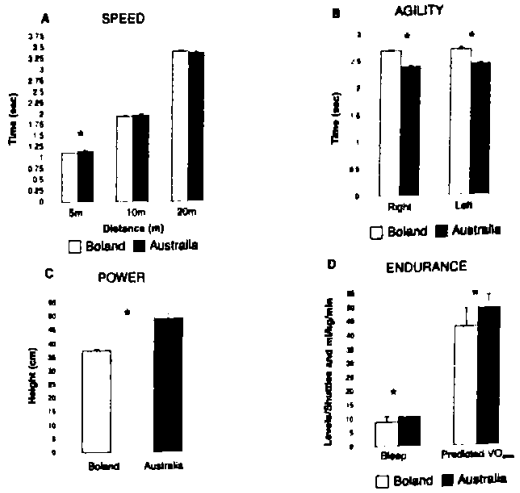

Fig. 1. A comparison of (A) horizontal speed, (B) agility, (C) vertical jump power and (D) endurance capacity of the Boland and Australian netball players (* $p < 0.05$).

The Australian players showed superior agility in both left and right feet compared with the Boland players (left: 2.44 – 0.10 s v. 2.71 – 0.15 s, $p < 0.05$; right: 2.40 – 0.10 s v. 2.69 – 0.12 s, $p < 0.05$). For both groups, there were no differences in foot speed between the left and right feet.

There was a statistically significant difference in vertical jump height between the 2 groups. On average, the Australians jumped 12 cm higher than the Boland group (49.0 – 7.0 cm v. 37.3 – 4.61 cm).

The results for the 20 m shuttle run test indicate that the Australians had greater aerobic endurance capacity than the Boland players ($p < 0.05$). The Boland players completed, on average, 2 shuttles less than the Australians. This relates to lower predicted VO_{2max} values for the Boland group, compared with the Australians (42.7 – 6.3 ml/kg/min v. 49.3 – 4.6 ml/kg/min.

Discussion

This study demonstrated that there were significant differences in both physical and physiological characteristics between elite Boland and Australian under-21 netball play-

TABLE I. Anthropometrical and flexibility data for elite Boland and state-level Australian netball players

	Boland				Australia			
Variables	N	Mean	SD	Range	N	Mean	SD	Range
Age (yrs)	48	20.4	3.3	18 - 24				
Weight (kg)	48	66.8	9.1	52 - 91	15	68.5	8.1	56 - 85
Height (cm)*	48	172.6	7.5	158 - 192	15	177.3	4.3	* 168 - 183
7 skinfold thickness (mm) *	48	108.2	29.7	41 - 178	15	82.4	29.4	33 - 159
% Body fat	48	25.0	4.3	13 - 34				
Sit-and-reach*	48	38.8	7.2	20 - 52	12	17.3	6.2	(4.5 — 24) *

$p < 0.05$.

ers. In 3 of the 4 physical tests the Australians showed superior performance.

On average, the Boland players were shorter in standing height and had greater skinfold thicknesses than their Australian counterparts. The latter may possibly indicate that the Boland players also had a higher body fat percentage than the Australians; however, body fat percentage values were not reported for the Australian players. In 1986, Bale and Hunt[1] reported the anthropometrical data for 29 English international netball players. Their per cent fat (24.5 – 3.9%) was similar to the Boland players data, but 4% higher than that of the provincial-level netball players of Elliott and Smith[6] and Woolford *et al.*[15] The range of the sum of 7 skinfolds (41 - 178 mm) for the Boland players was greater than that of the Australian players (33 - 159 mm), but extends well above the range of values reported by Telford *et al.*[14] for well-trained netball players (60 - 117 mm).

The Boland players did not perform well in the sit-and-reach test, indicating a lack of flexibility in the lower back and hamstring muscles. Although the applicability and specificity of the sit-and-reach test in netball can be argued, this test is widely used in sport as an indication of range of motion. Our results clearly show that this is a major weakness in the Boland players.

The fitness tests used in this study were selected to challenge the netball players in those aspects most important to their game, namely the ability to sprint from a stationary position and the ability to change direction at speed. Although the Boland players were significantly faster over the first 5 m of the 20 m sprint, there were no significant differences over 10 m and 20 m. The Boland players could therefore not sustain their speed over this short distance, possibly indicative of a lack of training for anaerobic speed and/or power. Since netball is characterised by repeated short sprints (often from a standing position), the ability to accelerate over a short distance is a very important performance parameter. It seems then that this aspect of the Boland players training was adequately addressed. However, the Boland players inability to sustain a high speed over 10 m and 20 m may catch up with them during a netball game when they are required to perform several short sprints. Therefore the need for superior anaerobic capacity must be emphasised in netball training.

Netball players should also be able to change direction, while maintaining their balance and speed. This ability was assessed using the 505-agility test. For both left and right feet, the Boland players were significantly slower than the Australian players. Again, in a game situation this is one of the most important physical requirements, which can greatly influence the outcome of a match. This, and sprint speed from a stationary position are fitness parameters that can easily be included in netball conditioning programmes.

The vertical jump test was included in the test battery, since jumping for height to intercept a ball during match play is an integral part of a netball game. Vertical jump height is an indication of the power of the extensor muscles of the hips, knees and ankles. On average, the Australian netball players jumped 24% higher than the Boland players, reflecting their greater leg power. Comparing our players results with the percentile scale of Barham and Wilson,[2] 19% of the Boland players were under the 50th percentile, while 23% were above the 90th percentile. Barham and Wilson[2] used a random sample of 120 netball players from all levels of competition to compile these percentile scores.

According to the endurance test results (multistage shuttle run test), the Australians were aerobically fitter than the Boland group. The Australians reached an average level of 10.73, while the Boland players reached 8.82. Although the mean aerobic capacities of the Boland players were within the range of the Australian players (8.27 - 13.00), the majority of our players were below the minimum value (8.27) for the Australian players.

The differences observed in the fitness tests could in part be explained by the differences in physical characteristics. As Ellis and Smith[9] pointed out, excess fat has no functional role in activities on court and can be regarded as dead weight. Excess fat decreases acceleration and is detrimental to a player s ability to rebound or leap for the ball.[15] It seems then that this is a specific area that coaches and netball players should work on.

It is also possible that our coaches concentrate more on the improvement of players ball skills and technique than on the acquisition of above-average fitness levels. Since our players are not full-time athletes and therefore have less time to work on this aspect of their sport, it is understandable that their fitness levels will only be average.

Conclusions

This study is the first attempt to provide normative data on provincial-level netball players in South Africa. Currently, great emphasis is placed on the development of all sport in South Africa and the introduction of sport to previously disadvantaged communities. However, in order to properly develop netball at all levels, one requires normative data for talent identification purposes. The results of this study may prove useful for this purpose, although more data should be collected from larger samples. It is also recognised that there is a relationship between physique and the type of sport in which people participate,[1] which highlights the need for comprehensive studies on the anthropometrical characteristics of netball players.

Secondly, the results of this study suggest that the physical fitness of Boland netball players, who we considered to be representative of top-level players in South Africa, is not on the same level as that of their Australian counterparts. The results not only highlight the shortcomings of the players, but are also a reminder to the coaches that physical fitness is an important ingredient in high-level netball performance.

The results of this study allow us to describe the general profile of provincial netball players in South Africa. As such, these results may be used for talent identification programmes,

but are also an indication to South African coaches of the strengths and weaknesses of South African players. It is suggested that similar data be collected from other provinces, in order to compile comprehensive South African norms. Furthermore, future studies should also focus on the differences between the various positions on the court, since the physical and physiological characteristics of goal shooters, defenders and centres may differ significantly.

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