BASKETBALL FITNESS TESTING PROTOCOLS

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# 1. Traceability Table

<table>
<thead>
<tr>
<th>Protocol Title</th>
<th>Date Implemented</th>
<th>Change Authorised by</th>
<th>Description of Alterations to Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP_Basketball_v1.0_2011</td>
<td>March 2011</td>
<td></td>
<td>Previous testing protocol document</td>
</tr>
</tbody>
</table>
| NP_Basketball_v2.0_2018 | March 2018       | Hamilton Lee         | Basketball Agility (Women’s protocol only) was changed to 505 Agility.
The previous agility test was of little value to coaches and conditioning staff so at the request of Jan Legg (S&C) the test was changed to the 505 (R & L legs for comparison). The database up to Dec 2017 was archived and a new 2018 database was created to avoid comparisons between different agility tests.
**Basketball Line Drill**
Electronic Light Gates are now the preferred method of timing in place of a handheld stopwatch.
*Functional movement screens removed from document*
*strength tests removed from document*
*warm up protocol added to document* |
2. Introduction

The testing protocols outlined in this chapter have been used extensively with elite junior players in programs of Basketball Australia. The tests presented here form a comprehensive test battery for junior players. A basic set of tests includes: anthropometry, 20m sprint, vertical jump, agility tests, sit and reach, line drill test, and the Yo-Yo intermittent recovery test (level 1). Coaches can elect, where equipment and specialist personnel are available, to add strength and power testing, and functional movement screening.

Various protocols have been established to assess the basketball-specific status of players preparing for national and international competitions. These performance and physical tests include body composition, upper and lower body strength, lower body power, physical competencies, speed, agility, repeat effort ability and aerobic endurance. Similar tests and testing programs have evolved elsewhere in the international game, particularly in the United States, for example, the NBA Combine test data (Kamalsky 2010) and SPARQ (Wood 2010), and in Europe. Some of this material has been published in the scientific literature but a substantial amount of work goes unpublished outside of the public domain. Other tests will evolve, and there are many variations of simple tests, giving coaches and scientists scope to develop more meaningful and useful tests. The comparative data on elite junior basketball players detailed here should provide a valuable resource for the basketball community.

The fundamental demands of basketball competition involve physiological contributions from both aerobic and anaerobic energy systems (Delextrat and Cohen 2008; Drinkwater et al. 2008; Ziv and Lidor 2009). A discrete set of physical competencies that translate into effective offensive and defensive performance during play are important as well. Basketball fitness also centers on strength (Drinkwater et al. 2008) to maintain the required musculoskeletal resilience to meet the demands of single and repeated games of tournament competition. The detrimental effect of fatigue experienced after basketball play has been assessed using many of the protocols described here (Montgomery et al. 2008a). A recent case study revealed that accumulated fatigue can negatively affect shooting performance (Erculi and Supej 2009). The relationships between fitness characteristics and game performance indicators are poorly understood, and the tests described in this chapter should be useful in this regard.

A comprehensive set of physiological and physical test protocols provides coaches and practitioners with information regarding the current fitness status of their players and short- to long-term improvement or impairment in key performance areas (Drinkwater et al. 2005, 2007; Montgomery et al. 2008b). Age and positional role differences in fitness performance in basketball are particularly evident in intermittent high-intensity endurance and agility performance (Abdelkrim et al. 2010b; Delextrat and Cohen 2009). It is clear that training should be individualized when dealing with positional roles in basketball. Interpretation of test data can influence decisions on training prescription to enhance fitness and performance but also career longevity and reduce the number of missed games through injury. Senior programs and teams need to establish their own normative data for interpreting test results.

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The benefits of a testing program are underpinned by specificity of the tests that measure key attributes of basketball and the efficiency with which the tests are administered to the entire playing roster. The tests selected here reflect recent and contemporary practice in high-level junior basketball and published scientific research. For example, cycle ergometer tests used in the 1990s have been superseded by the line drill test, which has greater relevance to on-court demands and discriminates seasonal performance (Montgomery et al. 2008a). Similarly, for aerobic assessment, the intermittent nature of the Yo-Yo intermittent recovery test is representative of game play and correlates highly with laboratory-based aerobic testing (Bangsbo et al. 2008; Castagna et al. 2008; Krstrup et al. 2003). Although the lane agility test used in the NBA Combine also has extensive historical data to assess how quickly a player moves around the key, the use of backward running in that test is questionable with respect to specificity, particularly in defensive play around the basket.

3. Athlete Preparation
Standardized pre-test preparation is needed to obtain reliable and valid physiological data.

3.1 Diet
Athletes should be encouraged to follow their normal dietary practices in the 24 to 48 h preceding testing. A light breakfast should be consumed before testing conducted in the morning, and similarly a light lunch should be consumed 2 to 3 h before afternoon testing.

3.2 Training
Athletes should be tested in a relatively fresh state so that they can give a full unhindered effort in the maximal effort tests. It is preferred that athletes have only a light skill-oriented session on the evening before testing, and that intensive training be conducted after testing.

3.3 Testing
Athletes should be familiar with test procedures and protocols before commencement. Written and verbal instructions should be provided as necessary. Athletes being tested for the first time should undertake familiarization trials or sessions, when possible. Written informed consent may be required (from the player or parent or guardian) prior to testing in some circumstances.

3.4 Laboratory / Court Environment
Anthropometry testing should be conducted in a suitable indoor area (small room) where athletes can be measured in private. The anaerobic capacity and power, flexibility and aerobic performance tests should all be conducted indoors, preferably on a basketball court with a properly sprung wooden floor. The surface should be clean, free of dust and in good condition. Environmental conditions should be recorded; if conditions are too adverse, testing should be postponed to another time.

3.5 Warm-up protocol
Basketball Australia has a recommended warm-up protocol for athletes undertaking physiological testing. It is recommended that athletes do foam rolling and static stretching in own time prior for 5-10 minutes prior to the warm up.

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General warm-up

A ten minute general warm-up is conducted prior to the Group Warm-up described below. The aim of the general warm-up is to progressively elevate core and muscle temperature prior to more vigorous activity. This consists of exercises that involve large muscle groups in a continuous sub-maximal activity such as running or court drills which can include using a basketball.

Group warm-up

Over the length of the court and back complete the following;

- Jogging x 2
- Side Steps, with change at halfway x 1
- Grapevine, with change at halfway x 1
- Skipping, x1
- Walking Lunge to half court, jog back to baseline x 1
- Side lunge to half court, jog back to baseline x 1
- Walking hamstring to glute, jog back to baseline x 1
- Run through to half court at the following intensities then walk back to the baseline;
  - 70%; 80%; 90%
- Stationary start acceleration efforts over 10m, then walk back to the baseline;
  - 95%; 100%
- 90deg turn and sprint to 3 point line x2/side, walk back to baseline between efforts.
- Defensive slides 2 out and 2 back x 3 (increasing intensity with each effort), rest approx. 10sec between efforts.
- Step to vertical jump x 4 (increasing intensity with each effort)
- Sprint out to 5m, turn and sprint back to baseline x 2, rest approximately 15sec between efforts.
4. Equipment Checklist

**Anthropometry:**

- [ ] Stadiometer (wall mounted)
- [ ] Balance scales (accurate to ± 0.05kg)
- [ ] Anthropometry box
- [ ] Skinfold calipers (Harpenden skinfold calipers)
- [ ] Marker pen
- [ ] Anthropometric measuring tape
- [ ] Arm span scale or suitable measuring tape and masking tape to fix to wall
- [ ] Recording sheet
- [ ] Pen

**20 m Sprint Test:**

- [ ] Electronic light gate equipment (e.g. Dual Beam Light Gates)
- [ ] Measuring tape
- [ ] Field marking tape
- [ ] Witches hats
- [ ] Recording sheet (optional for manual recording)
- [ ] Pen

**Vertical Jump Test:**

- [ ] Yardstick © jumping device (e.g. Swift Performance Yardstick)
- [ ] Measuring tape
- [ ] Recording sheet
- [ ] Pen

**Basketball Agility Tests:**

- [ ] Electronic light gate equipment (e.g. Dual Beam Light Gates)
- [ ] Measuring tape
- [ ] Court marking tape
- [ ] Recording sheet (optional for manual recording)
- [ ] Pen

**Sit and Reach Test:**

- [ ] Sit and reach box
- [ ] Measuring slide
- [ ] Recording sheet
- [ ] Pen

**Basketball Line Drill:**

- [ ] Stopwatch or electronic light gate equipment if available
- [ ] Recording sheet
- [ ] Pen

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Yo-Yo Intermittent Recovery Test:
[  ] Measuring tape
[  ] Court marking tape
[  ] Witches hats
[  ] Sound box or CD player
[  ] Yo-Yo Intermittent Recovery Test CD
[  ] Recording sheet
[  ] Pen

5. Recommended Test Order
It is important that field and strength tests are completed in the same order to control the interference between tests. This order also allows valid comparison of different test occasions. The order is as follows:

<table>
<thead>
<tr>
<th>DAY</th>
<th>TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or morning session</td>
<td>Anthropometry</td>
</tr>
<tr>
<td>2 or afternoon session</td>
<td>20 m sprint&lt;br&gt;Vertical Jump&lt;br&gt;Agility tests&lt;br&gt;Sit and reach&lt;br&gt;Basketball line drill&lt;br&gt;Yo-Yo intermittent recovery level 1</td>
</tr>
</tbody>
</table>

6. Test Protocols
6.1 Anthropometry
6.1.1 Rationale
Surface anthropometry is a traditional method to assess an athlete’s body composition. This testing enables coaches and support staff to track and evaluate changes in an athlete’s body composition over time (a within-subject comparison) and to compare anthropometric data across a group of athletes (between-subject comparisons). A detailed overview of anthropometric data of basketball athletes is available (Drinkwater et al. 2007; Drinkwater et al. 2008).

6.1.2 Test Procedure
Measurement of height, body mass, arm span and skinfolds should be carried out according to ISAK (Stewart et al. 2011) protocols prior to court testing. Skinfolds are recorded over 7 sites (triceps, biceps, subscapular, supraspinale, abdominal, front thigh and medial calf). The individual skinfold measures as well as the sum of the seven sites should be reported. More advanced anthropometric assessment including muscle girths, bone breadths and limb lengths can be conducted if required.
Although the description of skinfold measurement procedures seems simple, a high degree of technical skill is essential for consistent results. It is therefore important that these measurements be taken by an accredited ISAK tester who has been trained in these techniques. Where possible, the same tester should conduct each retest to ensure reliability.

6.1.3 Data Analysis
An anthropometric assessment gives a detailed overview of a player’s body composition. Changes in body composition targeted through specific training can be tracked through repeated anthropometric measures. This approach evaluates the effect of various training interventions on the athlete’s body composition. Depending on the training goal, the focus should be on changes in lean muscle mass or skinfolds rather than purely on weight gain or loss.

6.1.4 Normative Data
Table 1 presents anthropometric normative data for female and male junior basketball players.

<p>| Table 1: Anthropometric data for junior female and male basketball players |
|-----------------------------|------------------|-----------------|----------------------|</p>
<table>
<thead>
<tr>
<th>Gender</th>
<th>Height (cm)</th>
<th>Body Mass (kg)</th>
<th>Σ7 Skinfolds (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEMALE</td>
<td>182.8 ± 7.6 (158.8-204.0)</td>
<td>75 ± 11 (47-118)</td>
<td>92 ± 20 (47-165)</td>
</tr>
<tr>
<td>MALE</td>
<td>197.5 ± 9.1 (174.1–221.8)</td>
<td>91 ± 12 (59-141)</td>
<td>57 ± 17 (34-220)</td>
</tr>
</tbody>
</table>

Typical error: Height = 1.0cm; Body Mass = 1.5kg; Σ7 Skinfolds = ~ 1.5mm

Source: AIS Basketball Physical Testing Database 2010; 500 male and 500 female test results recorded 2003-2010; Females: 17.7 (14.2-27.7); Males: 17.8 (14.4-22.7)

6.2 20 m Sprint
6.2.1 Rationale
The 20 m sprint test determines an athlete’s acceleration and speed over a short distance. Basketball athletes usually only conduct high intensity efforts for a very short distance, or duration (McInnes et al. 1995; Bishop and Wright 2006; Abdelkrim et al. 2007; Narazaki et al. 2009). Similar to the vertical jump, an athlete’s sprinting ability has been linked to playing time (Hoffman et al. 1996) and level of competition (Drinkwater et al. 2007).

6.2.2 Test Procedure
- For basketball, the sprint test is conducted over 20 m, with split distances of 5 m and 10 m.
- Measure specified distances with the measuring tape, checking that there are no twists in the tape when laid out. It is useful, where possible, to use a lane marker or sideline (straight line) to lay the measuring tape along.
- Mark each interval (i.e. 5, 10, 20 m) with the appropriate tape (court marking tape is recommended) including a start line (0 m) and a finishing line (20 m).

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• Set the light gates at the appropriate intervals (0, 5, 10, and 20 m). Place two witches hats approximately 4 m after the last set of light gates. Athletes should be instructed to run right through to the witches hats to ensure they don't decelerate before they reach the final gate and thus increase their total time.
• Set the light gates on the start line at a lower height to ensure capture of the start. Other light gates should be set at approximately torso height and approximately 1.5 to 2.0 m apart.
• The starting position is with front foot toe just touching the start line (0 m), heel up on back foot, body mass over the front foot, and shoulders and hips square in a crouched “ready” position.
• Once the athlete is in the ready position, all subsequent movement must be in a forward direction (i.e., no rocking is allowed).
• The athlete may start in their own time once they have been advised that the system is ready.
• The athletes should be instructed to sprint as fast as possible, ensuring that they don’t decelerate until they have passed the witches hats set 4 m after the final gate.
• Record split times (at 5 and 10 m) and final time (20 m) for three trials to the nearest 0.01 s.
• Allow at least 2 min active recovery or rest between sprint trials (usually achieved by rotating athletes through as part of a group).
• Use the best time for each split and final time as the final result, even if these times come from different trials.

6.2.3 Data Analysis
The 20 m sprint is dependent on an athlete’s lower-body strength, power and sprinting technique. The 5 m and 10 m splits give an indication of the athlete’s ability to accelerate quickly from a standing start position. The final time gives an overall measure of the athlete’s sprinting ability specific to basketball (short distances). Maximal effort should be encouraged as motivation can influence the outcome of the sprint result. Providing immediate feedback (previous sprint times) can challenge and motivate the athlete to surpass the previous best result.

6.2.4 Normative Data
Table 3 presents sprint test normative data for junior female and male basketball players.

<table>
<thead>
<tr>
<th>Gender</th>
<th>5 m Time (s)</th>
<th>10 m Time (s)</th>
<th>20 m Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>1.17 ± 0.07</td>
<td>1.98 ± 0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.94 - 1.45)</td>
<td>(1.73 - 2.35)</td>
</tr>
<tr>
<td>Male</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>1.10 ± 0.07</td>
<td>1.84 ± 0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.94 - 1.37)</td>
<td>(1.43 - 2.25)</td>
</tr>
</tbody>
</table>

Typical error: Time = 0.04s

Source: AIS Basketball Physical Testing Database 2010; 500 male and 500 female test results recorded 2003-2010; Males: 17.6 (14.4-20.1); Females: 17.3 (14.2 -20.5)

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6.3 Vertical Jump

6.3.1 Rationale
Vertical jumping is a common feature of offensive and defensive movements in basketball competition (Abdelkrim et al. 2007, 2010a; McInnes et al. 1995; Narazaki et al. 2009). Vertical jump ability has been linked to an athlete’s playing time (Hoffman et al. 1996) and is greater in national-level athletes than state-level athletes (Drinkwater et al. 2007). During basketball play overall jump height with arms extended is important, and a jump is often preceded by movement of one or both feet during situations of rebounding or jump-shot shooting. The vertical jump with countermovement and arm swing is a traditional test to assess an athlete’s vertical jumping ability. Therefore this test is familiar to players and representative of game demands.

6.3.2 Test Procedure
Various commercially available jump measuring devices are available, such as the Vertec® or Yardstick®. Both are based on the principle of displaceable plastic vanes that record jump height. A significant advantage for sports such as basketball is to allow athletes to replicate the arm swing required on court, and therefore allow sport-specific values to be obtained. Furthermore, these devices allow the athlete an unhindered approach to the jump, which removes the distraction of avoiding contact with a wall-mounted device. Unpack the Yardstick® from its case and assemble as per the manufacturer’s instructions. Visually check for drooping or bent vanes, and check the base and extension poles for any damage.

Check the distance between the floor and the lowest vane with a tape measure to ensure that the zero vane height is accurate. Use the steel ruler to check the vanes for accuracy by holding the ruler at the distal end of the vanes and check 10 cm segments. If any 10 cm segment fall outside the 0.5 cm acceptable tolerance, repair or replace obviously faulty vanes.

Maximal reach height:
- Athlete should assume standing position directly underneath the device with both feet flat on ground.
- Keeping the heels on the floor and looking straight ahead, the athlete reaches upward with their dominant hand as high as possible, fully elevating the shoulder to displace the vanes.
- This is recorded as the standing reach height in centimetres (e.g. vane 25 is displaced 25 cm).
- The absolute standing reach height from the floor may be calculated as the pole setting height (i.e., the height the zero vane is from the floor; 160, 170, 180, 190, 200, or 210 cm) plus the highest vane displaced. Record this measure in centimetres.

Vertical jump height (Yardstick®):
- Athletes should be encouraged to warm-up and practice jumps incorporating maximum arm swing to help achieve the highest possible score.
- Move several of the lower vanes away before instructing the athlete to stand close to the Yardstick for their jump.

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• The athlete uses an arm swing and countermovement to jump as high as possible in order to displace the vanes at the height of the jump.
• The jump involves an anchored front foot with the trailing leg approximately one metre behind – the trunk is rotated towards the Yardstick apparatus. The trailing leg is brought forward to be alongside the front leg and a two foot take off used.
• The athlete performs at least three trials and may continue as long as improvements are being made. Vanes are not replaced after they have been displaced, but can be rotated around so as not to obstruct subsequent jump attempts.
• The best trial, that is, the highest vane displaced, is recorded as the jump height (NB - the recorded value is equivalent to the highest displaced vane not the last remaining vane!).
• Calculate jump height by subtracting the absolute standing reach height from the total jump height. Jump height should be recorded to the nearest 1 cm.

6.3.3 Data Analysis
The vertical jump height assessed in this test is dependent on lower-limb power as well as the optimal coordination of all muscle groups involved in this movement. The results from this test can indicate a change in these two factors. The test does not involve a cognitive component often required in basketball competition (e.g., timing of jump, anticipation of ball flight). This limitation must be considered when interpreting results.

6.3.4 Normative Data
Normative data for junior female and male basketball players are presented in Table 2.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Jump Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEMALE</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td></td>
<td>47 ± 6</td>
</tr>
<tr>
<td></td>
<td>(29-65)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
</tr>
<tr>
<td>MALE</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td></td>
<td>65 ± 8</td>
</tr>
<tr>
<td></td>
<td>(47-94)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
</tr>
</tbody>
</table>

Typical error: Jump Height = 1.4cm

Source: AIS Basketball Physical Testing Database 2010; 500 male and 500 female test results recorded 2003-2010; Males: 17.6 (14.4-20.1); Females: 17.3 (14.2-20.5)

6.4 Basketball Agility Tests
6.4.1 Rationale
Although the commonly accepted definition of agility involves both mental and physical components (Sheppard and Young 2006), the agility test outlined in this section focuses solely on the physical component of agility. From a physical point of view, agility is the ability to conduct sudden changes in direction and velocity as quickly as possible (Young and Farrow 2006). The men’s basketball agility test is derived from a “diamond agility drill” and has been modified to incorporate the new key format introduced by the international governing body of basketball (FIBA) in 2010.

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The basketball agility test measures an athlete’s ability to execute frequent changes in direction specific to the movement patterns seen in basketball competition. The athlete undertakes three maximal trials going toward both the left and the right sides. The test involves forward acceleration with four changes in direction. Electronic light gates are used to ensure accurate timing and are placed at the start–finish line of the agility test.

6.4.2 Men’s Test Procedure

- Using a measuring tape and field marking tape, mark the points for the start–finish line on the baseline as shown in figure 1. The marking points are placed a distance of 1.5 m from the inside intersection of the key with the baseline, leaving a 1.9 m start–finish line. Place the timing gates on the markers. Mark the centre of the start–finish line.
- The markers for change of direction are 30 cm x 30 cm squares named pivot boxes. Using the court marking tape, place these boxes on either side of the key (but on the outside of the tape marking out the key) 3.15 m from the baseline (as measured from inside edge of the baseline to the top of the pivot box), and on points located at 1.8 m from the short elbow (where free-throw line and half-circle meet). This 1.8m distance is measured from the corner of elbow to the bottom centre of pivot box.
- If using the Fusion timing gate system, set up the PDA system to be on “Track” > “Free Timing” > “1 Gate”
- Check the timing gates are operating correctly before the agility test proceeds.
- After providing instructions on the test procedures, allow each athlete to perform a 50% effort practice run to become familiar with the requirements of the test. Instruct the athlete to assume a stationary starting position, with the front foot up to and in the center of the starting line. The athlete should be instructed to “face the first pivot box” on their right or left and told that “the first movement is forward” to ensure a correct and standardized start.
- After a signal that the light gates are set, the athlete should start when ready. The light gate will start timing automatically as the athlete breaks the beam.
- The athlete sprints toward the first pivot box on the side of the key. A foot must be placed within each pivot box to ensure a valid trial. The athlete changes direction sprinting diagonally toward the upper pivot box, proceeds in a forward sprint to the opposite upper pivot box, sprints diagonally towards the final pivot box, and finishes with a sprint through the finish line (figure 1).
- Ensure that the athlete does not slow down before the finish gate and keeps sprinting right through.
- Record the total course time to the nearest 0.01 s on the appropriate recording sheet.
- Allow athletes two trials going towards the right and left side. A third trial for each side is optional.
- Allow adequate rest, at least 30 s, between consecutive sprints. Rotate athletes one sprint effort at a time as part of a larger group.
- Record the criterion times as the fastest trial on the right side and left side reported to the nearest 0.01 s.

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6.4.3 Women’s Test Procedure
The current agility test employed by the Women’s team is the 5-0-5 agility test.
• A metal tape measure and marking tape are used to mark out the points of the course as per the figure 2.
• Light gates are set at 5 m approximately torso height and 1.5 to 2.0 m apart.
• The starting position is with front foot toe to the start line.
• After a signal that the light gates are ready, the athlete can start in their own time.
• The athlete should sprint from the start line through the light gates to the zero line, where they are required to turn and accelerate off the line, back through the light gates. One foot must be on or over the zero line at the turn for it to be a valid trial.
• The athlete may slow down only after passing through the light gates for the second time.
• The time taken to cover the 10 m distance is recorded to the nearest 0.01 s.
• The athlete completes three trials turning on their preferred foot. Alternatively, three trials on both sides may be given. The fastest time is recorded as the best score.
6.4.4 Data Analysis

The basketball and 5-0-5 agility test is a practical method to assess an athlete’s physical ability to accelerate, decelerate and make rapid changes in direction. These tests are a pre-planned task and therefore does not involve a cognitive component which should be considered when comparing results to on-court performances. Development of acceleration, deceleration technique, turning footwork and lower-body power will improve agility test scores.

6.4.5 Normative Data

Table 4 presents normative data for the basketball agility test for junior male basketball players. Normative data for the 5-0-5 agility test for female basketball players are yet to be determined.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Agility Time (s)</th>
<th>Line Drill Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEMALE</td>
<td>Mean ± SD Range</td>
<td>TBA (2.80 – 3.22)</td>
</tr>
<tr>
<td></td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>MALE</td>
<td>Mean ± SD Range</td>
<td>5.30 ± 0.30 (5.00 - 5.60)</td>
</tr>
</tbody>
</table>

**Typical error:** Agility Time = 0.11s; Line Drill Time = 0.25s

**Source:** AIS Basketball Physical Testing Database 2010; line drill = 500 male and 500 female test results recorded 2003-2010; agility time = 20 tests per group; Males: 17.6 (14.4-20.1); Females: 17.3 (14.2 -20.5)

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6.5 Sit and Reach Test

6.5.1 Rationale

The sit and reach test measures the overall stretch length of the calf, hamstring, gluteal, and lower-back extensor muscles and passive tissues. This test gives an indication of an athlete’s range of movement around the lower back and pelvis.

6.5.2 Test Procedure

- Prior to this test the athlete should stretch their hamstrings and lower back.
- The athlete sits on the floor in front of the sit and reach box with the legs fully extended, placing the bare feet against the vertical surface of the box.
- One hand should be placed over the top of the other with the palms facing down, fingertips overlapping, and fingers outstretched, and the elbows should be straight.
- The athlete leans forward as far as possible, sliding their hands along the ruler of the sit and reach box. It may be necessary for the tester to apply gentle pressure above the knees to ensure leg extension is maintained. Full stretch must be held for at least 2 s to avoid bouncing.
• The distance the fingers pass beyond the toes is recorded as a positive score. If the fingers fall short of the toes or zero line, the score is recorded as a negative score. The best of three trials is recorded to the nearest 0.5 cm.

6.5.3 Data Analysis
The results from the sit and reach test should be used for within-athlete comparisons to evaluate changes in flexibility. Other factors not related to the athlete’s flexibility will influence the test score. These factors include anthropometric characteristics of arm length/trunk length and leg length. Consider any current or recent history of tightness, injury or restrictions in the hamstring, gluteal and lower-back muscle groups when interpreting results. Increasing range of motion and flexibility will improve test results.

6.5.4 Normative Data
Table 5 presents normative data for the sit and reach test for junior female and male basketball players.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Sit and Reach (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEMALE</td>
<td>Mean ± SD Range</td>
</tr>
<tr>
<td></td>
<td>14 ± 7 (-3.5 - 30)</td>
</tr>
<tr>
<td>MALE</td>
<td>Mean ± SD Range</td>
</tr>
<tr>
<td></td>
<td>13 ± 7 (-15 - 29.5)</td>
</tr>
</tbody>
</table>

Typical error: Sit and Reach = 1.4cm

Source: AIS Basketball Physical Testing Database 2010; 500 male and 500 female test results recorded 2003-2010; Males: 17.6 (14.4-20.1); Females: 17.3 (14.2-20.5)

6.6 Basketball Line Drill

6.6.1 Rationale
The basketball line drill is a sport-specific test to evaluate the anaerobic glycolytic capacity of an athlete. In performance terms, the basketball line drill tests the speed–endurance of a player in a basketball-specific context of transition play (getting up and down the court as quickly as possible).

6.6.2 Test Procedure
Light Gates
• Set-up the light gates in the middle of the baseline 1.5 to 2.0 m apart.
• The starting position is with front foot up to and in the center of the starting line.
• After a signal that the light gates are ready, the athlete can start in their own time.
• The athlete is required to run as fast as possible to the closest free throw line, back to the base line, to the center line, back to the base line, to the distant free throw line, back to the base line, to the opposite base line, and finally through the base line where the test commenced.

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• The athlete must touch the lines with one foot and should run through the line on the last leg of the test without slowing. Athletes should be able to touch the base line without triggering the light gates except on the last leg when they run through the base line. As a precaution to prevent the light gates stopping before the final return leg through the baseline, several splits can be programmed into the light gate systems depending on the features of the light gate system used.
• The time to completion is recorded to the nearest 0.01 s on the appropriate recording sheet. Each athlete should complete one trial.

Stopwatch
• The starting position is with front foot up to the baseline and in line with the center of the key
• On the start command, the stopwatch is started and the athlete is required to run as fast as possible to the closest free throw line, back to the base line, to the center line, back to the base line, to the distant free throw line, back to the base line, to the opposite base line, and finally to the base line where the test commenced.
• The stopwatch is stopped when the athlete crosses the base line on the last leg.
• The athlete must touch the lines with one foot and should run through the line on the last leg of the test without slowing.
• The time to completion is recorded to the nearest 0.01 s on the appropriate recording sheet. Each athlete should complete one trial.

6.6.1 Data Analysis
For the basketball line drill, the athlete is required to conduct multiple sprints with several rapid decelerations and accelerations. The results are therefore influenced by agility as well as straight line sprinting components. Having two athletes run at a time encourages the athletes to compete and give a maximal effort for this test. Compliance with the testing protocol (touching the line) needs to be monitored closely to ensure a valid result. If a line is missed, the test is terminated and the athlete can have a second trial after sufficient rest (minimum of 5 min). Strong verbal encouragement, especially toward the end of this test, can assist in the athlete pushing through associated fatigue. An enhanced anaerobic capacity and improved sprinting and turning technique will yield better results.

6.6.2 Normative Data
Table 4 (above) presents normative data for the basketball line drill for junior female and male basketball players – using stopwatch as the timing method.

6.7 Yo-Yo Intermittent Recovery Test
6.7.1 Rationale
The Yo-Yo intermittent recovery test (IRT) is now widely used in team sports to assess the endurance of team sport athletes. Performance in the Yo-Yo IRT level 1 has shown to significantly correlate with laboratory-based aerobic testing (VO2max) (Krustrup et al. 2003; Bangsbo et al. 2008) and basketball related endurance (Castagna et al. 2008).
6.7.2 Test Procedure

- This test should be completed at the end of the basketball testing session, because fatigue associated with this test may affect performance in the speed and power tests. Alternatives to the Yo-Yo IRT include the multistage shuttle run test and the cross-court sprint recovery (SPARQ).
- Using a measuring tape and court marking tape, measure out a 20 m test course as per figure 3.
- Place markers 2 m apart at both ends of the 20 m test course (i.e., at start and turning lines).
- In addition to marking the 20 m line, measure out a 5 m distance behind the start line.
- Place a marker on the recovery line aligned to the middle of the two markers on the start line, as outlined in the figure. Ensure there is one course setup per athlete being tested.
- Athletes assume a starting position on the 0 m line.
- The Yo-Yo test CD or MP3 track is started.
- At the time of the first signal, athletes run forward to the turning line. At the sound of the second signal, athletes arrive and turn at the turning line and then run back to the start line arriving on the next beep. When the start marker is passed, the athletes continue forward at a reduced pace (jogging) toward the 5 m mark, where they then turn around the cone and return to the start line. At this point the athletes stop and wait for the next signal to sound. It is important that the athletes are stationary on the start line before the commencement of each sprint.
- Athletes are required to place one foot either on or behind the start or turning lines at the sound of each beep.
- Athletes should continue running for as long as possible, until they are unable to maintain the speed as indicated by the CD (or MP3 file).
- The end of the test is indicated by the inability of an athlete to maintain the required pace for two trials. The first time the start line is not reached, a warning is given; the second time the athlete must withdraw.
- When the athlete withdraws, the last level and the number of 2 x 20 m intervals performed at this level are recorded on the appropriate recording sheet. (The last 2 x 20 m interval is included, even if the athlete did not complete it at the right pace.)
- The Yo-Yo IRT is effort dependent, so for valid results athletes must attempt to reach the highest level possible before stopping.
- Verbal encouragement should be given to the athletes throughout the test.
- Upon completion of the test, all athletes should be encouraged to perform a warm down.
- The final Yo-Yo intermittent recovery speed and interval score obtained by each athlete are used to calculate the total distance covered by the athlete during the test.
6.7.3 Data Analysis
The aerobic fitness assessed in the Yo-Yo IRT involves elements of agility because it requires the athlete to accelerate, decelerate, and turn frequently. Even pacing should be encouraged to ensure maximal distances. A rapid start (quick 3 steps) to hit the turn line at the beep, a low turn, and then a second rapid acceleration to the finish line are useful cues for the athlete. Reminding athletes to turn on opposite legs is another useful cue to prevent unilateral leg fatigue. It is important that the athlete continues to perform the test until they are informed to stop by the instructor. Development of aerobic fitness and running and turning technique will result in improvements in this test.

6.7.4 Normative Data
Table 6 presents normative data for the Yo-Yo Intermittent Recovery Test for junior female and male basketball players.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Level</th>
<th>Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td></td>
</tr>
<tr>
<td>FEMALE</td>
<td>16.4 ± 1.3</td>
<td>1240 ± 400</td>
</tr>
<tr>
<td></td>
<td>(12.9 - 20.2)</td>
<td>(280 - 2440)</td>
</tr>
<tr>
<td>MALE</td>
<td>18.8 ± 1.8</td>
<td>2000 ± 562</td>
</tr>
<tr>
<td></td>
<td>(14.6 - 22.7)</td>
<td>(680 - 3280)</td>
</tr>
</tbody>
</table>

Typical error: Level = ~4 intervals; Distance = 110m

Source: AIS Basketball Physical Testing Database 2010; 500 male and 500 female test results recorded 2003-2010; Males: 17.6 (14.4-20.1); Females: 17.3 (14.2 - 20.5)
7. References


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