

# Fitness testing in basketball players

## Introduction

Basketball is second most popular sport in the world. The typical format for adult male are four 10-min quarters. Success in basketball is predicated on players optimizing multiple basketball-specific skills, which are influenced by many different physical characteristics (explain in note). As a result, numerous tests have been introduced for the purpose of identifying talent and qualifying fitness across various sample of adult male players.

Note: physical characteristics of basketball game

Basketball is an intermittent, court-based team sport involving repeated transition between offence and defence and frequent changes in movements. During basketball match-play, periods of high intensity activity are interspersed with periods of low- to moderate intensity activities. These activities differ in term of movement pattern( e.g. running, jumping, shuffling), intensity, distance, frequency, and duration. Throughout a basketball match, jumps occur approximately every minute, which is greater than other sports. In addition, basketball players undergo extensive sprinting and high intensity shuffling activity, which emphasize the need to perform regular maximal effort during match-play.

Reference: Stojanović, E., Stojiljković, N., Scanlan, A. T., Dalbo, V. J., Berkelmans, D. M., & Milanović, Z. (2018). The Activity Demands and Physiological Responses Encountered During Basketball Match-Play: A Systematic Review. *Sports medicine (Auckland, N.Z.)*, 48(1), 111–135. <https://doi.org/10.1007/s40279-017-0794-z>

## Categories of fitness tests in basketball players

These tests were categorized based in the characteristics they assessed; body composition, muscular power, linear speed, change of direction speed, agility, strength, anaerobic capacity, and aerobic capacity.( Table 1)

Table 1 Categories of fitness tests in basketball players

category	test	Outcome variable
Muscular power	Countermovement jump Squat jump Vertical jump	Peak power and jump height Peak power and jump height Peak power and jump height
Linear speed	5-m sprint 10-m sprint 20-m sprint	Time Time Time
COD speed	Agility T-test Y-shaped COD Lane Agility test	Time Time Time
Agility	Y-shaped Agility tests	Time, response time and decision making
Strength	Bench press Back squat	1RM 1Rm
Aerobic capacity	Yo-Yo IRL1 Multi-stage Fitness test Incremental treadmill tests	Estimated VO <sub>2</sub> max and distance Estimated VO <sub>2</sub> max and distance Vo <sub>2</sub> max
Anaerobic capacity	Full court shuttle run RAST Wingate aerobic cycle test	Time Peak power, mean power and fatigue index Peak power, mean power and fatigue index

## **Body composition**

The most frequently implemented test and outcome variables used across studies were the sum of skinfolds at three sites (chest, abdomen thigh) and body fat percentage. Mean body fat percentage across competition levels revealed professional players varied between 7 and 20 %, while semi-professional 9-16% and collegiate 10-14 % ranges in body fat percentage. When mean body composition was reported according to playing position, guards (7-20 %), forwards (8-17 %), and centers (7-21%) demonstrated similar variance in body fat percentage.

## **Muscular power**

Muscular power predominantly using jump tests. The three most frequent jump tests adopted across studies were the countermovement jump CMJ, vertical jump VJ, and squat jump SJ. Two throwing tests were also used in studies to assess muscular power (upper body power) including seated

basketball throw with speed (km/hour) of throw taken as the outcome variable, and a seated medicine ball throw (1 kg) with horizontal displacement (m) of the ball used as the outcome variable.

Mean CMJ height ranged between 34 and 77 cm, while mean peak power outputs ranged between 2441 and 6647 W. Professional players recorded men VJ height between 39 and 69 cm and mean VJ peak power outputs of 2215-6701 W during the VJ. Professional players reached mean SJ jump height between 29 and 50 cm.

### **Linear speed**

The game demands of basketball require well-developed linear sprint and acceleration capacities. There are three frequently linear sprint performance tests across distance 5m, 10m and 20 m. Professional players demonstrated mean 5 m sprint times between 0.82 and 1.51 s, 10 m sprint times between 1.47 and 2.34 s, and 20 m ranged between 2.43 and 3.24s.

### **Change of direction speed**

The ability to rapidly change direction within the confines of the court is important for basketball performance. The Agility T-test is the most frequently change of direction speed test. Professional players demonstrated mean Agility T-test time ranged between 8.84 and 10.90 s across studies. The Lane Agility test is the second frequently COD speed test. Collegiate players demonstrated mean Lane Agility test time ranged between 10.16 and 11.80 s across studies.

## **Agility**

Basketball match-play requires players to interpret stimuli and rapidly execute an appropriate movement response, highlighting the need for a perceptual element to be present when assessing agility. Only three tests were used to assess agility including Reactive Agility test, Reactive COD test, and reactive Y-shaped COD test. The Reactive Agility test was performed exclusively at the semi-professional level and performance ranged between 2.00 and 2.18 s. Reactive COD test performance ranged between 2.52 and 2.77 s at semi-professional level.

## **Strength**

Muscular strength is an important quality in basketball players. repetition maximum outcome variables were most frequently gathered across studies, with 1RM and 3RM being the most used protocols (bench press and squat exercises). Professional players bench pressed 1RM loads between 70 and 112 kg. also their mean back squat 1RM loads ranged between 116 and 202 kg across studies.

## **Anaerobic capacity**

Well-developed anaerobic capacity allows basketball players to repeatedly perform high-intensity movements that are typically separated by brief rest periods during matches. The most frequently implemented tests were the WAnT, the RAST and the full court shuttle run. Peak power, mean power, fatigue index and time were the most reported outcomes variables.

## **Aerobic capacity**

Basketball players require well-developed aerobic capacities to tolerate the intermittent bouts of varying intensity encountered during matches. Players with high aerobic capacity are better able to tolerate multiple high-intensity sprints and have improved fatigue resistance. Incremental treadmill tests which involved bruce and various incremental running protocols, as well as the Yo-Yo IRL1 and MSFT were the most frequently used tests. The most common outcome variable reported from aerobic testing was maximum oxygen uptake ( $VO_{2\text{ max}}$ ).mean aerobic capacity during incremental treadmill tests ranged from 42 to 61 mL/kg/min across studies. Estimated  $VO_{2\text{ max}}$  from the MSFT ranged from 42 to 64 ml/kg/min and mean estimated  $VO_{2\text{ max}}$  derived during Yo-Yo IRL1 ranged between 47 and 60 mL/kg/min.

## **Reference**

Morrison, M., Martin, D. T., Talpey, S., Scanlan, A. T., Delaney, J., Halson, S. L., & Weakley, J. (2022). A Systematic Review on Fitness Testing in Adult Male Basketball Players: Tests Adopted, Characteristics Reported and Recommendations for Practice. *Sports medicine (Auckland, N.Z.)*, 52(7), 1491–1532. <https://doi.org/10.1007/s40279-021-01626-3>