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Review

# Vertical jump in female and male basketball players—A review of observational and experimental studies

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**Abstract**

The main purpose of this article was to review a series of studies ($n = 26$; 15 observational and 11 experimental) examining vertical jump (VJ) performances in female and male basketball players. Information on the tests used in these studies and their specific protocols, and the training programs conducted to improve VJ ability in elite basketball players, was assessed. It was found that vertical jump values varied greatly, from 22 to 48 cm in female players and from 40 to 75 cm in male players. These large variations can be explained mostly by the differences in testing protocols (each VJ protocol examined different physiological pathways) and skill level of players. The variations in VJ values among studies were greatly reduced when they used the same protocol. In addition, short plyometric training sessions as part of the strength and conditioning program were found to enhance VJ performances in basketball players. Based on the reviewed studies, five limitations associated with the testing protocols and the strength and conditioning programs used in the studies were outlined, among them the use of multiple testing protocols and lack of experimental studies. Three recommendations for basketball and strength and conditioning coaches were suggested, for one of which was including plyometric training in the annual training program.


*Keywords:* Basketball; Sports performance; Exercise test; Physical fitness; Female players; Male players

## Contents



## 1. Introduction

Vertical jump (VJ) is one of the most prevalent acts performed by basketball players. Jumping acts are part of various defensive (e.g., blocking, rebounding, and stealing) and offensive (e.g., passing, rebounding, and shooting) maneuvers performed by basketball players in practices and games. A number of studies have examined on-court performances of elite male basketball players. For example, McInnes et al.[1] found that, on average, a basketball player performs $1050 \pm 51$ movements during the game, such as standing, running, walking and jumping; among these, $46 \pm 12$ are

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VJ acts. Ben Abdelkrim, El Fazaa, and El Ati[2] reported $997 \pm 183$ and $44 \pm 7$, respectively.

Under real-game situations, players are required not only to perform such a high number of jumping acts, but also to do them in a competitive and demanding environment in which they are performing against players from the opposing team. They are required not only to jump high, but also to jump higher than their counterparts in a given defensive or offensive situation. Therefore, it is one of the desired goals of basketball players, regardless if their playing position is guard, forward, or center, to improve their jumping ability, in addition to achieving a high level of proficiency in the other defensive and offensive acts they have to perform during the game.

To improve the VJ ability of players, basketball coaches and strength and conditioning coaches should devote a considerable amount of time to strength and conditioning programs focusing on jumping performance. It has already been established in the literature on methodology of training that basketball players should work on their jumping ability in both the preparation and competition phases of the annual training program (e.g.,[3,4]). In order to appropriately plan strength and conditioning programs aimed at improving VJ in basketball players, basketball and strength and conditioning coaches who work regularly with the players during the entire training program should obtain relevant information on the physical, technical and physiological aspects of VJ in basketball. It is assumed that such information will help them to plan better short- and long-term VJ training programs, as well as to assess the contribution of these programs to jumping improvement.

The three purposes of the current article are: (a) to review a series of studies ($n = 26$; 15 observational and 11 experimental) on VJ in female and male basketball players—junior players, college players, national team players, and national professional league players; (b) to outline a number of limitations associated with the testing protocols used in the reviewed studies; and (c) to suggest practical recommendations for basketball coaches and strength and conditioning coaches working with elite basketball players.

## 2. Studies on vertical jump performances in elite female and male basketball players

Two categories of studies were reviewed: observational and experimental.[5] In observational studies, the researcher observes the overt behavior/s (i.e., the VJ) of the performer and describes his or her technique (i.e., "does the performer use his or her hands during the jump?") and/or the outcome (i.e., "what is the height of the jump?") of the behavior. Based on these observations, the researcher can obtain relevant and reliable information on the unique phenomena of the observed event, such as the average height of VJ in female and male basketball players, the average height of VJ in players playing different positions, or the jumping techniques demonstrated by players at different skill levels (i.e., beginning versus skilled players). In experimental studies, the researcher can manipulate conditions or treatments which have the potential to enhance behaviour.[5] One of the main objectives of experimental studies on VJ is to examine the effectiveness of task-pertinent training programs on jumping ability in basketball players. Researchers aim to obtain useful information on strength and conditioning programs which can be administered during the entire basketball training program and help players improve their VJ performance.

Fifteen studies observing VJ in basketball players were reviewed: six using female[6–11] and nine using male[7,8,12–18] players. A supplemental table summarising the observational studies on VJ in female and male basketball players is available online (see Table 2 online).

A number of protocols were used in the studies. In these studies, mean values of the jumping height ranged from 24.8 cm in one study[7] to 48.2 cm in another.[9] Most studies found values that were above 40 cm. The low value of 24.8 cm was reported when a testing protocol was used in which hands were kept on the waist throughout the test. This value was similar to a value measured in physical education students.[7]

A number of studies assessed VJ performances in players playing different positions. Only one study indicated a significant difference between guards and power forwards ($48.9 \pm 4.9$ cm versus $40.5 \pm 3.8$ cm, respectively).[11] In another study[6] centers showed significantly higher anaerobic power compared to guards when the VJ values were converted to anaerobic power ($108.5 \pm 12.7$ kg m s$^{-1}$ versus $88.9 \pm 12.9$ kg m s$^{-1}$, respectively).

Differences in skill levels were found to be related to VJ capability. A study comparing the best eight players in each playing position with the rest of the players in each position found that the best point guards had higher mean VJ values compared to the rest of the point guards (52.6 cm versus 44.8 cm, respectively). Similar results were found in a study comparing the best power forwards and the rest of the power forwards (50.5 cm versus 40.2 cm, respectively).[8]

One study found no differences in VJ among players playing different positions,[18] while another study reported higher values of VJ height in guards and forwards compared to centers.[17] The latter study also found higher power values in forwards and centers compared to guards. In another study[8] differences in VJ among players at different skill levels revealed that the best players tend to jump higher compared to other players. However, in this study only the difference between the best eight shooting guards and the rest of the shooting guards was found to be significant (68.6 cm versus 60.6 cm, respectively). In a recent study,[13] a comparison between elite players and average-level players revealed higher VJ values (by 8.8%) in elite players. In this study, elite players had playing experience of at least 3 years at a national or an international level, and were part of the first