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Research Article

Comparison of Vertical Jump Height in Professional Basketball Player with Flatfoot and Players without Flatfoot

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A B S T R A C T

Aim: Comparison of vertical jump height in professional basketball player with flatfoot and players without flatfoot.

Objective: 1) To study the vertical jump height of the player without flat feet through vertical jump test.

2) To study the vertical jump height of the player with flat feet through vertical jump test.
3) To compare the difference of the vertical jump height in both the groups by the vertical jump test scale.

Need of Study: Flat foot comprises of various biomechanical changes which includes overpronation of the foot. The overpronation of the foot affects the biomechanics of the legs and hence this leads to a series of changes in gait characteristics and may have effect on the activity like running, jumping, walking. As prevalence of the flatfoot among the basketball players is 23.32%. Thus, the vertical jump involved in basketball can also be assumed to be affected due to the biomechanical changes. A lot has been studied about the factors like speed of running, and foot posture as a whole, but there occurs no literature explaining the effect of flat foot on the vertical jump in basketball players, hence there was a need felt to analyse the effect of flat foot on vertical jump and its effect on the performance.

Keywords: Flat foot; Overpronation; Vertical jump

1. Introduction

The foot is one of the most important interactive, parts of the body with the ground especially in the upright posture. Foot and ankle consist of a complex arrangement of structures and joints that allow the foot to be flexible and accommodating in early stance phase whereas rigid in the late stance phase.

During growth the foot changes not only its dimensions but also its shape, large variation is displayed in the normal population at different ages, especially concerning characteristics of the medial longitudinal arch.

The human foot has longitudinal arches and transverse arch maintained by the interlocking shapes of the foot strong ligaments and pulling muscles during activities.

Foot arch is crucial factor for force transfer and shock absorption especially in impact sports such as jump and sprints[2]. Proper functioning of the leg helps the activity of walking, running, jumping, climbing stairs up and down. Foot determines the factor of lower extremity performances dysfunctions can be caused due to fault in the foot posture[8].

1.1 Flatfoot

Flat foot is one of the commonest deformities of the foot, Flat foot is the loss of the medial longitudinal arch of the foot, it is a fallen arch of the foot that cause the whole foot to make contact with the surface the individual is standing on[16]. The arch of the foot is a tough, with elastic connection of ligaments, tendons, and fascia between the forefoot and the hindfoot. The talocalcaneal interosseous ligament, tibio navicular portion of the deltoid ligament, spring ligament, and medial talocalcaneal ligament assist in stabilizing the arch of the foot. The arch serves as an adaptive and flexible base for the entire body. It functions to dissipate the forces of weight-bearing and acts to store

mechanical energy within the stretched elastic ligaments during the gait cycle. Dysfunction of the arch complex, specifically relating to flexible flat foot, can frequently be asymptomatic, but can alter the biomechanics of the foot[15]. The deformity may lead to changes in the mobility of joint ankles and feet which is likely to lead change in the pattern of active muscles, the flatfoot deformity can be developed due to prolonged use or due to stress on the foot.

The prevalence of the flatfoot among the basketball players is about 23.32% and considering the physiological and biomechanical requirement of the game the foot of basketball players is put under a lot stress, also studies have been proven that the basketball players have a more pronated (flatter feet) foot as compare to normal individuals.

1.2 Basketball

Basketball is a game played between two teams of five players each on a rectangular court each team tries to score by tossing the ball, there are various moments required while playing the sport among which the vertical jump is one of the most prevalent acts performed by basketball players. The intensity of the game is intermittent. There are lots of changes in movements that differ in their mode of activity (e.g., running/ jumping) and the degree of intensity. Depending on the style of play, the game can be played either at a high intensity or at a low intensity level. Basketball is a very dynamic sport, requiring a lot of running, jumping, and sudden changes in movement (accelerations and decelerations, cutting maneuvers, etc.). It is not surprising that the feet of basketball players are subjected to a lot of stress during the games and trainings, Jumping acts are part of various defensive and offensive manoeuvres performed by basketball players in practices and games[7].

Vertical jump is the act of raising one's centre of gravity higher in the vertical plane solely with the use of one's own muscles. It can be measured through the vertical jump test, it is a test of lower body power. The test was first described nearly 100 years ago (Sargent, 1921). The procedure below describes the method used for directly measuring the vertical jump height jumped. There are other methods such as using timing systems that measure the time of the jump and from that calculate the vertical jump height[14].

A high impact sport like Basketball with the high involvement of foot in the game may cause the anatomy of the foot to change. This may also lead to change in the arch of the foot and predispose it to the injury[2]. A lot of research has been conducted to evaluate the effects of flatfeet on athletic performance, some of the articles suggested that the flat feet does not cause any malfunction in the athletic performance, and some of them suggest the lower limb deformities and foot deformities have an effect on the players performance in sport. The performance of the basketball player can be determined through the vertical jump as ability of an athlete in vertical jumping is often linked to successful performance.

1.3 Hypothesis

1.3.1 Null hypothesis

H0) There will be no significance difference in the vertical jump height of the player with flatfeet and without flat feet.

1.3.2 Alternate hypothesis

H1) The vertical jump height of the player with flat feet will be more as compare to the player without flat feet.

H2) The vertical jump height of the player without flat feet will be more as compare to the player with flat feet.

2. Review of Literature

In their study[1] of Vertical jump in female and male basketball players--a review of observational and experimental studies, said that strength of the basketball players can be improved through plyometric and annual training

In their study[6] of A review on the basketball jump shot, said that the ability to shoot an effective jump shot in the sport of basketball is critical to a player's success this was concluded by analysing three sections a) ball trajectory b) phases of jump shot c) and additional variables.

In their study[5] of the foot posture index between elite athletic and sedentary college students, said that participation in high impact sports can be associated with a more pronated foot posture

In their study[3] of Medial Longitudinal Arch: Accuracy, Reliability, and Correlation Between Navicular Drop Test and Footprint Parameters said that-The correlations obtained between the navicular drop test and the footprint parameters evaluated were good. The navicular drop test appears to be a reproducible, valid, and simple test for evaluating medial longitudinal arch height, having fewer disadvantages than using footprint parameters.

In their study[4] of Evaluating the Medial Longitudinal Arch of the Foot: Correlations, Reliability, and Accuracy in People with a Low Arch said that -the Navicular Drop Test showed significant correlations with footprint parameters; correlations were good for the arch angle and Chippaux-Smirnak Index, and excellent for the Staheli Index. The Foot Posture Index-6 showed an excellent correlation with the Navicular Drop Test and a good correlation with the footprint parameters evaluated. All of the parameters showed high reliability.

In their study of A Comparative Study of Footprints of Basket Ball Players Versus Non Playing Individuals (2020)[2] said that - distance A (from 1st toe to heel), distance D (metatarsal distance),distance C (length of the longitudinal arch contour) and distance G(narrowest distance of the foot) are increased in basketball players as compared to nonplaying individuals. Also the Arch index is more in basketball players which indicated a relatively flatter feet in basketball players as compared to non-players. This indicates a flatter feet in basketball players as compared to non-playing individual.

In their study[8] of comparison of vertical jumping height in primary school boys and girls with and without flatfoot (2019) said that complication of flatfoot does not effect on the performance of 10 to 12 years old boys and girls the conclusion of the study was made using the outcome measures used for flatfoot was navicular drop test and for jump height was sargent jump test.

Methodology

Sample size - 130

Study design - comparative study

Sampling method - purposive sampling

Study population -basketball players

Duration of the study - 6 months

Study setting - basketball institute in and around pune

4. Criteria

4.1 Inclusion criteria

Professional basketball players

Players with flatfeet

Players without flatfeet

BMI - normal (18 to 24.9)

Age - 18to 25 years

Gender - males and females

Minimum years of playing - 5 years

4.2 Exclusion criteria

Any history of neurological condition or musculoskeletal disorder

Trauma to foot.

Subjects with recent fractures to (neck, trunk, upper limb, lower limb)

Subjects competing in others sport rather than basketball.

Other Foot deformities except flatfoot.

5. Materials

Measuring tape, Chalk, Pen, Paper, White card board, Chair, Index card.

6. Outcome Measures

1. Navicular drop test
2. Vertical jump test

6.1 Navicular drop test

A test used to quantify pronation of the foot. While the patient's foot is in a nonweight bearing position. The examiner places a mark over the navicular tuberosity. Next, the foot is placed on the floor again in a nonweight bearing position and a mark is made on a 3 × 5 index card to measure the distance between the floor and the navicular tubercle. The measure is repeated. When the patient bears weight on the foot and the distance between the two marks is recorded Inferior displacement of greater than 10 mm while bearing weight is considered hyper pronation of the foot (**Table 1**).

Table 1. NDT Value.

Supinated Foot	Neutral Foot	Pronated Foot
	6-8mm	10-15mm
<5mm	5-9mm	9mm

Figure 1: Vertical jump test.

6.2 Vertical jump

A vertical jump (**Figure 1**) or vertical leap is the act of jumping upwards into the air. It can be an exercise for building both endurance and strength, and is also a standard test for measuring athletic performance. It may also be referred to as a Sargent jump reliability for jump height (ICC = 0.813) (**Table 2**).

How to conduct the test

- The athlete warm up for 5 minutes.
- The athlete chalks the end of his/her fingertips.
- The athlete stands side onto the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marks the wall with the tips of the fingers (M1).
- From a static position, the athlete jumps as high as possible and marks the wall with the chalk on his fingers (M2).
- The assistant measures and records the distance between M1 and M2.
- The athlete repeats the test 3 times (**Figure 2**).
- The assistant calculates the average of the recorded distances and uses this value to assess the athlete's performance.

Figure 2 a). The Athlete one hand and marks the wall tips of the fingers (M1), **b)**. The assistant measures and records the distance between M1 and M2. **C)**. The Athlete jumps as high as possible and marks the wall with the chalk on his fingers (M2).

Table 2. The Athlete Male and Female Rating in Inches.

MALE		FEMALE		
Rating	**(inches)**	**(cm)**	**(inches)**	**(cm)**
Excellent	> 28	> 70	> 24	> 60
very good	24 - 28	61-70	20 - 24	51-60
above average	20 - 24	51-60	16 - 20	41-50
Average	16 - 20	41-50	12 - 16	31-40
below average	12 - 16	31-40	8 - 12	21-30
Poor	8 - 12	21-30	4 - 8	11-20
very poor	< 8	< 21	< 4	< 11

7. Procedure

The study was began with presentation to the ethical committee of P.E.S Modern College of Physiotherapy pune -05.

The participants were selected according to the inclusion and exclusion criteria.

Purpose was explained to the participants and written consent was taken.

Navicular drop test was performed on the participants to diagnose the flatfoot.

Then the participants were divided in two group according to their foot type.

A) with flatfoot B) without flatfoot

Participants were explained about the vertical jump test.

A warm up session of 5 min was performed prior to the test.

Then the test was performed as the participants were asked to stand by the side of the wall keeping the feet on the ground and raising one hand against the wall, the point of the finger tips was marked and recorded. This is called standing reach height.

Then the participants were asked to take a leap vertically as high as possible using both arms and legs to assist in projecting the body upwards, participant try to touch the wall at the highest point of jump (**Figure 3**).

The difference of the standing reach height and the jump height is scored and the best of three attempt is recorded (**Figure 4**).

Figure 3. Starting position.

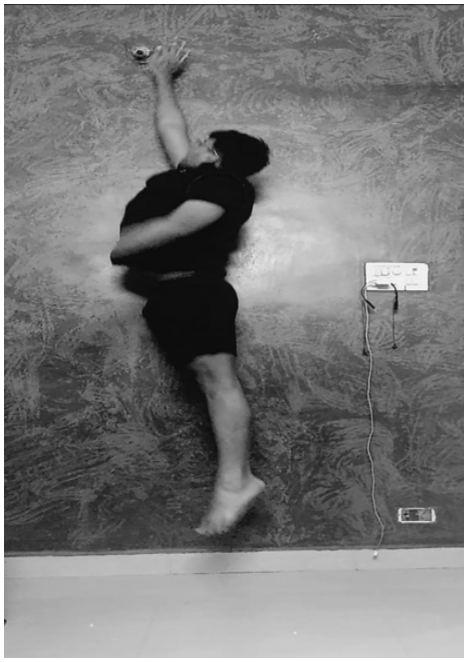

Figure 4: Ending position.

8. Data Analysis

The data collected was statistically analysed using Microsoft excel sheet and GraphPad.com.

Comparison of vertical jump height between professional basketball players with and without flatfeet was analysed using appropriate parametric test.

Unpaired t test was used to obtain the difference between the two groups (**Figures 5,6**).

The various statistical measures such as Mean, Standard Deviation (SD) and t test where utilized to analyse the data (**Figures 7,8**).

The results were concluded to be not statistically significant as p value is >0.05 (**Table 3**).

The data was represented in both tabular and graphical format (**Figure 9**).

Table 3. comparison of vertical jump height of players with and without flatfeet using vertical jump test.

Parameters	Vertical jump height mean score ± sd of players without flatfeet	Vertical jump height mean score ± sd of players with flatfeet	t value	p value	Results
	±2.80 20	20.23±3.11	0.4480	0.6549	Difference is considered not to be statistically significant

9.Result

In this study the difference of vertical jump height in basketball players with and without flatfeet was not statistically significant.

It is seen that there is no difference in the jump height of both the groups as the vertical jump height is a very short factor to determine that.

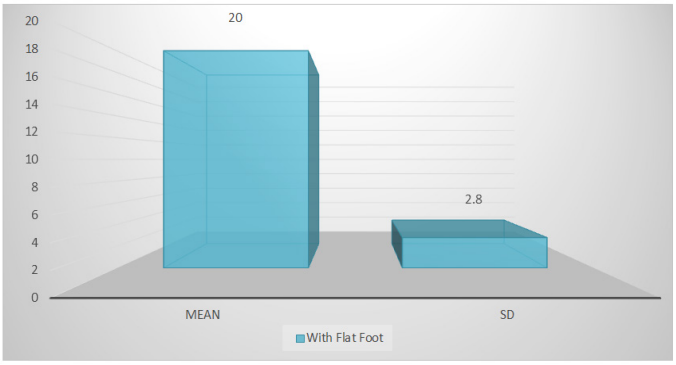

Figure 5. Graph showing SD and mean of players with Flatfoot**.**

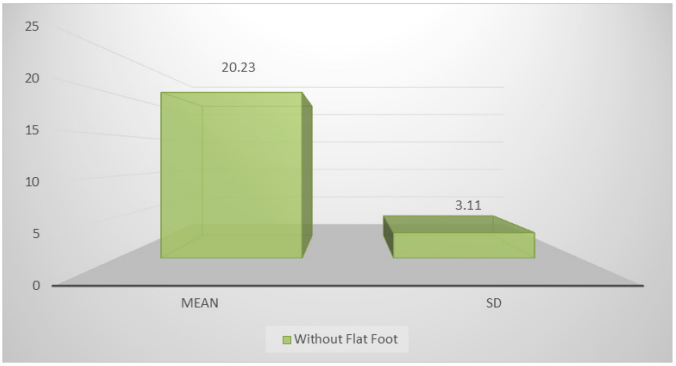

Figure 6. Graph showing SD and mean of players without Flatfoot.

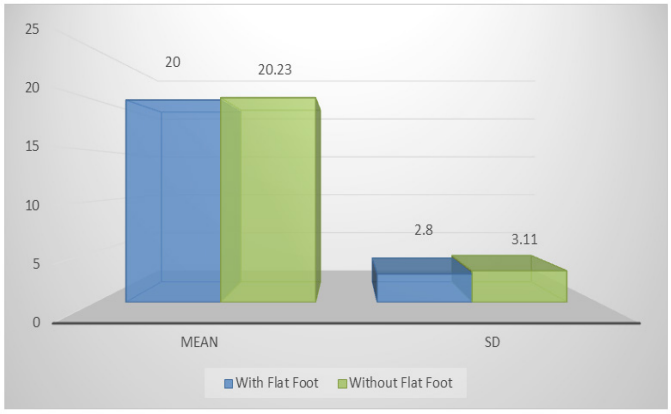

Figure 7: Graph showing SD and mean of players with Flatfoot and without Flatfoot.

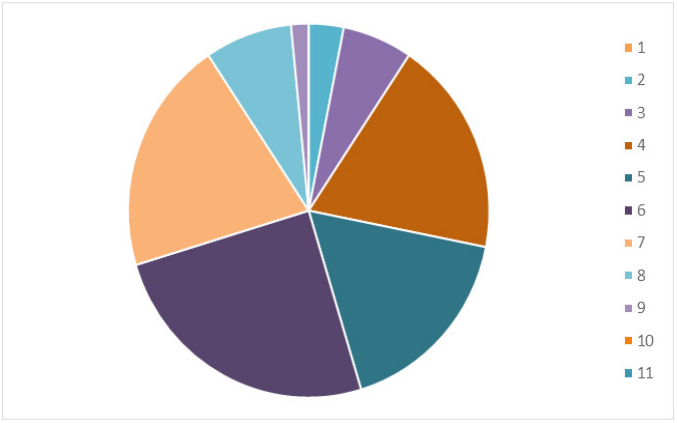

Figure 8. Pie chart showing the age distribution of players with Flatfoot.

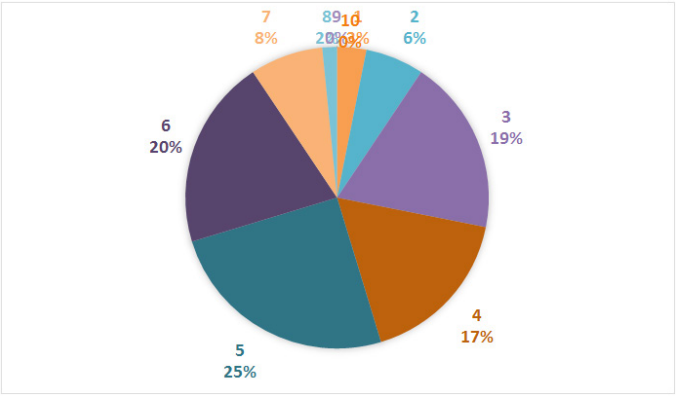

Figure 9: Pie chart showing the age distribution of players without flatfoot.

10. Discussion

The aim of this study was to compare the vertical jump height in professional basketball players with and without flatfeet. The age group of 16 to 25 years both male and female were taken in this study with those having an experience of playing from 5 years .130 professional basketball players were recruited for this study[8].

The foot typology was determined by performing navicular drop test. The navicular drop in each subject was measured for each leg to determine bilateral disorder and the results were used to classify the subjects into two groups: players with flatfeet and players without flatfeet.

To evaluate the difference of vertical jump height in the two, vertical jump test was performed. All the subjects were tested under identical conditions.

The test was fully explained to the participants before starting, after 5 min of warm up the test was performed, the test was repeated 3 times for each participant and the best measurement of the test was taken.

When the comparison was done between the two groups A) with flatfeet and B) without flatfeet there was no significant difference in the two groups as the p value obtain was greater than 0.05, ($p>0.05$) the value was obtaining by using the unpaired t test which was used to compare both the groups.

Thus results obtain from the study explains the fact that only flatfoot does not affect the jump ability of the players. Other factors rather than the flatfoot or combine with the flatfoot may affect the jump ability, the jumping activity is considered being an activity of very short duration. And other factors are responsible for the affection in the jump height of the player also other factors may compensate the affection of flatfoot, thus making no difference in the jump height of a player with flatfoot and player without flatfoot[8].

The good vertical jump height can be backed by various other factors those factors are like the 1) strength and momentum in ankle and knees 2) the power and speed of lower extremity 3) endurance of the player[8].

Flatfeet does affects activities like walking and running as ground reaction force works in conjunction with the anatomical biomechanics but considering the flattened arch height in pes planus the overall movement is slow and may differ from normal individuals[8].

The results of this study are similar to the study done by heidar sajedi, negar salari1, sajjad A. Alang and Cengiz Akalan the study was comparison of vertical jump height in primary school boys and girls with and without flat foot stating that there was no difference in the jump height in individuals with flatfeet and without flatfeet[9-13].

11. Conclusion

The study concludes that there is no significant difference in the vertical jump height of professional basketball players with or without flatfeet.

Hence we accept the null hypothesis which states there will be no significance difference in the vertical jump height of the player with flatfeet and without flatfeet.

12. Limitations

The study was bounded to adults within age group 16 to 25 years.

13. Future Scope

Other component rather than jumping can be compared.

Study population can be changed.

Study can be done in different age group.

Study can be done on different foot deformities and its relation with vertical jump.

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15. Conflicts of Interest

Authors declares that there are no conflicts of interest.

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