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Relationship between balance and vertical jump performance in basketball players: A pilot study

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Abstract
Background: The purpose of the study was to find the correlation between the balance and performance in vertical jumps in basketball players. Balance preparing is a fascinating and questionable strategy for preparing for mentors in light of the cross-over impact that it might have on athletic execution in different games and at various ages. Basketball is an extreme focus irregular game that requires both high-impact and anaerobic energy, shaped by quick and short dislodging, where changes in speed and vertical leaps are vital pieces of execution.
Objective of the Study: To find whether there is a correlation between balance and vertical jump performance in basketball players.
Methodology: A pilot study with a total of 20 professional basketball players in and around Mangalore aged from 18 to 30 years had participated in the study The initial assessment of players to include them according to inclusion and exclusion criteria was done and the subjects were asked to perform Balance Error Scoring System (BESS), Y-balance Test and Vertical Jump.
Results: Spearman's correlation coefficient was calculated between the parameters. It shows that there is a weak positive correlation between vertical jump and BESS (r=0.081, p>0.05) and a weak negative correlation between vertical jump and YBT (r=0.029, p>0.05).
Conclusion: The findings of this research point out no correlation between BESS performance and Vertical jump performances, YBT performance and balance training may not result in improvement of performance in basketball players.

Keywords: BESS, YBT, performance test, vertical jump, balance, anaerobic energy

Introduction
Basketball is one of the world's most famous court games, being played in pretty much every country no matter what. It is a high-intensity intermittent game formed by fast and short displacement in which both aerobic and anaerobic energy is needed. As speed and vertical jumps are integral parts of performance and balance ability for reducing risk of injury in basketball. Basketball players use the vertical jump (VJ) as one of their most common moves. Basketball players perform numerous defensive (e.g., blocking, rebounding, and stealing) and offensive (e.g., passing, rebounding, and shooting) moves in practice and games that include jumping [1]. Landing in a balanced stance and with proper technique is also vital for good performance when transitioning from a leap to other skills [2]. It was observed that when balance training was implemented, the occurrence of injury rate was reduced by 38 % [3].
As basketball requires the players to constantly address actual contact and different circumstances including balance insecurity, for example, basketball specific accelerations and decelerations, changes in direction, penetrations into the defensive perimeter, boxing out, dribbling and defensive position recuperation. Thus the training of the players with balance will reduce the injury rate.
Balance is the ability to keep one's center of gravity over a stable base of support, which is achieved by neuromuscular responses to continual visual, vestibular, and somatosensory feedback [4]. The ability to control the balance of the body while standing is a complex and integrative procession from a variety of sensory and motor inputs and is fundamental for different types of physical activities. Balance is a basis for further control and coordination of more complex movements and therefore has an important role in sports activities such as basketball an important role in sports activities such as basketball.

Studies show that performing high-level movements requires both static and dynamic balance in order to minimize the risk of injuries during practice and in competition [5].

However there are discrepancies in literature regarding importance of postural control and vertical jump performances. Jallai T *et al.* (2011), Muehlbauer *et al.* (2013) and Abbas Asadi *et al.* (2017) found no significant correlation between postural control and vertical jump performance [6, 7, 8]. In contrast, Erkmen N *et al.* (2010) found statistically significant relationship among single-leg static balance and Vertical jump in football players [9]. Due to controversies of the study majority of those studies lack the rationale for adding balance training in the conditioning protocol of basketball.

Nonetheless, the connection between balance capacity and performance is not completely clear and required additional proof. This study aims to find the relationship between balance and vertical jump performance in basketball players. This will give a scientific rationale for using balance training as an adjunct with other forms of exercise. As a therapist's or practitioner's point of view, knowledge about the relationship between balance and vertical jump performance may be important for the identification of a person with poor performance and thus may help in planning pre-season training.

Methods

Subjects

20 professional basketball players in and around Mangalore aged from 18 to 30 years had participated in the study. Ethical clearance was obtained from the institutional ethics committee. The subjects participating in the study were given an information sheet containing the study details and, also the patient consent form was obtained from the subjects prior to the study. The inclusion criteria were, between the ages 18 to 30 years, professional basketball and males only. Subjects were excluded if they were suffering from recent injury to the lower extremity or back (last 6 months), neurological disorders like stroke or concussion, any vestibular deficits like benign paroxysmal positional vertigo (BPPV), recent orthopaedic surgeries like ACL reconstructions, unwillingness to participate. Written informed consent was obtained and demographic data were obtained. The initial assessment of players to include them according to inclusion and exclusion criteria was done.

Outcome Measures

1. Balance Error Scoring System (BESS)

The BESS comprises: double-leg, single-leg, and tandem stances on firm and foam surfaces. A stopwatch was used to measure the time each of the 20-second trials. One BESS error was scored if the subject engaged in any of the following: (1) lifting the hands of the iliac crests; (2) opening the eyes; (3) stepping, stumbling, or falling; (4) moving the hip into more than 30° of flexion or abduction; (5) lifting the forefoot or heel; or (6) remaining out of the test position for longer than 5 seconds. Error scores was calculated for each condition and sum was obtained as the total BESS score. Subjects were allowed to familiarize themselves with the different conditions. Once they were comfortable on standing each surface, they were instructed to correct positioning for each of the conditions.

In double-leg stance condition subjects had to stand with feet together. Then in single-leg stance was performed on the non-dominant leg. The dominant leg was positioned so that the hip was flexed to approximately 30° and the knee flexed to 90°, leaving the foot approximately 6 to 8 inches. (15.24 to 20.32 cm) off the ground. Instruction to the subject was not to lean on the non-dominant leg was given. The non-dominant foot was positioned behind the dominant foot in the tandem stance and was instructed to maintain the stance with the great toe of the non-dominant foot touching the heel of the dominant foot. For all conditions, the subjects were instructed to remain still with eyes closed and hands on the hip. After this instruction, subjects were given 3 familiarization trials on each condition before the actual data collection. During the familiarization and testing sessions, each condition lasted for 20 seconds. During the testing, the examiner observed from 8 to 10 feet away from the subject [10].

2. Y- Balance Test (YBT)

The Y- Balance Test –Lower Quadrant is a standardised performance test. The device utilizes the anterior (A), postero-medial (PM), and postero-lateral (PL) components of the Star Excursion Balance Test. The posterior line was positioned 135 degrees from the anterior line with 45 degrees between the posterior lines. The subjects were instructed to stand on the leg i.e.; dominant leg, with the most distal part of the great toe placed on the center of the grid. While maintaining a single-leg stance, they were instructed to use the opposite leg to reach, as far as possible toward the end of the line along a grid in the A, PM, and PL directions and were instructed to touch the ground lightly with the most distal part of the reaching foot before returning to the starting position. The reach distance was then measured using a measuring tape. The subject's hands were held at the iliac crest during the test. All tests were performed barefoot to rule out the influence of shoes. After 3 practice trials were completed, the subjects rested for 30 second and then performed three test trials in each direction. The test were discarded and then repeated in the same manner if a subject failed to maintain the unilateral stance, lifted or moved the standing foot from the grid, or failed to return the reaching foot to the starting position. The longest reach distance in each direction was used for the analysis.

For an accurate analysis, the data of reach distance will be normalized with the leg length to exclude the influence of leg length. The leg length will be measured with a tape measure from the anterior superior iliac spine to the center of the ipsilateral medial malleolus. The composite score will be calculated according to the formula {(sum of all three directions)/ (limb length × 3)} × 100 [13].

3. Vertical jump

A Counter-Movement Jump (CMJ) was performed with the subject standing in an upright position. A fast downward movement which was immediately followed by a fast upward vertical movement as high as possible, all in one sequence. Arm swing was allowed. Initial measurement of height was taken from ground to the tip of fully flexed upper extremity. The final measurement was taken as the person jumps and tries reaching maximal height, the difference between the measurements which were the vertical displacement between a bodily landmark (e.g., hand) at the beginning and at the end of the jump using a mark on a wall. Three trials were carried out with 30 second rest in between the trials. Demonstration and practice trial was allowed before commencing the measurement trials [12].

Data Analysis

The collected demographic and outcome measures was

assessed for their normality using Kolmogorov–Smirnov test. The data deviated from normal distribution, and then the descriptive statistics were analyzed by using Spearman's correlation. The level of significance was set at 5% to measure the correlation of between the balance and performance as vertical jump. The collected data was analyzed using statistical package for social science software version 1.6.

Results

Total of 20 subjects were considered for data analysis. The mean age (in years) of the study subjects was 27.7 years with standard deviation of 1.625 years. And the body mass index (BMI) mean was 22.71 kg/m^2 with a standard deviation of 0.449 kg/m^2. Demographic data and the outcome measures data of the sample is presented in Table 1. It shows that there is a weak positive correlation between vertical jump and BESS (r=0.081, p>0.05) presented in Table 2 and a weak negative correlation between vertical jump and YBT (r=0.029, p>0.05) presented in Table 3. And the results are not statistically significant enough as presented in Tables 2 & 3.

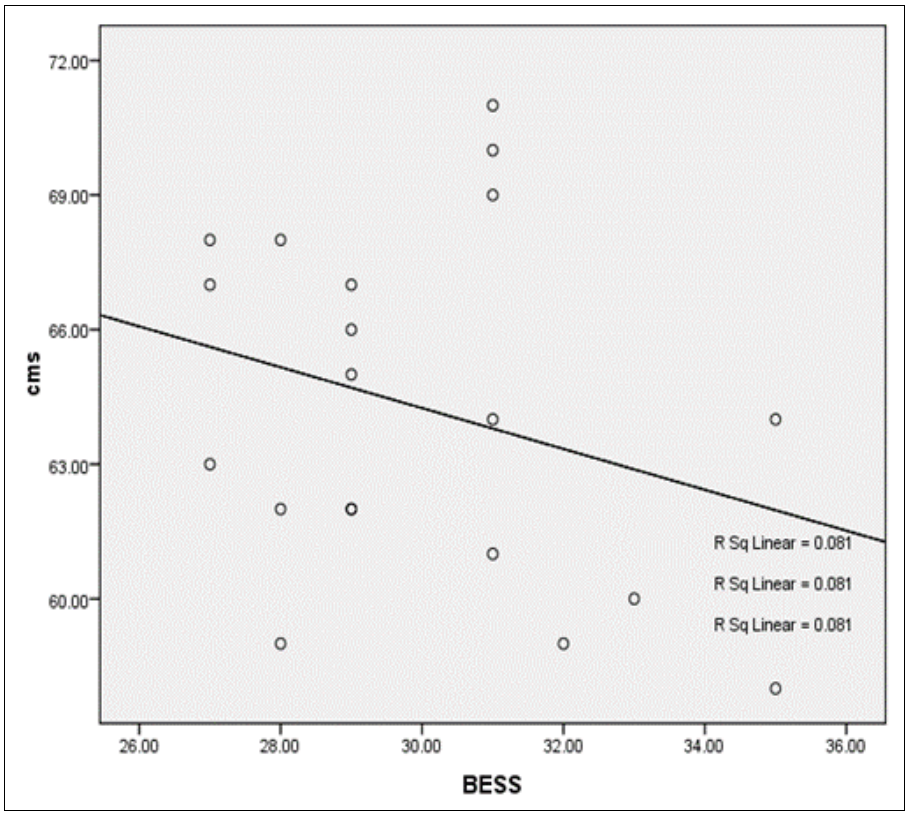

Fig 1: Scatter diagram of vertical jump and BESS with its line of regression

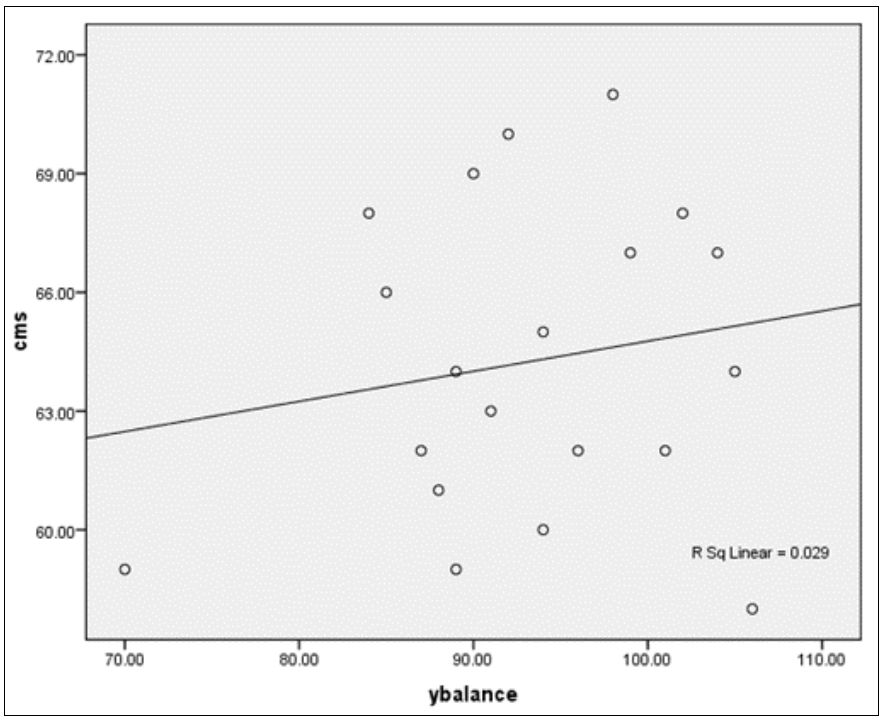

Fig 2: Scatter diagrams of vertical jump and YBT with line of regression

Table 1: Descriptive statistics of demographic data and outcome measures

Descriptive Statistics				
	Minimum	**Maximum**	**Mean**	**Std. Deviation**
Age (years)	25	30	27.70	1.625
Height (cms)	168	185	179.45	3.734
Weight (kgs)	66	78	73.15	2.961
BMI	21.74	23.50	22.71	.44932
Vertical jump (cms)	58.00	71.00	64.2500	3.89162
BESS	27.00	35.00	30.0000	2.42791
Y-balance test (Composite Score)	70.00	106.00	93.2000	8.67907

Table 2: Spearman's correlation of Vertical jump and BESS.

Correlations				
			cms	**BESS**
Spearman's rho	Vertical jump	Correlation Coefficient	1.000	-.246
		Sig. (2-tailed)	.	.297
		N	20	20
	BESS	Correlation Coefficient	-.246	1.000
		Sig. (2-tailed)	.297	.
		N	20	20

Table 3: Spearman's correlation of Vertical jump and YBT

Correlations				
			cms	y-balance
Spearman's rho	Vertical jump	Correlation Coefficient	1.000	.102
		Sig. (2-tailed)	.	.669
		N	20	20
	Y-balance Test (YBT)	Correlation Coefficient	.102	1.000
		Sig. (2-tailed)	.669	.
		N	20	20

Discussion

The effects of balance and proprioceptive activities on bio motor characteristics have been studied in the literature. While some of them reveal that balance activities have a major impact on performance, this study was designed to find whether the relationship between vertical jump and balance (static and dynamic) among basketball players. The measurement of static balance was done with a balance error scoring system (BESS) and dynamic with a Y-balance test (YBT). Players whose training includes a balanced regimen were found to have better performance in the games [3, 4]. So, it has been considered that balance training promotes in performance. In various sports rehabilitation programs BESS and YBT are used to assess whether the injured player can return back to the game or not [16, 17].

The results of the study indicated that there was a positive correlation between the Vertical jump (CMJ) performance and Y- Balance test (r= 0.004, p>0.05) and a negative correlation with Balance Error Scoring System (r=0.000, p>0.05). Counter Movement Jump with BESS and YBT did not have any statistically significant correlations between each other. Body mass and BMI had a negative correlation clearly a negative effect on vertical jumping height

As per results of the study obtained it doesn't show significance in the study statistically. Thus rejecting the hypothesis and accepting the null hypothesis i.e there is no correlation between the vertical jump (CMJ) and balance (BESS and YBT). The findings of our study agree with other similar studies. Goktepe, *et al.* 2016 found that there were significant correlations between drop jump and static balance but no correlation with countermovement jump (CMJ) and static jump. As it is still unclear how sports-specific demands affect static and dynamic balance among athletic sports.

Though some sports like soccer has found to have more balance than non-soccer players [18]. Hamilton, *et al.* 2008 found that, performance on the BESS was not significantly related to any of the tests performed i.e. triple hop distance (THD), and vertical jump.

It is known that deficits in balance or lower limb power lead to higher risk of injury but unknown results in performance [6]. In basketball players the risk of injury is maximum during the landing phase of the jump and the risk factor increases when there is deficient in muscle power and balance. Jallai T *et al.* study found no significant correlation between static balance and vertical jumping performance and suggest that change in static balance during bi- and uni pedal standing measured on a force platform doesn't affect vertical jumping.

Basketball players use the vertical jump (VJ) as one of their most common moves. As studies suggest vertical jumping and other exercises that require explosive power may represent the capacity to maintain a balanced posture, but horizontal jumping does not. And in a study that compared balance training with isotonic training among the basketball players, balance training showed the superiority in terms of balance test and muscular power which could be due to improvement in the intra- and inter-muscular coordination of knee extensors.[3, 17] As the balance training develop more muscular power in comparison to isotonic training it is the reason that basketball players had better outcomes. The increase in the muscle strength plays an important role in performance of the basketball players. Thus the training of basketball players includes other programs that include strengthening of the muscles such as plyometrics. So in the present study, vertical jump performance and balance are not significantly related suggesting balance training is not enough for the improvement of performance.

The findings obtained in the most of above-mentioned research are supportive of our findings. The present study provides insight about how much a basketball player should be focusing on balance training over other training and how basketball players should not only be dependent on balance training programs to improve the performance

Limitations and Recommendations

The sample size of the study was small in number. The inclusion of only male subjects in the study doesn't give a generalized idea about the basketball players. As balance assessment can be varied according to the outcome measure even though the objective is same. So, we can further improvise the current investigation by taking multiple variants of balance outcome measures for correlation and with the larger sample size and also including female subjects in the study.

Conclusion

The findings of this research point out no correlation between BESS performance and Vertical jump performances, YBT performance and balance training may not result in improvement of performance in basketball players. Thus, study results pointing that only balance training exercises in the basketball players is probably not going to improve the performance in terms of vertical jump.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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