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Sharath UR
Assistant Professor,
Kempegowda Institute of
Physiotherapy, KIMS & RC
Bangalore Rajiv Gandhi
University of Health Sciences,
Bangalore, Karnataka, India

Prakruthi Bhujanga
Post Graduate, Scholar
Kempegowda Institute of
Physiotherapy, KIMS & RC
Bangalore Rajiv Gandhi
University of Health Sciences,
Bangalore, Karnataka, India

Pradeep K Reddy
Assistant Professor,
Kempegowda Institute of
physiotherapy, KIMS & RC,
Bangalore, Karnataka, India

Shridhar S
Assistant Professor,
Kempegowda Institute of
physiotherapy, KIMS & RC,
Bangalore, Karnataka, India

Corresponding Author:
Sharath UR
Assistant Professor,
Kempegowda Institute of
Physiotherapy, KIMS & RC
Bangalore Rajiv Gandhi
University of Health Sciences,
Bangalore, Karnataka, India

A study on effect of wobble board balance training program on static balance, dynamic balance, triple hop distance and vertical jump height in basketball athletes

Sharath UR, Prakruthi Bhujanga, Pradeep K Reddy and Shridhar S

Abstract

Balance is one of the important coordination abilities in the field of sports in general and basketball in particular. Balance training assist in increase in proprioception, kinaesthetic awareness, muscular strength and core strength. Hence, the intension of the present study is to evaluate the balance of basket ball player with help of wobble board. The study was conducted on 50 healthy basketball players between the age group of 18 years – 22 years and they were randomly divided in to control group (n =25) and experimental group (n = 25). The training group were given eight weeks of training. The result was obtained by pre and post-test reading of wobble which showed significant improvement. Similarly, there is a significant improvement in star excursion balance test in all the eight directions in group A. The pre and post treatment of triple hop distance and vertical jump height showed equal improvement in training for group B. This study concluded that wobble board balance, star excursion balance test, triple hop distance and vertical jump height test is an effective mean for improvement of static and dynamic balance in basketball athletes.

Keywords: Static balance, dynamic balance, triple hop distance, vertical jump heights, wobble board balance, star excursion balance

Introduction

Balance is the process of maintaining the position of the body's center of gravity vertically over base of support and relies on rapid, continuous feedback from visual, vestibular and somatosensory structure and then executing smooth and coordinated neuromuscular actions. The relationship between balance ability and sport injury risk has been established in many cases but the relationship between balance ability and athletic performance is less clear [6].

The rationale for inclusion of balance training in an overall conditioning program can be strengthened if it is also shown to have a positive influence on athletic performance [6].

Balance training was demonstrated to reduce muscular strength imbalance between the legs and is effective for gaining muscular strength. A proposed mechanism of the enhancement in motor skills from balance training is an increase in the rate of force development. Balance is a form of neuromuscular control which contributes in developing physical and skill performance [7].

The basketball players can go anywhere freely in the court where it divides into upper zone and lower zone and therefore, they may need to change in direction together with dribbling, jump shots and passing on even or hard surfaces. All of the skills above required the payers to have great joint acceleration from jump landing and cutting maneuver. Suitable jump landing technique is also important to incorporate into balance training as their normal training routine [8].

Lower extremities injuries especially ankle sprain will always making the players or coach physiology stress. This is because the lack of awareness to importance of balance training as their normal training routine will increase risk of ankle sprain among basketball players and thus effect the performance [8].

Static balance is the ability to maintain the postural stability and orientation with center of mass over the base of support and body at rest. Static balance has an ability to maintain a base of support with minimal movements. According to bannister, is that on static balance adequate amount of muscle power at lower limb and trunk erect position with normal posture and impulses are needed in order to acquire the proper static balance [10].

Dynamic balance is the ability to perform a task while maintaining or regaining a stable position or the ability to maintain or regain balance on unstable surface with minimal extraneous motion [6]. Dynamic balance is the ability to transfer the vertical projection of the center of gravity around the supporting base of support [9]. Dynamic balance is a skill related component of physical fitness that involves maintenance of equilibrium while moving and as such is becoming an integrated component of strength and conditioning regimen's [10].

Vertical jumping is a fundamental component of many sports and also may be predictive of performance in other sports in which it is not the primary component. A vertical jump or vertical leap is the act of raising one's center of mass higher in the vertical plane, solely with the use of one own muscle. It is a measure of how high an individual or athlete can elevate off the ground (jump) from stand still. Basketball involves many lateral movements and jump squatting etc. which require strong leg muscle and stability of the core [6].

2. Method and material (Times New Roman, 12, Bold)

The data was collected from Khanteerava stadium Bangalore, Kittu rani channama stadium Bangalore, Beagles basketball club Bangalore and Sahakar Nagar basketball club Bangalore. The study was randomized control study which was performed on 50 subject in a convenient random sample method and the study duration was 12 months. Material used are wobble board of standard size, foam pad, stop watch, spotter, BESS score card, A functional testing grid, Reliability and consistency testing facility (2*2 meter), Sticky tape, Measuring tape, Performance recording test.

2.1 Inclusion criteria: Age: 18 to 22 years, both males and females, Subjects who are practicing the game for at least one year.

2.2 Exclusion criteria: Fracture of lower limb bone in past one year, Soft tissue injury of lower limb, Any surgery in past one year, Evidence of current orthopaedic lower limb injury, Soft tissue injury of upper limb, Currently completing a balance training program prior to Commencement of the current study, Lower limb injury and / or illness during the study, History of unstable ankle joint limiting unilateral balance capabilities and History of injury limiting unilateral balance capabilities.

2.3 Methodology

Subject are screened for inclusion and exclusion criteria; they

Group A control group

| Phase and weeks | surface | protocol |
|-----------------|--|--|
| Phase 1 week 1 | floor and with eyes open | Single- leg stance while swinging raised leg and Single – leg squat (30 – 45 degree), single – leg stance while performing, functional activities (dribbling, catching), Tandem stance, Single leg stand and tandem stance with power dribbling. |
| Phase 2 week 2 | Floor and air cushion with eye closed | Single-leg stance Swinging the raised leg, Single leg squat (30-45 degree), tandem stance. Jumping landing Techniques: jumping 2 feet to 2 feet alternate, landing foot with basketball throwing on backboard [8]. |
| Phase 3 week 3 | Air cushion and wobble board eyes open | Jumping landing techniques: Single leg stance, Jumping hopping with landing On single leg(alternating the landing, leg Jumping landing 2 feet to 2feet with partner throwing ball (subject throws back to partner in air), Jumping landing 2 feet to 1 feet with partner throwing the ball [8]. (subject throws back the ball to partners while in the air). Jumping landing 2feet to 1 feet with 180 degree with Coach passing ball [8]. Exercises on board: single leg stance, Swinging the raised leg, Single leg squat (30-40 degree Double leg stance while rotating the board. |
| Phase 4 week 4 | Air cushion and wobble board with eyes close and | jumping landing techniques: Single leg stance with disturbance, Tandem stance with disturbance, Single leg stance with power dribbling, Jumping to hopping with landing on single leg (alternating the landing leg), Jumping to landing to catch held high basketball, Rebounding exercises on both leg and |

are randomly divided in to control (n-25) and training group (n-25). They are given eight weeks of training (for first two weeks on floor and next six weeks on wobble board) and training is given five times a week for first four weeks and three times a week for next four weeks with their routine training for agility and strength under the supervision of the physiotherapist. Before each testing and training session the subject complete 5minutes of warmup exercises, pre week (0week) and post week (8week) measurement's, of static balance (BESS score), and dynamic balance (SEBT score) And triple hop distance and vertical jump are noted for group B [7].

Balance error scoring system: The balance error scoring system consists of 6 separate 20- second balance tests that the subject performed in different stances and two different surfaces. The test consisted of 3 stance conditions. (A) Double leg stance (B) single leg stance (C) tandem stance. The BESS can be performed for approximately 10 minutes to conducts [18]. Each of the twenty second trials is scored by counting the errors or deviations from the proper stance, accumulated by the subject. The examiner will begin counting error's only after the individual has assumed the proper testing position [18].

Single leg stance: Direction to subject: If you were to kick a ball, which foot would you use? [This will be the dominant foot]. Now stand on your non-dominant foot. Before continuing the test assess the position of the dominant leg as such: the dominant leg should be held in approximately 30 degrees of hip flexion and 45 degrees of knee flexion] Again, you should try to maintain stability for 20 seconds with your eyes closed. I will be counting the number of times you move out of this position [18].

Tandem stance: Directions to the subject: Now stand heel-to-toe with your non-dominant foot in back. Your weight should be evenly distributed across both feet. [18] Again, you should try to maintain stability for 20 seconds with your eyes closed. will be counting the number of times you move out of this position [18].

Sebt test: The Star Excursion Balance Test (SEBT) is a functional test that incorporates a single-leg stance on one leg (e.g. right leg) whilst trying to reach as far as possible with the opposite leg (e.g. left leg). The participants stand in a square at the center of the grid with 8 lines extending from the center at 45° increments [19].

2.4 Intervention

| | | |
|----------------|---------------------------------------|--|
| | open | single leg with Disturbance ^[8] . Exercises on board: Single leg stance, Swinging the raised leg Single leg squat (30-45 degree, Single leg stance while rotating the board ^[7] . |
| Phase 5 week 5 | Exercise on board eyes open and close | Close: single leg stance open: single leg squat, open: single leg stance while rotating the board, open: single leg stance while performing functional activities (dribbling, catching) ^[7] . Exercises on wobble board: single leg stance, single leg squat double leg squat |

Group B

- a) Triple hop jump test: we fix a standard cloth tape measure to the ground, perpendicular to starting line. Participants are asked to stand on the designated testing leg, with the great toe on the starting line, they are asked to perform three consecutive maximal hops forward on the same (dominant) limb. Arm swing is allowed. the investigator measured the distance hopped
- b) From the starting line to the point where the heel stuck the ground upon completing the third hop. All participants are allowed one to three test trails. Participants trails are limited to three on each leg to avoid the effect of fatigue. A test trail was repeated if the participant are unable complete a triple hop without losing balance and contacting the ground with opposite leg 30 seconds of time is given between each trial. The maximum distance achieved during three is recorded in centimetre and is used for the analysis. Participants can wear self- selected footwear during the test is recorded in centimetre and is used for the analysis. Participants can wear self- selected footwear during the test^[38].
- c) Vertical jump test: is performed using a counter movement jump. Participants are tested wearing self-selected athletic footwear. Testing begin by having the

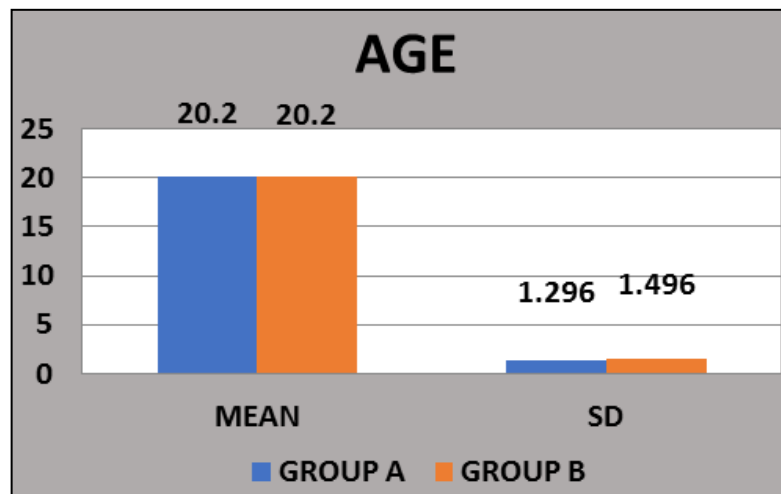
participants stand beneath the jump it measurement standard, with the side of the preferred reach hand positioned closest to the standard and feet flat on the ground and shoulders width apart. Participants are permitted to 1 to 3 practice jump before completing 3 tests trials and is recorded in centimetre and is used for analysis^[29].

Standing jump test: is performed according. A start line is determined on skid floor and tape meter is extended from the start line. There are on the front parallel to the floor and knees are bent, subjects are instructed to push of vigorously and jump forward as far as possible. The participants has to land with the feet together and to stay upright. The distance is measured from the ground upon completing the test. The test is repeated twice and the best score is recorded in centimeter^[29].

3. Results

Table 1: Age of the study participants

| | Mean | SD |
|---------|------|-------|
| Group A | 20.2 | 1.296 |
| Group B | 20.2 | 1.496 |



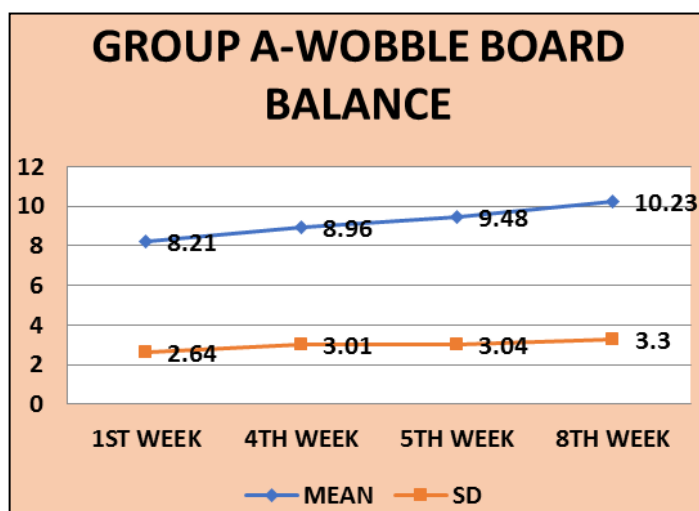
Graph 1: showing mean and standard deviation of age of study participants

Table 2(a): group a-comparison of wobble board balance between the time intervals

| Group A- Wobble Board Balance | | | | | |
|---------------------------------|--|----------|----------|----------|--|
| | 1st Week | 4th Week | 5th Week | 8th Week | |
| Mean | 8.21 | 8.96 | 9.48 | 10.23 | |
| SD | 2.64 | 3.01 | 3.04 | 3.3 | |
| % Difference (Mean & SD) | 1 ST Week Vs 4 TH Week | | 8.63 | | |
| | | | 2.8 | | |
| | 1 ST Week Vs 5 TH Week | | | 15.72 | |
| | | | | 3.47 | |
| 1 ST Wee Vs 8Th Week | | | | 25.05 | |
| | | | | 7.54 | |

Table 2(b): Group a-analysis of wobble board balance between the time intervals

| Group A- Wobble Board Balance | | | | |
|--------------------------------------|--|----------|----------|----------|
| | 1st Week | 4th Week | 5th Week | 8th week |
| Mean | 8.21 | 8.96 | 9.48 | 10.23 |
| SD | 2.64 | 3.01 | 3.04 | 3.3 |
| P value (Paired t test) | 1 ST Week VS 4 TH Week | | | 0.35 |
| | 1 st Week VS 5 TH Week | | | 0.12 |
| | 1 ST Week VS 8 TH Week | | | 0.02* |
| | 4 TH Week VS 5 TH Week | | | 0.54 |
| | 4 TH Wee VS 8 TH Week | | | 0.16 |
| | 5 TH Week VS 8 TH Week | | | 0.40 |



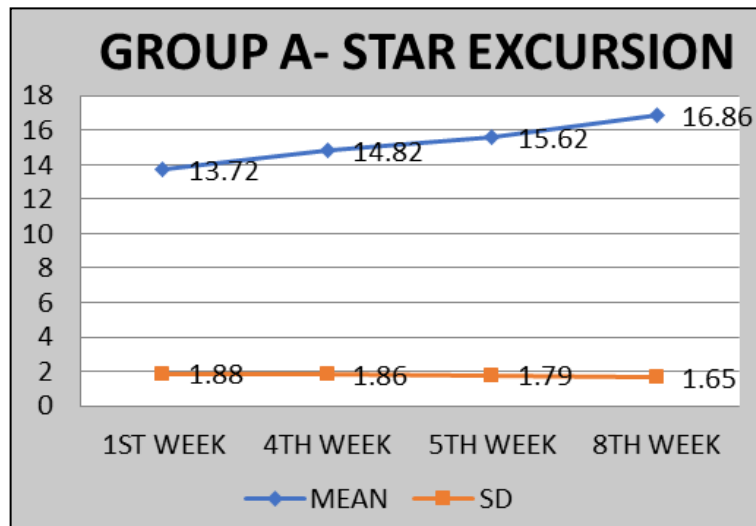
Graph 2: showing mean and standard deviation on Group-A

Table 3(a): Group a-star excursion test -comparison between the time intervals

| Group a- star excursion | | | | |
|---------------------------------|--|----------|----------|----------|
| | 1st Week | 4th Week | 5th Week | 8th Week |
| Mean | 13.72 | 14.82 | 15.62 | 16.86 |
| Sd | 1.88 | 1.86 | 1.79 | 1.65 |
| % Difference (Mean & Sd) | 1 st Week Vs 4 th Week | | 7.83 | |
| | | | 3.78 | |
| | 1 st Week vs 5 th Week | | | 13.85 |
| | | | | 5.03 |
| 1 st Wee vs 8th Week | | | | 22.76 |
| | | | | 8.60 |

Table 3(b): group a-star excursion test –analysis between the time intervals

| Group A- Star Excursion | | | | |
|--------------------------------|--|----------|----------|----------|
| | 1st Week | 4th Week | 5th Week | 8th Week |
| MEAN | 13.72 | 14.82 | 15.62 | 16.86 |
| SD | 1.88 | 1.86 | 1.79 | 1.65 |
| P value (Paired t test) | 1 st Week VS 4 th Week | | | 0.04* |
| | 1 st Week VS 5 th Week | | | 0.0006* |
| | 1 st Week VS 8 th Week | | | 0.0001* |
| | 4 th Week VS 5 th Week | | | 0.11 |
| | 4 th Wee VS 8 th Week | | | 0.0002* |
| | 5 th Week VS 8 th Week | | | 0.012 |



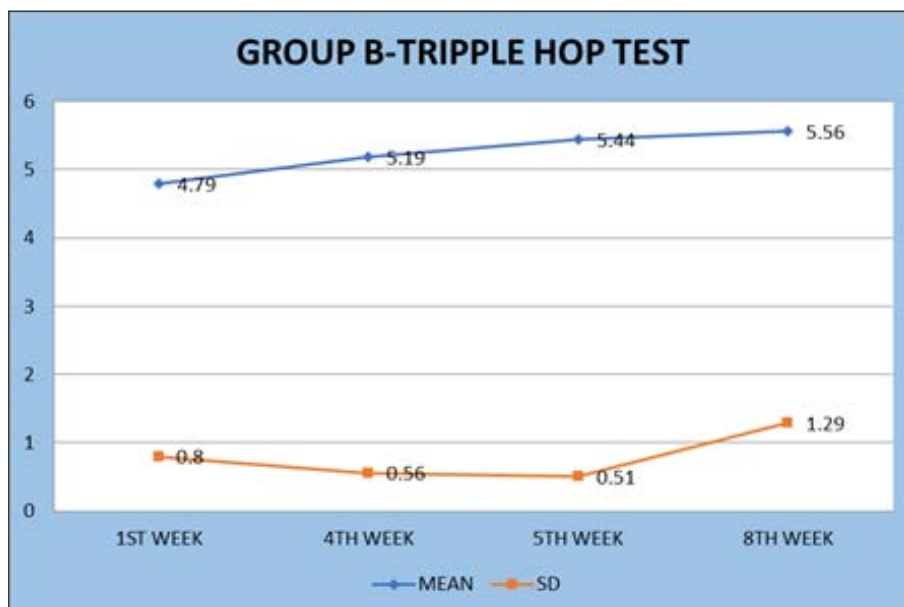
Graph 3: showing mean and standard deviation on Group-A

Table 4(a): Group b-triple hop test –comparison between the time intervals

| Group B-Triple Hop Test | | | | |
|----------------------------------|--|----------|----------|----------|
| | 1st Week | 4th Week | 5th Week | 8th Week |
| Mean | 4.79 | 5.19 | 5.44 | 5.56 |
| SD | 0.80 | 0.56 | 0.51 | 1.29 |
| % Difference (Mean & SD) | 1 ST Week Vs 4 th Week | | 10.13 | |
| | | | 8.07 | |
| | 1 ST Week Vs 5 th Week | | | 15.63 |
| | | | | 10.68 |
| 1 ST Wee Vs 8 Th Week | | | | 23.55 |
| | | | | 14.76 |

Table 4(b): Group b-triple hop test –analysis between the time intervals

| Group A- Triple hop Test | | | | |
|--------------------------|--|----------|----------|----------|
| | 1st Week | 4th Week | 5th Week | 8th Week |
| Mean | 4.79 | 5.19 | 5.44 | 5.56 |
| SD | 0.80 | 0.56 | 0.51 | 1.29 |
| P value (Paired t test) | 1 ST Week VS 4 TH Week | | | 0.04* |
| | 1 st Week VS 5 TH Week | | | 0.0013* |
| | 1 ST Week VS 8 TH Week | | | 0.014* |
| | 4 TH Week VS 5 TH Week | | | 0.10 |
| | 4 TH Wee VS 8 TH Week | | | 0.19 |
| | 5 TH Week VS 8 TH Week | | | 0.66 |



Graph 4: showing mean and standard deviation on group-b

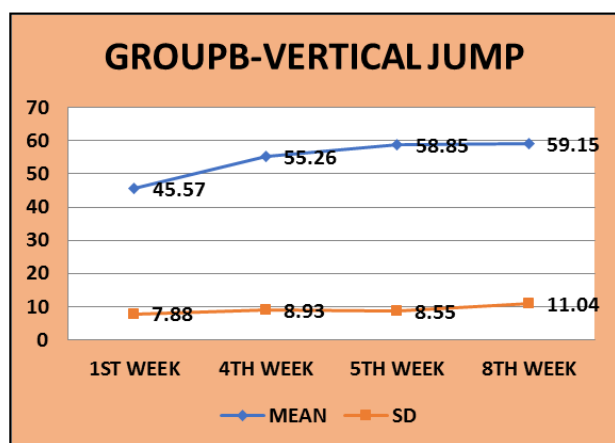
Table 5(a): Group b-vertical jump test –comparison between the time intervals

| Group B-Vertical Jump | | | | |
|---------------------------------|--|----------|----------|----------|
| | 1ST Week | 4th Week | 5th Week | 8th Week |
| Mean | 45.57 | 55.26 | 58.85 | 59.15 |
| SD | 7.88 | 8.93 | 8.55 | 11.04 |
| % Difference (Mean & SD) | 1 ST Week Vs 4 th Week | | 55.26 | |
| | | | 8.93 | |
| | 1 ST Week Vs 5 th Week | | 32.96 | |
| | | | 16.78 | |
| 1 ST Wee VS 8th Week | | | 38.04 | |
| | | | 15.48 | |

Table 5(a)- shows the mean standard deviation value of GROUP B(VERTICAL JUMP)

Table 5(b): Group b-vertical jump test –analysis between the time intervals

| Group B-Vertical Jump | | | | |
|-------------------------|--|----------|----------|----------|
| | 1st Week | 4th Week | 5th Week | 8th Week |
| Mean | 45.57 | 55.26 | 58.85 | 59.15 |
| SD | 7.88 | 8.93 | 8.55 | 11.04 |
| P value (Paired t test) | 1 st Week Vs 4 th Week | | 0.0002* | |
| | 1 st WEEK VS 5 TH WEEK | | 0.0001* | |
| | 1 st Week Vs 8 th Week | | 0.0001* | |
| | 4 th Week Vs 5 th Week | | 0.153 | |
| | 4 th Wee Vs 8 Th Week | | 0.112 | |
| | 5 th Week Vs 8 th Week | | 0.721 | |

**Graph 5:** Showing mean and standard deviation on group-b vertical jump test

4. Discussion

The aim of the study is to compare the effect of static balance, dynamic balance, triple hop distance, vertical jump test with wobble board balance in basketball players. The subjects (50 males) included in the study were between the age group of 18-22 years with mean age standard deviation 20.2 ± 1.2 for Group A and 20.2 ± 1.4 for Group B.

In this study based on 8 week static and dynamic balance program with wobble board, star excursion test in all the eight direction are used for assessing static balance (which has improved the stability of core muscle as well as the proprioception), triple hop distance (improved the unilateral balance of players) and vertical jump test (help to prevent injuries during the acceleration and deceleration during the counter movements) are used for assessing the dynamic balance.

But this study is based on time intervals of each session which shows significant score in improvement in static balance with

(star excursion test) a pre-week mean and standard deviation of 13.8 ± 1.88 that is 1st to 4th week and post week (5th – 8th week) after the intervention with a mean and standard deviation of that is 16.86 ± 1.65 and in wobble board pre week score of 8.21 ± 2.64 and in post week 10.23 ± 3.3 . For group A but there is not much improvement shown between the 4th and 5th week scores.

For group B this study showed significant score in improvement in dynamic balance with Triple hop distance) a pre-week mean and standard deviation of 4.79 ± 0.80 and vertical jump height 45.57 ± 7.88 post week 59.15 ± 11.04 but there is not much improvement shown between the 4th and 5th week interventions.

Thus this study shows significant improvement in the scores of both static balance and dynamic balance.

Limitation: Samples included was with population with age group 18- 22 years, so result cannot be generalized to other age groups. Only male gender is consider, so cannot be applied to female population. Limited samples are taken.

Recommendation: Different size of balancing board should be used to select best choice for each age group. Similar study should be conducted in both male and female basketball athletes with different age groups. The static and dynamic balance can be further be checked with the other functional parameters like, continuous plyometric training, agility and sprint time.

5. Conclusion

This study infers that both the group has shown statistically significant improvement in improving dynamic and static balance in basketball players ($p < 0.05$).

As compared to the group which received static balance training the group with dynamic balance training showed statistically more significant while improving balance in basketball players. Hence the null hypothesis is rejected and the alternative hypothesis is accepted that there is significant improvement in static balance and dynamic balance in performance of basketball player.

6. References

1. Reghunandan V, Gopinathan K, Reghunandan R. Elementary human anatomy and physiology. 3rd edition. Vallabh prakashan publishers, 2017.
2. Mary Kristen Jesse. A Study on Normal Anatomy and Imaging of the Hip: Emphasis on Impingement Assessment. Thieme Medical Publishers, 2013. DOI <http://dx.doi.org/10.1055/s-0033-1348090>. ISSN 1089-7860.
3. Fred Flandry, Gabriel Hommel. A study on Normal Anatomy and Biomechanics of the Knee Sports Med Arthrosc Rev 2011;(19):82-92.
4. Vinodh Rajkumar R. Force couple mechanics on femur during closed kinetic chain activities of lower limbs. Int J Physiother Res 2014;2(6):766-71.
5. Peter McGinnis M. Biomechanics of sports and exercise biomechanics of sports and exercise; 3rd edition; United States of America, 2012.
6. Con Hrysomallis. A study on Balance Ability and Athletic Performance Sports Med 2011;41(3):221-232.
7. Neeraj Panwar, Gaurav Kadyan, Aseem Gupta, *et al.* Effect of wobble board balance training program on static balance, dynamic balance & triple hop distance in male collegiate basketball athlete. Int J Physiother Res 2014;2(4):657-62.
8. Ai Choo Lee, Pitt Fang Kuang. A study on the

- effectiveness of sports specific balance training program in reducing risk of ankle sprain in basketball. *Int J Physiother* 2016;3(6):731-736.
9. Susan Sullivan BO, Lesli Portnry G. *Physical Rehabilitation*; FA Davis publishers, 2014.
 10. Rajan Balakrishnan, Ellanchezlian Emelita, *et al.* A study on Comparison of static and dynamic balance among male Amateur basketball players. *International Journal of Physical Education, Sports and Health* 2016;3(1):364-369.
 11. Mother sole Cronin, *et al.* A study on ground reaction force profile of specific jump – landing task in females. *strength and conditioning journal* 2013;35(2):47-54.
 12. Kerim Sozbir. A study on Effects of 6-Week Plyometric Training on Vertical Jump Performance and Muscle Activation of Lower Extremity Muscles. *The Sport Journal*, 2016. <http://thesportjournal.org>.
 13. Guilherme Cesar M, Hannah Edwards T, *et al.* A study on prediction of athletic performance of male and female athletes measured by triple hop for distance. *TRENDS in sport sciences* 2017;1(24):19-25.
 14. Nongnapas Charoenpanich, Rumpa Boonsinsukh, Sirod Sirisup, *et al.* A study on Principal component analysis identifies major muscles recruited during elite vertical jump. *Science Asia* 2013;39:257-264.
 15. Diarmaid Fitzgerald, Nanthana Trakarnartanakul, *et al.* A study on Effects of a Wobble Board-Based Therapeutic Exergaming System for Balance Training on Dynamic Postural Stability and Intrinsic Motivation Levels. *Sports Phys Ther* 2010;40(1):11-19.
 16. Tyler Hamilton R, Sandra Shultz J, *et al.* A study on Triple-Hop Distance as a Valid Predictor of Lower Limb Strength and Power. *Journal of Athletic Training* 2008;43(2):144-151.
 17. Adam Larcom. Reported A study on The Effects of Balance Training on Dynamic Balance Capabilities in the Elite Australian Rules Footballer. *At School of sport and exercise science. Australia*, 2013.
 18. James Onate A, Brian Beck C, Bonnie L, Van Lunen. A study on On-Field Testing Environment and Balance Error Scoring System Performance during Preseason Screening of Healthy Collegiate Baseball Players. *Journal of Athletic Training* 2007;42(4):446-451.
 19. Phillip Plisky J, Mitchell Rauh J, Thomas Kaminski W, *et al.* A study on Star Excursion Balance Test as a Predictor of Lower Extremity Injury in High School Basketball Players. *Orthop Sports Phys Ther* 2006;36(12):911-919.
 20. Nurtekin Erkmen, Halil Taskin, Ahmet Sanioglu, *et al.* A study on Relationships between Balance and Functional Performance in Football Players. *Journal of Human Kinetics* 2010;26:21-29.
 21. Tamara Valovich C, Mc Leod, Travis Armstrong, Mathew Miller, *et al.* A study on Balance Improvements in Female High School Basketball Players After a 6-Week Neuromuscular-Training Program. *Journal of Sport Rehabilitation* 2009;18:1-17.
 22. Thomas Vencurik, Jiri Nykodym. A study on The Intensity of Load Experienced by Female Basketball Players during Competitive Games. *International Scholarly and Scientific Research & Innovation* 2015;9(7). Publication/10002086.
 23. Heitkamp HC, Horstmann T, Mayer F, *et al.* A study on Gain in Strength and Muscular Balance After Balance Training. *IntJ Sports Med* 2001;22:285-290.
 24. Eadric Bressel, Joshua Yonker C, *et al.* A study on Comparison of Static and Dynamic Balance in Female Collegiate Soccer, Basketball, and Gymnastics Athletes. *Journal of Athletic Training* 2007;42(1):42-46.
 25. Anis chaouachi, Carlo Castagna, *et al.* A study on effect of warm-ups involving static or dynamic stretching on agility, sprinting, and jumping performance in trained individuals. *Journal of Strength and Conditioning Research* 2009;0(0):1-11.
 26. David Behm G, Anis Chaouachi. A study on A review of the acute effects of static and dynamic stretching on performance. *Eur J Appl Physiol*. DOI: 10.1007/s004211-011-1879-2.
 27. Elke Cumps, Evert Verhagen, Romain Meeusen. A study on Prospective epidemiological study of basketball injuries during one competitive season: Ankle sprains and overuse knee injuries. *Journal of Sports Science and Medicine* 2007;6:204-211.
 28. Aerts I, Cumps E, *et al.* A study on A systematic review of different jump-landing variables in relation to injuries. *J Sports med phys fitness* 2013;53:509-19.
 29. Gabriele Boccolini, Alessandro Brazziti, *et al.* A study on Using balance training to improve the performance of youth basketball players. *Sport Sci Health* 2013;9:37-42.
 30. Amy Dykes A . Reported A study on Dynamic balance of ballroom dancers and soccer players. *At college of health and human development, Pennsylvania on*, 2015.