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LONG TERM EFFECT OF BOSU BALL TRAINING ON STATIC AND DYNAMIC BALANCE AMONG AMATEUR BADMINTON PLAYERS

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ABSTRACT

Introduction: Balance is essential in badminton due to rapid direction changes, lunges, jumps, and reflexive movements, all of which demand strong static and dynamic balance to optimize performance and reduce injury risk. While traditional training improves general fitness and skills, functional tools like the BOSU (Both Sides Up) ball are increasingly used to enhance proprioception, core stability, and neuromuscular coordination. Objective of the study was **t**o evaluate the long-term effects of BOSU ball training on static and dynamic balance in amateur badminton players and also to assess the potential effect of balance on badminton performance. **Method:** Forty-eight amateur players (18–30 years) underwent BOSU ball training three times weekly for four weeks, alongside regular badminton practice. Each session included warm-up and cool down (10 minutes each), and BOSU exercises were performed in 4 sets of 10 repetitions. Static and dynamic balance were assessed using the Flamingo Balance Test and Y-Balance Test at baseline, Week 4 (post-intervention), Week 6, and Week 8 (retention phase). **Result:** Static balance improved significantly in both legs (Flamingo Test: Right & Left, $p < 0.001$) with partial retention by Week 8. Dynamic balance (Y-Balance Test) showed a significant improvement in the left leg ($p < 0.001$), while the right leg showed improvement without statistical significance ($p > 0.05$). **Conclusion:** BOSU ball training significantly enhances static and dynamic balance, with retained effects particularly in the left leg. It supports the hypothesis that BOSU training yields long-term balance improvements and suggests it be integrated into regular badminton training for improved athletic performance.

Keywords: BOSU ball, Static balance, Dynamic balance, Badminton, Proprioception, Flamingo Test, Y-Balance Test.

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INTRODUCTION

Badminton ranks among the world's most popular sports. It is a racquet sport; competitors wield racquets to volley a shuttlecock across a central net, either in one-on-one singles matches or team-based doubles games. The rectangular playing area is split evenly, with rivals occupying opposite halves of the court. In badminton, players engage in fast-paced exchanges, strategically manoeuvring the shuttlecock to out manoeuvre opponents and secure points. The sport demands rapid footwork and agility, as competitors must swiftly respond to shots of varying speeds and trajectories. Within the compact 80 square meter court, players execute high-intensity, repetitive movements, constantly adapting to the dynamic nature of each rally.[(1)] Badminton is one of the fastest racket sports with short intervals, high intensity and agile footwork. The speed of badminton smashes can be as high as 30 m/s [1].

Badminton players must rapidly assess their opponent's movements and predict the shuttlecock's path, making split-second decisions. This process heavily relies on dynamic balance control, encompassing lunges, stable landings, and swift adjustments like accelerating, decelerating, and changing direction. Enhanced dynamic balance correlates with faster directional changes, improved control during jumps and smashes, and more effective lunges. Consequently, training methods focused on boosting dynamic balance and agility show significant potential for elevating a player's competitive performance [2].

Players must efficiently navigate the court, minimizing steps to reach the shuttlecock while maintaining equilibrium and body control. Proficient badminton requires two fundamental abilities such as stroke play and footwork. The former relies heavily on eye-hand coordination, while the latter is primarily dependent on balance. These elements work in tandem to create effective game play [3].

Balance can be described as the ability to control the body's position in space for the purpose of balance and orientation.[(4)] Postural balance, often known as balance, can be characterised in two ways: statically as the capacity to sustain a base of support with little movement, and dynamically as the capacity to carry out an action while keeping one's position steady[4].

Both static and dynamic balances are crucial for badminton players to excel in the sport and minimize the risk of injuries. By boosting their static balance, athletes may retain their centre of gravity within the parameters of their base of support and maintain an erect stance. This is essential for maintaining stability and executing specific stances for prolonged periods. Static balance also plays a fundamental role in sports-specific postural control and contributes to efficient performance[5].

Objectives of the study are to determine the long-term effect of BOSU ball training on static and dynamic balance among amateur badminton players and also to assess the potential effect of balance on badminton performance.

METHODOLOGY

Source of Data: Badminton Clubs in and around Bangalore - Smash Hit Badminton Academy, King's Court Badminton Academy

Method of collection of data

Type of study: Repeated measures, Experimental study (Single group)

Population: Amateur Badminton players

Sample size: Total samples allocated were 48 for the study.

Sample design: Simple random sampling technique.

Study duration: study conducted for duration of 6 Months.

Inclusion Criteria: Club level Amateur Badminton Players, Age group – 18 – 30 years, Both Male and Female, Playing badminton for at least 2 years, 3-4 hours a week, Willing to complete the intervention and the tests.

Exclusion Criteria:

Recent injury, trauma to the lower limb, Any major systemic disease, Participants having ACL, hamstring, meniscus, ankle, or any other lower-extremity injuries that are associated with diminished dynamic balance during the last three years, Any Cardiovascular conditions, Players having severe visual and hearing deficits, Existence of any other factor that interfere with balance, Players with any other neurological or musculoskeletal impairments.

Materials Required: BOSU ball, Stop watch, measuring tape, Weighing machine, Balance beam

Procedure: Ethical clearance was obtained from the Institutional Ethical Committee with Reference No. PIEC/PIP/15/2024 dated 020/06/2024. Informed consent was obtained from all participants after explaining the study purpose. Subjects were then asked to perform the tests. Demographic information such as name, age, height, weight, number of playing years was collected from the participants. The study consisted of one group which underwent BOSU ball training 3 times a week for consecutively 4 weeks along with their regular badminton training which was followed in their club. Each session consisted of 10-minutes of warm-up and 10-minutes of cool down period.

Each component of BOSU ball had 4 sets and 10 repetitions. A pre-test and post-test was conducted using flamingo test and Y balance test to assess static and dynamic balance respectively. All the participants were instructed regarding the procedure of pre-test and post-test. A post-test was conducted at the end of 4th week of intervention. After which, the participants were asked to continue their regular badminton training then at the end of 6th week and 8th week a post test was conducted and the data was recorded in order to check the retaining effect of BOSU ball training on static and dynamic balance among amateur badminton players.

Flamingo Balance Test (FBT): Participants were instructed to stand on a balance beam measuring 50 cm in length, 5 cm in height, and 3 cm in width. They performed the test by balancing on one leg, with the opposite leg flexed at the knee so that the foot was held close to the buttocks, and their hands placed on the iliac crests mimicking the posture of a flamingo. Once the subject assumed this position, the evaluator started the stopwatch. Each time the participant lost balance, the stopwatch was paused, and the participant was asked to resume the position. This process continued until the cumulative duration of 1 minute was completed. Each participant performed three trials per leg with eyes open. The number of balance losses (falls) was recorded for each trial, and the average was taken for analysis[7].

Y-balance Test (YBT): The Y-Balance Test was performed to assess dynamic balance and neuromuscular control of the lower limbs. The test was conducted in three directions which consisted of Anterior, Posteromedial, and Posterolateral directions, forming a Y-shape. Participants were instructed to stand on the testing leg at the center of the grid, with their toes aligned just behind the start point. The non-stance leg was used to reach as far as possible along the specified direction, lightly touch the line with the distal part of the foot, and then return to the original stance position without compromising balance. Before the actual values were recorded, participants were given a demonstration followed by practice trials in each direction to familiarize them with the task and minimize learning effects. After the familiarization phase, three formal test trials were recorded for each reach direction. The order of testing directions was either clockwise or counterclockwise and remained consistent for all participants.

The distance from the central platform to the point of maximum reach was measured in centimeters using the markings. If the participant failed to touch the line, lost balance, shifted or lifted the stance foot, or used the reaching foot for weight support, the trial was considered invalid and was repeated. The maximum reach distance for each direction was recorded, and the average of the three valid trials was taken for analysis[8].

Composite reach scores were calculated by summing the maximum reach distances in all three directions, dividing by three times the leg length, and multiplying by 100 to express the score as a percentage (%) for Right and Left as (Right total% and Left Total%) respectively. Leg length was measured from the anterior superior iliac spine (ASIS) to the distal tip of the medial malleolus using a standard measuring tape, with the participant lying in a supine position. The test was performed separately for the right and left limbs. Adequate rest was provided between trials to avoid fatigue and ensure consistency[9].

BOSU Ball Training:

Players underwent the following Programme during intervention period which are as follows:

Exercises	No. of Reps / Sets	Resting time between sets	Resting time
Squats on both legs on BOSU ball	10 x 4	30-seconds	1-minute
Single leg Squats on BOSU ball	10 x 4	30-seconds	1-minute
Forward lunge on BOSU ball	10 x 4	30-seconds	1-minute
Backward lunge on BOSU ball	10 x 4	30-seconds	1-minute
Unilateral Forward Jumps from ground on the BOSU ball and holding landing position.	10 x 4	30-seconds	1-minute
Lateral jumps on one-foot from ground on the BOSU ball and holding landing position	10 x 4	30-seconds	1-minute
V-side on BOSU ball	10 x 4	30-seconds	1-minute
Double feet jumping	10 x 4	30-seconds	1-minute
on the BOSU ball	10 x 4	30-seconds	1-minute
Plank feet on BOSU ball	10 x 4	30-seconds	1-minute
Tuck jumps on BOSU ball	10 x 4	30-seconds	1-minute

Data Analysis

The collected data were compiled, entered, and analysed using SPSS version 23.0. Descriptive and inferential statistics were used as appropriate:

The descriptive measures of mean, standard deviation (SD), and range were used to describe the quantitative background variables and outcome scores.

Freidman test of repeated measure NP ANOVA was used to evaluate the effect of the BOSU ball training program on Flamingo Balance Test (static balance) and Y- Balance Test (dynamic balance) scores at different intervals (pre-test, week 4, week 6, and week 8).

The level of significance was set at $p < 0.05$.

Microsoft Excel and SPSS Graphical Editor were used to generate the relevant tables and graphs to visually represent the data and findings.

RESULTS

Table 1- Gender proportion of Amateur Badminton Players (n=48)

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Sr. No.	Gender	No.(%)
1.	Male	27(56.3)
2.	Female	21(46.8)

Table -1 represents out of the total sample size of 48 participants, the gender distribution showed that 27 (56.3%) were male players and 21 (46.8%) were female players. This distribution reflects a fairly balanced gender representation in the study group, allowing generalizability of findings to both male and female amateur badminton players.

Graph-1 Gender proportion of Amateur Badminton Players

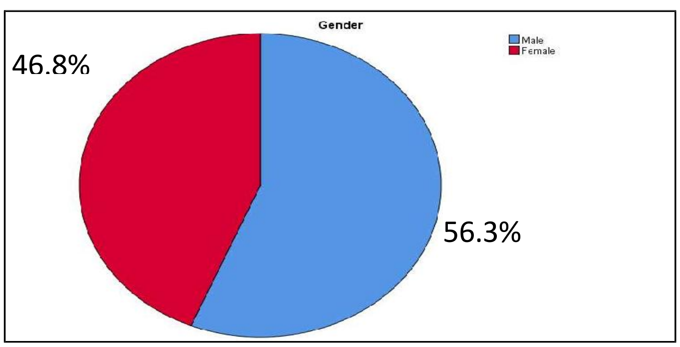
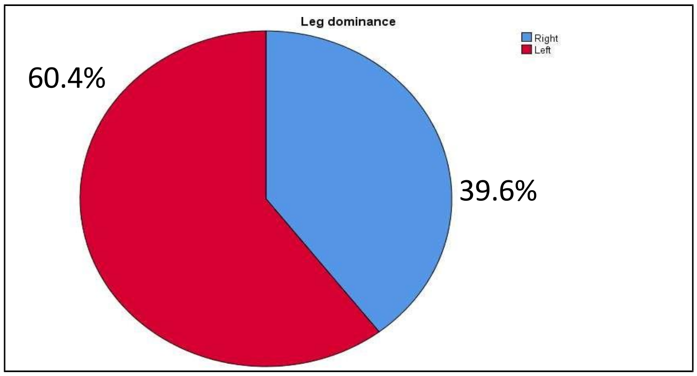


Table: 2- Description of qualitative background variables of Amateur Badminton Players (n=48)

Sr. No	Background Variable	No.(%)
1.	Leg Dominance (Right)	19(39.6)
2.	Leg Dominance(Left)	29(60.4)

Table-2 represents leg dominance, 29 players (60.4%) were found to be left-leg dominant and 19 players (39.6%) were right-leg dominant. This finding shows the majority of participants were left-leg dominant, which could potentially influence balance performance and training responses.



Graph-2: Dominance proportion of Amateur Badminton Players

Table-3: Description of quantitative background variables of amateur Badminton players

S.No.	Background variables	Subjects	
		Range	Mean ±SD
1	**Age in years**	18-30	24.98±3.56
2	**Height(cm)**	160-189	173.58±8.95
3	**Weight(kg)**	54-84	67.52±6.64
4	**BMI**	19-25	22.42±1.67
5	**Years of playing**	2-5	3.44±1.18

The table-3 outlines the quantitative background variables of Amateur badminton players. Out of total sample size (n=48), age of the subjects were ranging from 18-30 years with the mean age and SD of 24.98 ± 3.56 years and the height ranged from 160 to 189 cm, with a mean and SD of 173.58 ± 8.95 cm. The weight of the players varied between 54 to 84 kg, with the mean and SD of 67.52 ±

6.64 kg. The Body Mass Index (BMI) ranged from 19 to 25, with a mean and SD of 22.42 ± 1.67, ranging from 19-25 suggesting that the participants were within a healthy weight range. Years of playing experience ranged from 2 to 5 years with the mean and SD of 3.44 ± 1.18. This confirms the sample consisted of healthy, moderately experienced amateur badminton players suitable for the intervention.

Table-4: Pre and post-test of Flamingo no. of falls in a min (Right) of Amateur Badminton players

S.No.	Outcome measure	Flamingo leg falls (Right)		Freidman test of repeated measure NP ANOVA
		Range	Mean ±SD	
1	**Pre test**	12-15	13.73±1.14	Chi-square =134.56, df=3, p<0.001, S
2	**Week-4**	7-10	8.50±1.05	
3	**Week-6**	7-10	8.58±1.08	
4	**Week-8**	8-11	9.48±.1.22	

Note: S-Significant (p<0.05).

Table 4 shows the performance of amateur badminton players in the Flamingo Balance Test (Right Leg), revealing a progressive improvement in static balance from pre-test to Week 8. At baseline, participants recorded the range of 12-15 with the mean and SD of 13.73 ± 1.14 falls, which significantly reduced to the range of 7-10 with the mean and SD of 8.50 ± 1.05 by Week 4, indicating a substantial gain in static balance following 4 weeks of BOSU ball training.

Between Week 4 and Week 6, performance remained stable, with a slight increase in falls ranging from 7-10 with the mean and SD of 8.58 ± 1.08, suggesting early signs of a plateau or minor detraining effect after stopping BOSU training. However, by Week 8, the number of falls increased further to the range of 8-11 with mean and SD of 9.48 ± 1.22, reflecting a continued but moderate loss in static control. Despite this gradual increase after Week 4, the overall comparison from Pre-test to Week 8 still showed a remarkable reduction of 4.25 falls, indicating that static balance improvements were significantly retained over the long term. The change across all time points was statistically significant (Chi-square = 134.56, p < 0.001), confirming the long-term benefit of BOSU ball training on right-leg static balance.

Table-5: Pre and post-test of Flamingo no. of falls (Left) in a min of Amateur Badminton players

S.No.	Outcome measure	Flamingo leg falls (Left)		Freidman test of repeated measure NP ANOVA
		Range	Mean ±SD	
1	**Pre test**	13-15	13.98±0.88	Chi-square =10.693, p<0.001, S
2	**Week-4**	7-10	8.42±1.16	
3	**Week-6**	7-10	8.69±1.20	
4	**Week-8**	8-11	9.88±.1.06	

Note: S-Significant ($p<0.05$)

Table 5 shows the results of the Flamingo Balance Test (Left Leg)**.** At the pre-test, the number of falls ranged between 13-15 with the mean and SD of 13.98 ± 0.88 **,**by Week 4 the range reduced to 7-10 with the mean and SD 8.42±1.16 indicating a significant improvement in static balance similar to the right leg. Between Week 4 to Week 6, although the range narrowed to 7-10 the mean and SD slightly increased to 8.69 ± 1.20 showing a small regression.

This sequence continued up to Week 8, where the range was from 8-11 and the mean and SD increased to 9.88 ± 1.06. This gradual decline in performance after Week 4 suggests a minor regression following cessation of BOSU ball training. However, when comparing Pre-test to Week 8, the number of falls still decreased by approximately 4.10, highlighting a sustained improvement in balance.

The Friedman test confirmed that these changes were statistically significant (Chi-square = 10.693, $p < 0.001$), validating that BOSU ball exercises had a lasting effect on left-leg static balance. Overall improvement from pre-test to Week 8 was 4.25 falls for the right leg and 4.10 fall for the left**,** with both showing significant gains.

Table-6: Pre and post-test of Y-balance (Right) of Amateur Badminton players

S.No.	Outcome measure	Y- balance (Right)		Freidman test of repeated measure NP ANOVA
		Range	Mean ±SD	
1	**Pre test**	85.99-89.44	87.23±0.94	Chi-square =5.856, p>0.05, NS
2	**Week-4**	85.21-91.83	90.168±1.47	
3	**Week-6**	83.20-95.20	88.14±.3.04	
4	**Week-8**	85.91-89.84	88.069±1.03	

Note: NS- Not Significant (p>0.05), S- Significant (p<0.05)

Table 6 presents the outcomes of the Y-Balance Test (Right Leg), used to assess dynamic balance. The pre-test ranges from 85.99-89.44 with mean and SD of 87.23 ± 0.94, which improved significantly to the range of 85.21-91.83 with mean and SD of 90.168 ± 1.47 by Week 4, indicating improved neuromuscular coordination and limb control after BOSU ball training.

However, by Week 6, the score decreased to the range of 83.20-95.20 with mean and SD of 88.14 ± 3.04, and further to the range of 85.91-89.84 with mean and SD of 88.069 ± 1.03 at Week 8, suggesting a slight decline in dynamic control as the retention period progressed. Although the improvement from pre-test to Week 4 was significant (+2.94), the gains were not fully maintained in the absence of ongoing training.

The total gain from Pre-test to Week 8 was only +0.84, and the Friedman test found these changes to be not statistically significant (Chi-square = 5.856, p > 0.05), implying that the dynamic balance benefits on the right leg were not well-retained.

Table-7: Pre and posttest **Y-balance (left)** of Amateur Badminton players.

S.No.	Outcome measure	Y-balance (Left)		Freidman test of repeated measure NP ANOVA
		Range	Mean ±SD	
1	**Pre test**	85.87-89.63	87.83±0.92	Chi-square =19.575, p<0.001, S
2	**Week-4**	87.00-92.60	90.02±1.51	
3	**Week-6**	85.20-97.48	89.71±.3.03	
4	**Week-8**	85.97-89.97	88.18±1.03	

Note: NS- Not Significant (p>0.05), S- Significant (p<0.05)

Table 7 displays the results for the Y-Balance Test (Left Leg). The range of the baseline ranges from 85.87-89.63 with mean and SD of 87.83 ± 0.92, which improved to a range of 87.00-92.60 with mean and SD of 90.02 ± 1.51 by Week 4, demonstrating a substantial gain following BOSU ball intervention. From the Week 4 to Week 6, where week 6 ranges from 85.20-97.48 where the score slightly decreased with the mean and SD of 89.71 ± 3.03, and by Week 8, it further dropped to the range of 85.97-89.97 with the mean and SD of 88.18 ± 1.03. Despite the regression, the total change from Pre-test to Week 8 showed a net gain of +0.35, indicating some degree of retained dynamic balance improvement. The initial gain from pre-test to Week 4 was +2.19, while the drop from Week 4 to Week 8 was -1.84, suggesting that while BOSU training is effective short term, continued stimulus is required for lasting improvement. However, unlike the right leg, these changes were statistically significant (Chi-square = 19.575, p < 0.001), suggesting that the BOSU training had a more meaningful and durable impact on the left leg's dynamic balance.

Overall improvement from pre-test to Week 8 was +0.84 in Right leg (not statistically significant), +0.35 in Left leg (statistically significant, p < 0.001)

DISCUSSION

The recent study aimed to evaluate the long-term effect of BOSU ball training on static and dynamic balance among amateur badminton players. A total of 48 participants (27 males and 21 females) were included, with majority being left-leg dominant (60.4%). The focus was on analysing changes through the Flamingo Balance Test (FBT) for static balance and the Y-Balance Test (YBT) for dynamic balance, across four time points: pre-test (Week 0), post-intervention (Week 4), and retention phases (Week 6 and Week 8).

Gender-based distribution revealed a slightly higher representation of males, which is reflective of typical participation patterns in club-level sports. Previous literature, by Wong et al., reported no significant gender differences in static or dynamic balance in amateur badminton players, but noted that females may rely more on proprioceptive feedback, while males may engage more muscular strategies for postural control. This suggests both genders benefit comparably from balance training interventions like BOSU ball workouts[10].

Leg dominance also played an influential role. The current study observed that while the left leg was dominant in a greater proportion of participants (60.4%), both legs responded similarly to training. A study by Gökdemir et al. suggested that while leg dominance can affect initial balance performance due to neuromuscular familiarity, with consistent training, both dominant and non-dominant limbs can achieve functional symmetry in postural control[15].

Our findings corroborate this, as both limbs showed parallel significant improvement trends after the intervention period at end of week 4 for both static and dynamic, while both the legs responded differently during the retention period which is week 6 and 8 where left leg retention was significantly seen, whereas in the right leg the retentions were not significantly visible for dynamic. In static both the leg responded significantly during the retention period[16].

The demographic data of the sample (n=48) shows participants had a mean age of 24.98 SD (3.56) years is consistent with previous findings, where athletes typically show better neuromuscular responsiveness, quicker motor learning, and enhanced proprioception, which can affect both static and dynamic balance outcomes. According to Towel et al., age plays a critical role in balance ability. Age is significantly correlated with performance in balance and coordination tasks in badminton, individuals often demonstrating superior scores due to higher neuroplasticity and faster recovery rates.[1] In our study, participants aged between 18–30 years showed better improvements in YBT and fewer falls in FBT across all weeks[11].

Height and weight are also critical anthropometric parameters influencing balance. The individuals with more height have a higher centre of gravity, which can make postural control more challenging, particularly during single-leg stance tasks like the Flamingo Balance Test. Similarly, increased body weight can impact balance by altering joint loading and requiring more muscular effort for stabilization. Gökdemir et al. reported that higher BMI was associated with lower static and dynamic balance, which aligns with our findings—where taller and heavier participants had slightly more falls during the FBT, especially during the pre-test. However, participants still showed overall improvement post-intervention, suggesting that balance training should be implemented in their regular training protocol[12].

Years of playing experience also showed a noticeable influence on performance. Participants had an average mean of 3.44 SD (1.18) years of playing experience demonstrated better baseline performance in both tests. This is in line with Bhargavi and Viswanadh, who concluded that prolonged exposure to sport-specific movements improves sensorimotor control and reflexive balance responses. Additionally, experienced players often possess greater familiarity with single-leg postures and rapid directional shifts, inherently benefiting their balance capacity[13].

The Flamingo Balance Test results demonstrated a significant improvement in static balance during the intervention period, with partial retention observed in the follow-up weeks. From pre-test to Week 4, participants showed a marked reduction in the number of falls on both right and left legs (Right: 13.73 to 8.50; Left: 13.98 to 8.42), indicating enhanced static postural control. This aligns with findings from Joshi et al., who reported that unstable surface training effectively stimulates proprioceptors and joint stabilizers, leading to rapid balance improvements[14].

Between Week 4 and Week 6, the number of falls increased slightly (Right: 8.58; Left: 8.69), suggesting the onset of early detraining, as described by Mujika & Padilla, wherein neuromotor adaptations begin to decline once the stimulus is removed. [(21)] The decline continued into Week 8 (Right: 9.48; Left: 9.88), reflecting a gradual regression in static control, although the overall performance remained significantly better than baseline. When comparing pre-test to Week 8, a total improvement of 4.25 falls (right) and 4.10 falls (left) was observed, confirming that BOSU ball training has a lasting impact on static balance, with meaningful retention over time. This supports the work of Tura et al., who emphasized the value of unstable surface training in enhancing lower limb proprioception and postural endurance[15].

The Y-Balance Test outcomes indicated that while dynamic balance improved during the intervention period, the retention of those gains was less than with static balance. From pre-test to Week 4, both right and left legs showed notable increases in reach distance (Right: 87.23 to 90.168; Left: 87.83 to 90.02), reflecting enhanced neuromuscular coordination, joint stability, and postural control. These improvements are consistent with the findings of Sawant and Chavan and Lu et al.**,** who reported that BOSU-based exercises promote core engagement, ankle proprioception, and dynamic limb control**,** all of which contribute to improved functional reach and balance in athletes[13]. However, from Week 4 to Week 6, a moderate decline was observed (Right: 88.14; Left**:** 89.71), followed by a further reduction between Week 6 and Week 8 (Right: 88.07; Left**:** 88.18). This downward trend aligns with the findings of Malwanage et al.**,** who emphasized that gains in dynamic balance are more sensitive to detraining due to the greater neuromotor complexity and central integration required[16].

Notably, while the right leg's overall improvement of +0.84 from pre-test to Week 8 was not statistically significant, the left leg showed a significant gain of +0.35 from pre-test to week 8, indicating relatively better retention. This difference attributes to limb dominance, motor control variability**,** or asymmetric postural strategy adaptation. These findings suggest that dynamic balance adaptations require sustained neuromotor stimuli for long-term maintenance, and that training protocols should include ongoing or periodic balance reinforcement to prevent reversal of gains and preserve performance outcomes[17].

These findings align with prior studies such as Lu et al. and Salam et al., which emphasized that

BOSU-based interventions effectively enhance both proprioceptive feedback and dynamic motor control in athletes[19]. The data from this study further support the inclusion of BOSU training as a valuable addition to athletic conditioning programs, particularly for sports like badminton that demand high agility, balance, and lower limb coordination.

Balance plays a critical role in badminton performance, as the sport requires rapid directional changes, single-leg stances, and dynamic postural adjustments during play. Improved static and dynamic balance enhances footwork control, stroke execution, and overall court agility. In this study, the observed improvements following BOSU ball training—particularly the significant gains in static balance and retained improvements in dynamic balance—highlight the transfer of balance gains to functional badminton performance. These findings align with Lu et al., who demonstrated that balance-focused interventions can improve quickness and dynamic control in badminton players[19]. Therefore, the observed enhancement in postural stability directly supports the objective of improving game performance through balance training.

CONCLUSION

The present study aimed to investigate the effects of BOSU ball training on static and dynamic balance among amateur badminton players. The Alternate hypothesis states that there is significant long term effect of BOSU ball training on static and dynamic balance among Amateur Badminton players. Significant improvements were observed in both the right and left legs in the Flamingo Balance Test, with sustained reductions in the number of falls noted even at Week 8, indicating strong neuromuscular adaptations in static balance.

Dynamic balance, as measured by the Y-Balance Test, also showed improvement post-intervention, though partial regression was observed during the follow-up phase, especially in the right leg. Notably, the left leg showed statistically significant retention of dynamic balance gains at Week 8. The improvements were evident immediately after the 4-week intervention and were partially retained at weeks 6 and 8, indicating a lasting effect of the training.

The retention of static balance gains beyond the intervention period may reflect more durable neuromotor adaptations in proprioceptive control, whereas dynamic balance may require more frequent neuromotor stimulation to sustain improvements. In conclusion, the findings of this study support the integration of unstable surface training into regular conditioning programs for amateur athletes, particularly badminton players. Overall, BOSU ball training was found to be an effective and practical method for enhancing balance control, which is critical for badminton players who frequently engage in single-leg stance, quick direction changes, and rapid movements. Therefore, the study remarkably shows potential effect of balance on badminton performance.

Limitations: The study was conducted only on amateur badminton players aged 18–30 years, limiting generalizability to other sports, age groups. The absence of a control group limits the ability to compare BOSU training directly against traditional or no interventional methods. External factors like footwear, or time of day during testing were not standardized, potentially influencing test performance.

Recommendations: Future researches can incorporate more sensitive, objective balance assessment tools such as force platforms, motion capture, or instrumented stability systems for more precise measurement. Future studies can include Psychological Metrics: Confidence, fear of injury, and mental focus also influence balance and performance; these could be evaluated alongside physical metrics. Future researches can assess athletes across different sports, competitive levels (elite, sub-elite), and age groups to validate broader applicability. Future studies can extend the training program and include long-term follow-up (e.g., 12 weeks or more) to assess sustained improvements and performance transfer.

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