International Journal of Religion
2024
Volume: 5| Number 5 | pp. 424 – 431
ISSN: 2633-352X (Print) | ISSN: 2633-3538 (Online)
ijor.co.uk
DOI: https://doi.org/10.61707/6wv4gr93

# The Impact of Bosu Training on The Development of Static and Dynamic Balance in Teenage Basketball Players

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***Abstract***

*The study aimed to investigate the impacts of Bosu training on the development of static and dynamic balance in male basketball players aged 14-16 years who play actively in basketball clubs in Bingöl and train more than 7 hours weekly according to a training schedule. The study included 30 basketball players, 15 in the control group and 15 in the experimental group. The experimental group attended 30 minutes of Bosu training in addition to basketball training for 8 weeks. Anthropometric measurements, such as height, weight, BMI, and static and dynamic balance measurements, were taken before and after the training period. The data were analysed using the SPSS package. The distribution of the pre-test and post-test data was examined for each group. Normality of the data distribution and homogeneity of variances were checked using the Mauchly sphericity test and the Levene test. Then, the dependent variables within each group were compared using the paired-sample t-test. The study used a p-value of less than 0.05 to assess the significance of the results. The mean values of height, weight, and BMI of the experimental group after the 8-week Bosu training program showed no significant difference ($p>0.05$). The analysis results regarding the Bosu training program's static and dynamic balance measurements yielded a statistically significant difference between the pre- and post-test comparisons of the experimental group for most of the static and dynamic balance variables ($p<0.05$). However, there was no statistical difference in the control group or between groups ($p>0.05$). It was concluded that Bosu training can positively contribute to the improvement of static and dynamic balance in young basketball players.*

***Keywords:*** *Basketball, Bosu Training, Dynamic Balance, Static Balance*

## INTRODUCTION

Athletic performance depends on various skills, such as gender, age, body structure, and physical fitness, which can be developed and measured (Mcard et al. 2000; Willmore and Costill 1999). The most competitive sports are those that attract a large segment of society and receive mass support (Çakto and Altınok 2020). Basketball is such a sport. In basketball, coaches and athletes aim to achieve their best performance in games by developing mental, physical, technical, and tactical characteristics, and team awareness. Training and the use of scientific methods are crucial to achieving this goal. Furthermore, the physical characteristics of the athletes play a crucial role in their ability to perform at a high level and secure victories for their teams (Tusunawake et al., 2003). Basketball requires a range of complex biomotor skills, including agility, speed, coordination, accuracy, endurance, and explosive power. Providing athletes with optimal balance conditions can enhance their biomotor skills (Iskandar and Rismayadi, 2019). The ability of basketball players to maintain good balance positively affects their performance by improving their control over their body stability (Kostopoulos et al., 2012). In this regard, it is essential to improve athletes' balance skills through training in order to enhance their performance (Şahan and Erman, 2009).

In recent years, the significance of balance training in training programs and improving athletic performance has increased. Sports involve the performance of high-level motor tasks during learning, training, or competition, as well as the maintenance of static and dynamic balance (Erkmen et al., 2007). Balance control is a complicated motor skill that involves the planning and execution of flexible movement patterns and the integration of sensory inputs (Ferdjallah et al., 2002). Balance is a crucial coordination skill in sports, including basketball. It is a form of neuromuscular control that enhances physical and skill performance.

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Balance allows athletes to control their bodies in static or dynamic aspects and protects them from falls and injuries during fast movements (Panwar et al., 2014). To improve athletic performance and reduce the risk of injury, it is recommended to integrate Bosu and other balance training into balance training programs (Laudner and Koschnitzky, 2010). Balance is a crucial aspect of basketball, and it is therefore imperative to improve the current low levels of balance to ensure future success, particularly for young basketball players (Nugraha et al. 2022).

Core training on an unstable surface has become a popular method. Warm-up training that was traditionally performed on a fixed surface is now performed on variable equipment. There are many tools and methods available to create a training environment on an unstable surface. However, the most common training tools on the market today that provide a variable surface to improve balance are balance boards, foam pads, plate balls, balance discs, and Bosu balance balls (Şan et al., 2019). In addition to fixed surfaces such as balance boards and stability tables, and movable surfaces such as plate balls, Bosu balls, balance bars, and trampolines, kinesthetic skills training tools have recently become an essential part of training programs (Lephart et al., 2007).

This study investigated the impact of Bosu training on the static and dynamic balance development of young basketball players with the aim of contributing to the relevant literature on how to improve balance.

## MATERIALS AND METHODS

### Research Model

The study employed an experimental method to investigate the effects of a Bosu exercise program on basketball players aged 14-16 who train at least 7 hours a week in basketball clubs in Bingöl province. The study employed an experimental method on basketball players aged 14-16 who train at least 7 hours weekly in basketball clubs in Bingöl province. The sample comprised 30 volunteer basketball players who were randomised into two groups: control and experimental. The study lasted 8 weeks, with a minimum of 7 hours of training per week. The experimental group received 30 minutes of Bosu training in addition to their regular basketball training, while the control group only received basketball training. Anthropometric measurements including height, weight, and BMI, as well as static and dynamic balance measurements, were taken both before and after training. The study adhered to the tenets of the Declaration of Helsinki, and the participating athletes provided informed consent by completing a digital form indicating their voluntary participation. To eliminate the learning effect on the test results, all athletes, including the control group, were informed of the training and testing procedures before the study began. The research was approved by the Ethics Committee of the Institute of Health Sciences at Bingöl University, dated 18.10.2022, number 22/18, decision: 11 (see Appendix-1).

### Data Collection Tools

Anthropometric measurements of height, weight, and body mass index (BMI) were obtained from both experimental and control basketball players.

**Table 1. Age, Height, Weight, and BMI values of the participants**

| Variables | Group | N | $\bar{x}$ | Sd |
|---|---|---|---|---|
| **Age (years)** | Experiment | 15 | 14.86 | .83 |
| | Control | 15 | 14.66 | .89 |
| **Height (m)** | Experiment | 15 | 1.68 | 0.12 |
| | Control | 15 | 1.68 | 0.09 |
| **Weight (kg)** | Experiment | 15 | 52.79 | 7.20 |
| | Control | 15 | 52.27 | 9.83 |
| **BMI (kg/m2)** | Experiment | 15 | 18.60 | 1.56 |
| | Control | 15 | 18.24 | 2.39 |

Table 1 presents the arithmetic means and standard deviations for both the experimental and control groups. The experimental group had a mean age of 14.86±0.83 years, a height of 1.68±0.12 m, a weight of 52.79±7.20 kg, and a BMI of 18.60±1.56 kg/m2. The control group had a mean age of 14.66±0.89 years and a height of 1.68±0.09 meters. Table 1 demonstrates that the descriptive findings regarding age, height, weight, and BMI values of the athletes in both the experimental and control groups were not significantly different before the exercise program. This indicates a homogeneous distribution between the groups.

## Static Balance Measurement

The study used the Pagani TM brand stabilometric platform (Elettronica Pagani, Italy) to measure static balance. This non-invasive method records the oscillations of the body while standing. The system comprises a 50x50 cm platform that continuously calculates the individual's weight and the position of the centre of gravity. The platform is connected to a computer system. Basketball players were instructed to stand on the platform with their feet at a 30-degree angle and their heels 2 cm apart. They were then asked to count slowly while looking straight ahead in a comfortable upright position. The assessment lasted 90 seconds, with 30 seconds for both feet, 30 seconds for the right foot, and 30 seconds for the left foot. The assessment was carried out without any visual or auditory distractions to ensure accurate results (Posturology and Stabilometry, 2003).

## Dynamic Balance Measurement

Dynamic balance stability was measured using a Libra (EasyTech) device. The balance platform has a large support surface and consists of 3 interchangeable plugs of different structural difficulties (40 cm = high; 24 cm = medium; 12 cm = easy). Participants were instructed to fixate their gaze on the computer screen, which was positioned 3 meters away at eye level. The difficulty level was set to medium using the 24 cm plug. The dynamic balance test was carried out using a platform designed to measure dynamic balance in the double-leg position. Two 30-second measurements were taken, and the best result was recorded. The result of the dynamic balance test was balanced.

## Bosu Training Application

The study involved providing the experimental group with a Bosu training application designed by Korkmaz and Akın (2021) to improve their body mobility. The experimental group performed Bosu training three times a week for a period of eight weeks, with the level of difficulty gradually increasing. The exercise range, number of repetitions, and sets, as well as the increase in load, were all considered. With an aim to increase the number of repetitions, we differentiated the muscle groups involved in the movement and included additional weights. The number of sets for all movements was set at 2, with a rest period of 1 minute between sets. After the third movement, a rest period of more than 5 minutes was given. Although the number of repetitions varied depending on the exercise during the first week, it increased from 25-35 to 40-55 repetitions by the end of the eighth week. Additionally, the basketball training sessions outlined in the club program were continued. At the end of the study, the exercise program was completed and evaluated. The subjects in the control group continued their regular basketball training without participating in any additional exercise programs.

## Data Analysis

The data were analysed using the SPSS 25 package. The pre-test and post-test distributions of the research data were examined for each group, and normality and homogeneity of variances were determined using the Mauchly sphericity test and the Levene test. Considering test results, a paired-sample t-test was performed to compare the dependent variables within each group. Additionally, sequential measurements were made. The graphs were generated using Excel. The tests were expressed as arithmetic mean ± standard deviation ($\bar{x} \pm$ sd) and a significance level was set at $p < 0.05$.

# FINDINGS

**Table 2. Static Balance Comparisons of Experimental and Control Groups**

| Variables | Groups | N | In-group comparisons | | | | | Between-group comparisons | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Pre-test $\bar{x}\pm$Sd | Post-test $\bar{x}\pm$Sd | t | p | In-group difference (%) | F | p |
| | Experiment | 15 | -0.10±0.38 | 0.02±0.15 | -1.418 | 0.178 | -0.12(12) | 0.927 | 0.344 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Right-Left Standard Deviation (mm)** | Control | 15 | 0.03±0.34 | 0.06±0.25 | -0.564 | 0.582 | -0.03(-10) | | |
| **Forward-backward Standard Deviation (mm)** | Experiment | 15 | -0.26±0.60 | -0.07±0.39 | **-2.817** | **0.014** | -0.19(73.07) | 0.312 | 0.581 |
| | Control | 15 | -0.33±0.42 | -0.18±0.37 | **-3.076** | **0.008** | -0.15(45.45) | | |
| **Left-Right Mean Oscillation Velocity (mm/s)** | Experiment | 15 | 1.26±0.42 | 0.90±0.32 | **4.583** | **0.000** | 0.36(28.57) | 8.923 | **0.006** |
| | Control | 15 | 1.12±0.43 | 1.06±0.36 | 0.807 | 0.433 | 0.06(5.35) | | |
| **Forward-Backward Mean Oscillation Velocity (mm/s)** | Experiment | 15 | 1.39±0.49 | 0.94±0.35 | **3.631** | **0.003** | 0.45(32.37) | 10.057 | **0.004** |
| | Control | 15 | 1.06±0.32 | 1.04±0.33 | 0.367 | 0.719 | 0.02(1.88) | | |
| **Pressure Centre Analysis (mm)** | Experiment | 15 | 42.38±15.06 | 40.71±14.92 | 1.297 | 0.216 | 1.67(3.94) | 0.571 | 0.456 |
| | Control | 15 | 38.18±13.83 | 37.52±13.56 | 1.885 | 0.080 | 0.66(1.72) | | |
| **Oscillation Area (cm2)** | Experiment | 15 | 6.63±4.32 | 5.07±4.05 | **6.577** | **0.000** | 1.56(23.52) | 2.951 | 0.097 |
| | Control | 15 | 5.80±5.82 | 5.20±5.84 | 1.163 | 0.264 | 0.6(10.34) | | |

***p<0.05***

Upon examining Table 2, no significant difference was found in the pretest-posttest comparisons of the experimental and control groups in the 'Right-Left Standard Deviation' value. Similarly, there was no statistically significant difference in the comparison between the groups. However, meaningful differences were found between the experimental and control groups on the 'Forward-Backward Standard Deviation' variable (p<0.05). Although there was a within-group difference, no significant difference was found in the between-group comparison. The pretest-posttest comparison of the experimental group showed a statistically meaningful difference in 'Left-Right Mean Oscillation Velocity' (p<0.05). There was no statistically significant difference in the control group. However, a statistically significant disparity was found when comparing the two groups (p<0.05). Additionally, a statistically significant difference was found in the in-group comparison of the experimental group in the variable 'Forward-Backward Mean Oscillation Velocity Speed' (p<0.05). Conversely, no difference was found in the control group. There was no statistically meaningful difference found in the pretest-posttest comparisons of the experimental and control groups when examining 'Pressure Centre Analysis'. Similarly, no significant disparity was found in the comparison between groups. However, when examining the 'Oscillation Area' variable, a statistically significant difference was found in the in-group comparison of the experimental group (p<0.05). No significant disparity was found in the control group, and there was no statistically significant difference found in between-group comparisons.

**Table 3. Dynamic Balance Comparisons between Experimental and Control Groups**

| **Variables** | **Groups** | **N** | **In-group comparisons** | | | | | **Between-group comparisons** | |
|---|---|---|---|---|---|---|---|---|---|
| | | | **Pre-test x̄±Sd** | **Post-test x̄±Sd** | **t** | **p** | **In-group difference (%)** | **F** | **p** |
| **Dynamic Stability Performance (s)** | Experiment | 15 | 4.05±1.68 | 2.82±1.23 | **5.687** | **0.000** | 1.23(30.37) | **3.831** | **0.048** |
| | Control | 15 | 4.11±1.58 | 4.03±2.093 | 0.147 | 0.885 | 0.08(1.94) | | |
| **Right Oscillation Area** | Experiment | 15 | 40.84±17.65 | 37.88±17.32 | **17.941** | **0.000** | 2.96(7.24) | **29.446** | **0.000** |
| | Control | 15 | 34.68±17.08 | 33.61±17.23 | **3.507** | **0.003** | 1.07(3.08) | | |
| **Left Oscillation Area** | Experiment | 15 | 20.31±10.64 | 17.20±8.20 | 1.697 | 0.112 | 3.11(15.31) | 1.327 | 0.259 |
| | Control | 15 | 21.24±10.40 | 20.26±10.07 | **3.889** | **0.002** | 0.98(4.61) | | |
| **Right External Oscillation Area** | Experiment | 15 | 2.90±3.62 | 2.38±3.49 | 1.144 | 0.272 | 0.52(17.93) | 0.624 | 0.436 |
| | Control | 15 | 5.42±4.67 | 4.50±4.31 | 4.860 | 0.000 | 0.92(16.97) | | |
| **Left External Oscillation Area** | Experiment | 15 | 0.48±0.53 | 0.16±0.29 | 1.780 | 0.097 | 0.32(66.66) | 0.840 | 0.367 |
| | Control | 15 | 0.80±1.07 | 0.65±1.04 | **5.602** | **0.000** | 0.15(18.75) | | |
| **Right Oscillation Reaction Time** | Experiment | 15 | 3.85±2.78 | 1.66±2.25 | **2.242** | **0.042** | 2.19(56.88) | 2.746 | 0.109 |
| | Control | 15 | 5.30±4.99 | 4.77±4.73 | **2.533** | **0.024** | 0.53(10) | | |
| **Left Oscillation Reaction Time** | Experiment | 15 | 0.52±0.52 | 0.23±0.29 | 1.709 | 0.110 | 0.29(55.76) | 0.068 | 0.796 |
| | Control | 15 | 0.81±0.48 | 0.47±0.45 | **6.996** | **0.000** | 0.34(41.97) | | |

***p<0.05***

Upon examining Table 3, a comparison of dynamic balance was made between the experimental and control groups. The variable 'Dynamic Balance Performance' showed a significant difference in in-group comparisons, while no significant difference was found in the control group ($p<0.05$). Between-group comparisons also revealed a significant difference ($p<0.05$ level). Statistically significant differences were reached in the pretest-posttest comparisons of the experimental and control groups when analysing the 'Right Oscillation Area' ($p<0.05$). Additionally, between-group comparisons also showed statistically significant differences at the same level. No statistically significant disparity was observed in the experimental group when analysing the 'Left Oscillation Area'. However, a statistically significant difference was found in the pretest-posttest comparison of the control group ($p<0.05$). No significant disparities were shown in between-group comparisons. Additionally, no significant differences were found in the in-group comparisons of the experimental and control groups for the variable 'Right External Oscillation Area'. Similarly, no meaningful differences were revealed in the pretest-posttest comparisons of the experimental group for the variable 'Left External Oscillation Area'. Statistically significant differences were found in in-group comparisons of the control group ($p<0.05$). However, no significant differences were found in between-group comparisons. When analysing the variable 'Right Oscillation Reaction Time', statistically significant disparities were found in in-group comparisons of both the experimental and control groups ($p<0.05$). Although the experimental group did not show a significant difference in the variable 'Left Oscillation Reaction Time', the pretest-posttest comparisons of the control group revealed a statistically significant difference at the $p<0.05$ level. Additionally, no significant difference was found in the between-group comparisons.

## DISCUSSION

This study investigated the impact of an 8-week Bosu training on the development of static and dynamic balance in male basketball players (aged 14-16) in the Bingöl Junior League.

### The Effect of Bosu Training Program on Static and Dynamic Balance Development

In basketball, training using a Bosu ball and Theraband for the lower extremities can improve postural balance in terms of dynamic and static balance by acting on the proprioceptive system. Boccolini et al. (2013), Ha et al. (2018), and Grueva-Pancheva (2021) have shown that 30 minutes of balance training twice a week for 12 weeks can improve the balance and uprightness of young basketball players. In their study 'The influence of ankle strengthening exercise on balance in young basketball players', Nugraha et al. (2022) found that providing Bosu ball training to U-16 and U-18 basketball players after regular training had a statistically significant positive effect on improving their dynamic balance, both on the right and left side.

After a 12-week study investigating the impact of Bosu training on balance in male volleyball players aged 10-14 years, the experimental group showed a statistically meaningful disparity in the right leg and double leg mean dynamic balance values compared to the control group ($p<0.05$). Additionally, there was an improvement in the right leg and double leg mean values in the experimental group (Yıldızbaş 2019). In their study, Okludil and Serin (2022) reported that an 8-week Bosu exercise program positively affected the static balance ability of adolescent female volleyball players.

Cerrah et al., (2016) investigated the influences of functional balance training on static and dynamic balance performance in adolescent soccer players. The experimental group underwent the training for 6 weeks, 3 days per week, and 35 minutes per session. The results yielded a statistically significant improvement in the static balance scores of all variables (dominant, non-dominant, double leg) and the dynamic balance score of the dominant leg after balance training on hard ground and with Bosu balls ($p<0.05$). Furthermore, Nisha et al. (2015) reported that a 4-week balance training program using Bosu and a multidirectional balance board effectively improved dynamic balance performance in soccer players aged 18-25 years.

The study examined the effect of Bosu training on static balance in tennis players aged 12-14 years over a period of 10 weeks. The results revealed a meaningful difference in the standard deviation of left and right swing/oscillation, static balance score, forward and backward swing speed, left and right swing speed, and swing speed of static balance score in the in-group comparison of static balance scores in the experimental group (Bayrakdar et al. 2020) ($p<0.05$). Sannicandro et al. (2014) reported a significant improvement in balance measurements of young tennis players who underwent balance training using Bosu, inflatable discs, and inflatable cushions.

Kılınç Boz (2018) investigated the impact of swimming and Bosu training on dynamic and static balance in children aged 6-13 years. The study found that applying Bosu training for 10 weeks, 3 times a week, 60 minutes per session, according to the principle of continuity and increasing load, significantly improved balance performance in terms of static and dynamic balance levels.

A study was administered to investigate the effect of Bosu training on biomotor characteristics in female taekwondo athletes aged 12-14 years. The study revealed a significant difference in post-test dynamic balance performance, right external oscillation area, right oscillation reaction time, and left oscillation reaction time values in favour of the experimental group. The experimental group also showed an improvement in their dynamic balance (Sarıkaya 2022). In a comparable study, İpekoğlu et al. (2018) observed that a Bosu training program that included taekwondo-specific techniques improved the static and dynamic balance performance of 24 professional adolescent taekwondo athletes (aged 15-17) who trained twice a week for 12 weeks.

Prasetyo et al. (2023) reported that Bosu ball training, consisting of 18 circuits of training sessions, positively improved static balance scores in archers aged 14-17 years. Similarly, Elfateh (2016) concluded that 10 weeks of Bosu ball training improved static and dynamic balance in young fencing athletes.

In their study titled 'Balance board and Bosu ball: which one is better in improving static and dynamic balance skills in healthy university students', Nalçakan and Yol (2020) found that applying balance training using a balance board and Bosu ball to 52 healthy, active university students for 8 weeks resulted in a positive improvement in the static balance of the experimental groups ($p<0.05$).

Uçar and Bayazıt (2021) reported a significant difference in the static and dynamic balance scores of athletes who regularly attended the fitness centre ($p<0.05$). The experimental group performed regular and systematic training on the Bosu and Power Plate with weights for 12 weeks.

Paterno et al. (2004) reported significant results in anterior-posterior dynamic balance scores following a 6-week Bosu ball training program in young women ($p<0.05$). Similarly, Yaprak (2018) found that an 8-week core exercise program using Bosu and Swiss balls improved static and dynamic balance in healthy young male athletes. Cuğ et al. (2016) reported that a 4-week balance training program, which involved unstable surface training on a Bosu ball, contributed to dynamic balance skills in healthy young adults.

Yaggie and Campbell (2006) found a significant difference in static balance skills in the experimental group after four weeks of Bosu ball training compared to the control group, which consisted of 19 out of 36 participants. Haksever et al. (2017) reported an increase in dynamic and static balance as well as functional parameters after eight weeks of balance training using standard balance equipment such as Bosu, wobble board, and balance board in healthy individuals. Nalçakan and Yol (2020) found that balance training using a Bosu ball and balance board three days a week for a period of eight weeks significantly improved the dynamic balance of the experimental groups consisting of 52 healthy, active university students ($p<0.05$). The study titled 'The effects of strength training with Bosu ball on balance and anaerobic performance for eight weeks' reported that Bosu training also had a positive effect on dynamic balance scores ($p<0.05$) (Şan et al., 2019).

Antonio et al. (2013) reported that a 12-week proprioception training program, using Bosu and a Swedish ball, significantly improved the static and dynamic balance in those over 65 years of age ($p<0.05$). In a study titled 'Effects of unstable surface balance training on postural oscillation, stability, functional ability and flexibility in women', Nepocatych et al. (2016) applied a three-week training program to two groups working on Bosu ball and stepping board. The study concluded that Bosu training can improve dynamic balance ability in women.

Çavuşoğlu and Çankaya (2022) reported that Bosu ball training for 12 weeks positively influenced the development of static and dynamic balance skills in hearing-impaired children. In a similar study, Korkmaz and Akın (2021) found a statistically significant difference between the pre-test and post-test scores of the Bosu group in the distance travelled in dynamic balance tests performed with two feet and in the bipedal medial (right-left) swing score, after an 8-week Bosu training program for hearing-impaired sedentary women ($p<0.05$).

A review of the literature research shows that Bosu exercises have a positive effect on static and dynamic balance scores, as shown in various studies. Our research also found a positive effect on the development of static and dynamic balance in young basketball players (see Tables 2 and 3). When we compare the findings of

Bosu training in the experimental group with the literature, we found similar positive results in many studies. The results concluded that Bosu training programs positively affect dynamic balance performance, regardless of the sports branch.

## CONCLUSION

Our study examined the results of static balance measurements of Bosu training applied to a group of young male basketball players over eight weeks. The pretest-posttest comparisons of the experimental group showed a significant difference in most of the static balance variables ($p<0.05$). However, no statistical difference was found in the control group or between-group comparisons ($p>0.05$). Most of the dynamic balance variables of Bosu training showed a significant difference in the pretest-posttest comparisons of the experimental group ($p<0.05$). However, no statistical difference was found in the control group or the between-group comparisons ($p>0.05$). Therefore, it was concluded that Bosu training can positively contribute to the development of static and dynamic balance in young basketball players.

This article is based on a Master's thesis completed at Bingöl University, Institute of Health Sciences, Department of Physical Education and Sports.

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