



The Effect of Bosu Ball Strengthening Exercise on Dynamic Balance Among UniKL RCMP Athletes

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ABSTRACT

Acute ankle sprains are prevalent among athletes and often result in long-term impairment, including chronic ankle instability. Strengthening interventions like Bosu ball exercises may enhance dynamic balance and reduce injury recurrence. This randomized control trial compared the effects of Bosu ball exercises versus general ankle stretching on dynamic balance in 50 UniKL RCMP athletes aged 18–25. Participants were assigned to either an intervention group (Bosu ball exercises) or a control group (general stretching). Both groups trained once weekly for four weeks. The Y Balance Test assessed dynamic balance pre- and post-intervention. The intervention group showed significant improvements ($p < 0.05$), whereas the control group showed minimal change. In conclusion, Bosu ball exercises are more effective than general stretching in enhancing dynamic balance and should be integrated into athletic training programs.

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1. INTRODUCTION

Dynamic balance is essential for athletic performance and injury prevention. Impaired proprioception and ankle instability frequently lead to sprains, especially in sports involving sudden, multidirectional movements. Ankle sprains are among the most common injuries in sports and can significantly delay recovery [11]. While multiple studies have evaluated strength-based interventions in specific populations, such as basketball players, limited research exists on their broader application across multiple sports [27].

Although various exercises have demonstrated benefits for ankle stability, most past research has been limited to a single sport or generalized populations. This study seeks to address this gap by evaluating the effects of Bosu ball training versus general stretching in athletes across various sports at UniKL RCMP. Understanding how balance-based exercises contribute to injury prevention and performance enhancement can help design targeted, sport-specific programs [27][10].

2. LITERATURE REVIEW

2.1 Anatomy and Biomechanics of the Ankle

The foot and ankle consist of 26 bones and 33 joints, with key articulations like the talocrural, subtalar, and transverse tarsal joints. These structures enable motion such as dorsiflexion, plantarflexion, inversion, and eversion [2].

2.2 Relation Ankle Proprioception with Balance

Proprioception is the sense of body position and movement, essential for postural control and joint stability. It involves feedback from muscles, tendons, and ligaments and plays a crucial role in dynamic balance [4][10][30].

2.3 The Effect of Ankle Strengthening Exercise

Strength training improves neuromuscular control, muscle power, and endurance. Exercises like barefoot running and TheraBand routines enhance ankle function and dynamic balance [24][31][32].

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1.4 Isometric and Isotonic Contraction

Both isometric (static) and isotonic (dynamic) contractions contribute to muscle activation. Evidence shows that incorporating both enhances dynamic stability [5][33].

1.5 Importance of Dynamic Balance Assessment

Tools like the Y Balance Test assess movement control and postural stability. They are useful in performance optimization and injury risk assessment in dynamic sports [3][27][28].

1.6 Prescription of Strengthening Exercise

Effective programs depend on training volume, frequency, and progression. Literature suggests that 2–4 sessions per week are optimal for improving strength and function [9][17][29][38].

1.7 Effectiveness Ankle Strengthening Exercise

Bosu ball and unstable surface training significantly enhance balance and proprioception in various populations, including athletes with ankle instability [10][27][35].

1.8 Limitations of Strengthening Alone

Without balance-specific stimuli, strength training may not sufficiently improve postural control. Neuromuscular and sensorimotor engagement is essential [6][8][20].

3. METHODOLOGY

This quasi-experimental, pre-post design study was conducted at UniKL RCMP and included 50 athletes aged 18–25. Participants were randomly assigned to two groups of 25 each: Procedures:

- Intervention Group: Performed single-leg stance exercises on a Bosu ball for 10 seconds (3 sets x 10 reps).
- Control Group: Conducted seated heel raises for 15 seconds (5 reps).

Sessions were conducted once per week for four weeks. Dynamic balance was assessed using the Y Balance Test in three directions: anterior, posterolateral, and posteromedial.

Outcome Measurement Procedure (Y Balance Test): Participants performed three trials per direction, with the maximum reach recorded and normalized using limb length. A composite score was calculated. Here is the procedure of Y Balance Test (YBT):

- 1) The test taker stands on a point or platform with bare feet or wearing sports shoes.
- 2) Place both hands on the waist.
- 3) Test takers can try 3-6 times in each direction before taking the real test.
- 4) The actual test was carried out 3 times in each direction.
- 5) Participants are asked to move their legs to produce as far as possible and return their feet to the starting position.
- 6) The support leg must not be lifted or shifted when the other leg is moving.
- 7) The maximum coverage distance is then recorded in "cm" units.
- 8) Assessment of the Y Balance Test, the best achievement from each direction is then added and divided by three times the length of the leg (measured

from the ASIS to the medial malleolus), multiplied by 100 as the normalized value.

- 9) The composite direction value is calculated by the formula: $[(\text{sum of the greatest reach in each direction}) / (3 \times \text{limb length})] \times 100$.

Data were analyzed using SPSS v29. Paired and independent t-tests were applied. Significance was set at $p < 0.05$.

Ethical Approval: This study received ethical clearance from the UniKL RCMP Research Ethics Committee (Ref No: UniKLRCMP/MREC/MARCH-JULY2024/FPHS/BACH.PH YSIO/FYP-023). Written informed consent was obtained from all participants.

4. RESULTS

The intervention group showed significant improvement in dynamic balance ($p < 0.05$). Control group did not show statistically significant changes ($p > 0.05$). Between-group comparisons also revealed significant differences in post-test scores favoring the intervention group.

Table 1. Demographic profiles of subjects (N=50)

Group	Variables	Frequency (n)	Percentage (%)	Mean	SD
Intervention	Age			22.32	1.0
	Gender	Male	52.0		
		Female	48.0		
Control	Age			20.52	2.0
	Gender	Male	52.0		
		Female	48.0		

Table 1 presents the demographic characteristics of the participants. A total of 50 student athletes from UniKL RCMP participated in this experimental study. There were more female participants than male participants in both groups. In both the intervention and control groups, 52.0% of the participants were female, while 48.0% were male. Specifically, there were 26 female students and 24 male students.

Table 2. The effect of Bosu ball exercise on dynamic balance between pre- and post- intervention within intervention group

Variables	Group A (Bosu ball exercise) (n=25)		
	Pre-Mean ± SD	Post-Mean ± SD	P-value
Right leg	99.44 ± 16.013	118.12 ± 14.034	<0.001**
Left leg	98.12 ± 17.503	119.44 ± 14.709	<0.001**

Table 3. The effect of Bosu ball exercise on dynamic balance between pre- and post- intervention within intervention group

Variables	Group B (General ankle stretching exercise) (n=25)		
	Pre-Mean ± SD	Post-Mean ± SD	P-value
Right leg	106.56 ± 18.260	99.24 ± 15.746	0.034
Left leg	103.76 ± 19.190	100.48 ± 18.113	0.198

Based on Tables 2 and 3, there is a significant difference in dynamic balance for all participants between the pre- and post-intervention Bosu ball exercises ($p < 0.05$). Meanwhile, there is no significant difference in dynamic balance for all participants between the pre- and post-intervention general ankle stretching ($p > 0.05$).

Table 4. Comparison of The Effectiveness of Bosu Ball and Stretching Exercise on Dynamic Balance Between Groups

Variables	Group	Pre-Mean $\pm$ SD	Post Mean $\pm$ SD	p-value
Right leg	Intervention	99.44 $\pm$ 16.013	118.12 $\pm$ 14.034	<0.001
	Control	106.56 $\pm$ 18.260	99.24 $\pm$ 15.746	
Left leg	Intervention	98.12 $\pm$ 17.503	119.44 $\pm$ 14.709	<0.001
	Control	103.76 $\pm$ 19.190	100.48 $\pm$ 18.113	

In the Table 4, the independent t- test was used to compare the dynamic balance between intervention and control groups. There were also significant differences of the dynamic balance between intervention and control groups ($p < 0.05$).

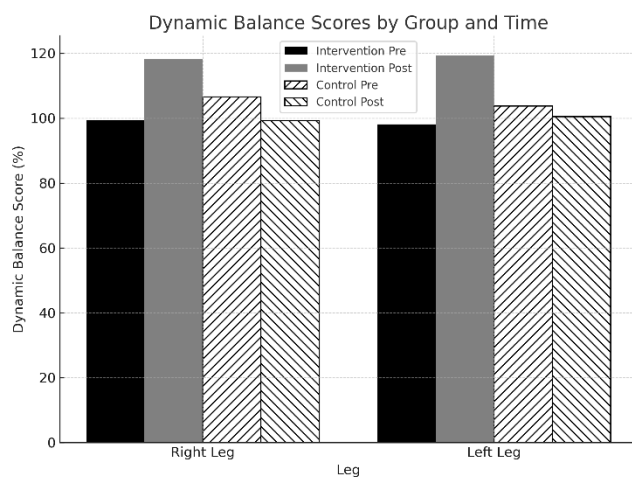


Fig.1. Graph for the comparison mean of pre- and post-test dynamic balance scores for intervention and control groups.

Participants who underwent Bosu ball strengthening exercises showed significant improvements in dynamic balance for both right and left legs. In contrast, the control group (general ankle stretching) showed either no improvement or slight decreases in performance.

5. DISCUSSION

In this study, 50 participants were divided into two groups using a randomized controlled trial. The study lasted for 4 weeks, with one meeting per week. The study aimed to investigate whether performing Bosu ball exercises would affect dynamic balance compared to regular ankle stretching exercises. The overall data show that the dynamic balance of those who performed the Bosu exercises improved significantly over the control group who performed the general stretching exercise. The results indicate an improvement in dynamic balance for the intervention group, with both the right and left legs showing increases in average scores. For the right leg, the average score increased from 99.44% before the intervention to

118.12% after the intervention. The left leg also showed a substantial increase, going from an average of 98.12% to a score of 119.44% after the intervention. Both scores mean that the average person in the Bosu group performed significantly better at a dynamic balance task after the group trained in the Bosu ball exercise class.

The major enhancement in both legs indicates that Bosu ball exercises influenced dynamic balance positively. The balancing challenges provided by the unstable surface of the Bosu ball compelled the participants to use all available stabilizing muscles [23]. The body stability is divided into joint stability and muscle stability. The differences between doing single leg stand on Bosu ball and on the floor can be explained in terms of muscle engagement, balance challenge, and stability. Balancing on the floor is simpler because of its firm, stable surface, whereas on a BOSU ball, the instability significantly raises the difficulty, demanding continuous adjustments and engagement of the core, ankle, and hip stabilizing muscles. The results are in line with previous research demonstrating that balance training on unstable surfaces works effectively for dynamic balance [27].

In contrast, the control group, which engaged in general ankle stretching, did not experience a significant improvement in dynamic balance. The average dynamic balance scores for the right leg slightly decreased from 106.56% before the intervention to 99.24% afterward. Similarly, for the left leg, the mean scores dropped from 103.76% to 100.48%. These results indicate that general ankle stretching alone may not be effective in improving dynamic balance. In this study, the participants performed dynamic ankle stretching involving multiple muscles for only 1 minute and 15 seconds, once a week for 4 weeks. This is not considered long-term stretching. Long-term stretching generally refers to interventions performed regularly over a more extended period, such as several months, with more frequent sessions per week. According to reference [19] long-term stretching is thought to increase ankle joint ROM and improve ankle motion, leading to a better ability to maintain dynamic equilibrium. However, it is effective even if it only targets single muscles during stretching. Stretching a single muscle can impact balance ability in more challenging situations (increased dependence on somatosensory input and dynamic conditions). Therefore, this justifies why the control group experienced a decline in dynamic balance after the 4-week intervention. Although stretching can enhance flexibility and decrease rigidity, it does not seem to offer the neuromuscular activation necessary for enhancing stability. Balance requires not only muscle flexibility but also the nervous system's ability to coordinate muscle activation and respond to movement [39]. The nervous system controls and coordinates the body's actions and responses by sending electrical signals between the brain, spinal cord, and muscles.

On the other hand, the study from [25] which investigated the effects of balance training on individuals with chronic ankle instability. The study found that balance training significantly improved dynamic balance and functionality in these individuals, emphasizing the need for balance specific exercises beyond general ankle stretching to improve dynamic stability. The Bosu ball is commonly used in workouts to improve dynamic balance. It challenges the stability by an unsteady surface, prompting the body to activate numerous muscles and enhance neuromuscular coordination. However, some studies suggest that combining Bosu ball exercises with other forms of

training is highly effective in enhancing dynamic balance among athletes. According to study from [1], athletes who performed exercises on the Bosu ball alongside traditional agility drills exhibited greater improvements in dynamic balance compared to those who only did traditional exercises.

After analyzing the data for this study, several people from the control group who only performed general ankle stretching showed improvement in their dynamic balance. However, the improvement was seen in only one leg, not both. According to the study from reference [7], the reasons why some individuals in the control group, who solely engaged in basic ankle stretching exercises, might have seen enhancements in their dynamic balance is due to factors other than the stretching routine. Engaging in physical activities such as walking long distances could improve their neuromuscular coordination and balance. Their balance improvements may have been influenced by previous conditioning, natural variations in proprioception or involvement in other activities that enhance muscle strength and coordination. Therefore, it is probable that their advancements are a result of both stretching and other regular physical activities or level of fitness.

In summary, performing a single leg stand on the Bosu ball may provide significant benefits for improving dynamic balance among athletes, as well as contributing to long-term functional outcomes. However, studies directly comparing the effects of Bosu ball exercises with general ankle stretching routines are limited. To gain a comprehensive understanding of the optimal use and impact of these interventions, further comparative studies are needed. Such research could clarify how different training methods contribute to balance improvement and identify the most effective strategies for enhancing athletic performance and injury prevention.

6. CONCLUSION

Bosu ball exercises significantly improve dynamic balance in athletes and outperform general ankle stretching in this regard. These exercises should be integrated into training and rehabilitation protocols. Future research should explore the long-term effects and combinations of Bosu training with other modalities for various sports populations.

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