

Circuit training bosu ball: effect on balance and accuracy of archery athletes

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim Balance is very decisive in producing good and correct basic archery techniques, resulting in good archery accuracy. This study aims to determine the effect of circuit training bosu ball on improving balance and accuracy in archery athletes.

Material and Methods This study was an experimental research design that involved 12 archery athletes at Bibis Archery Club Bantul Regency, aged between 14-17 years. The training program consisted of 18 circuit training sessions using a bosu ball. The archery accuracy test was used to assess the athletes' accuracy in sticking arrows to a target located 30 meters away. The balance test was conducted using the Stork Stand Test, which involved standing on one leg, on the dominant leg, for as long as possible. The statistical analysis used was a t-test, specifically paired sample test.

Results The pretest balance and archery accuracy scores of the 12 archery athletes at Bibis Archery Club Bantul Regency were recorded. The pretest balance score averaged 44.12 seconds, and the pretest archery accuracy score was 216.50. After 18 circuit training sessions with bosu ball, the posttest balance score increased to an average of 51.44 seconds, and the posttest archery accuracy score increased to an average of 282.83. Statistical analysis revealed that the improvement in balance and archery accuracy was significant, with a p-value of $0.000 < 0.05$, indicating that the training using bosu ball can effectively improve the balance and archery accuracy of young athletes.

Conclusions Overall, our findings suggest that circuit training with bosu ball significantly improves balance and archery accuracy in young athletes. Specifically, the participants demonstrated an average increase in their balance scores improvement in their archery accuracy following the training. These results highlight the potential benefits of incorporating bosu ball exercises in the training regimen of archery athletes.

Keywords: circuit training, bosu ball, balance, accuracy

Introduction

One of the growing sporting achievements in Indonesia is archery. Archery is a precision sport that requires consistency and stability of movement so that the arrow is accurate [1, 2]. The characteristics of archery are releasing arrows through a certain trajectory towards a target at a certain distance [3, 4]. Archery is one of the measurable sports and the accuracy of hitting the target is the most absolute thing for an archer. In the sport of archery, every athlete must be able to shoot his arrows at a predetermined target [5]. The physical components needed in archery include muscle strength, muscle endurance, and Balance is a component needed in archery because it must be able to hold the body, while on the other hand aiming to release the shot [6, 7]. Due to the lack of balance, concentration, and endurance of the athlete's arm muscles, it has implications for low archery accuracy.

Balance is an integral part of all movement. Balance is defined as the ability to maintain or restore the body's center of mass within the basic body of support to prevent falls and complete the

required movements and it is usually divided into two basic components, namely static and dynamic. Balance is very decisive in producing good and correct basic archery techniques, resulting in good archery accuracy. Some studies show that balance has an effect on archery results conducted by [8, 9, 10].

Accuracy and balance in archery can be achieved through continuous and systematic exercises, by practicing presenting distractions, practicing using key words, practicing structuring routine activities, practicing eye control, and practicing focusing or training methods provided by the coach. Balance training is a great exercise to maintain the body's equilibrium when in various positions to control the body's center of mass against its fulcrum. Experts in the field of physical activity recommend using bosu balls in three specific types of training: cardio, human balance, and posture control [11].

The characteristic of the bosu ball is that when the dome side is facing up, this training medium provides an unstable surface, while the device remains stable. This combination of stable/unstable allows it to be practiced by many users, from youngsters, to the elderly, or for elite athletes to

heal. The Bosu Ball with dome on top can be used for sports training and aerobic activities. In this position, the bosu ball is highly unstable and can be used for other forms of exercise. Benefits of using bosu ball equipment High-intensity workouts with a handy bosu mix, full mixed body workout with intense calorie-burning cardio and core, getting extreme results in the least amount of time.

Bosu exercise contributes to burning fat in the body by allowing that blood circulation in the body is fastened, from improving blood circulation to losing weight, as well as increasing growth hormone and building muscle. Bosu exercises are commonly used by people who want to perform cardio exercises, as well as increase the strength of the lower body and middle muscles [12]. Performing exercises on an unstable surface has been proposed to increase proprioceptive demands and stress muscles to a greater extent than performing exercises on a stable surface [13]. The bosu exercise for 6 weeks had significant improvements in the right and left anterior, posteromedial and posterolateral directions with a p -value < 0.0001 and in core stability with a p -value < 0.0001 [14]. Bosu training can improve muscle strength, dynamic balance, agility and functional performance [15].

The research hypothesis: It is hypothesized that balance training using bosu ball for 18 meetings can improve the balance of archery athletes, which will lead to more stable archery accuracy.

The purpose of the study: The purpose of this study is to investigate the effect of exercise using bosu ball on the accuracy of archery athletes at Bibis Archery Club Bantul Regency. The study aims to determine whether balance training with the bosu ball can improve the balance and accuracy of archery athletes.

Materials and Methods

Participants

The population in this study were archery athletes at Bibis Archery Club Bantul Regency, totaling 12 athletes. The sample criteria in this study were athletes aged 14-17 years. This research was carried out during the Covid-19 pandemic, so researchers implemented strict health protocols. Previously, athletes/respondents had filled out and signed a questionnaire stating their willingness to conduct research.

To ensure the safety of all participants during the research, a protocol was applied that included several measures. These measures included checking the athlete's body temperature before starting the research and providing water, soap, and hand sanitizer for the athletes to wash their hands first. The distance between athletes was also kept at a safe level, and all those involved in this study always used masks/face shields.

Ethical Aspect of the Research:

This research was conducted in accordance with the Principles of the Declaration of Helsinki. Ethics committee approval was obtained from the Research Ethics Committee University. Parents/guardians of the children included in the study were informed in detail about the study and their written consent was obtained.

Research Design

This type of research is experimental. The experimental method is defined as a systematic method to establish relationships that contain causal phenomena. The instruments used are the archery accuracy test and the Stork Stand Test. The archery accuracy test is the sticking of arrows according to the target at a distance of 30 meters, how to calculate by means of an archer doing 36 arrow shots and totaling the results of the number of each arrow. Balance tests are measured using the Stork Stand Test. The Stork Stand Test is done by standing on one leg, on the dominant leg forever. Time starts when the testee lifts one leg until the testee loses balance [16]. Treatment was conducted for 18 meetings. The scheme of exercises with the Bosu ball is shown in Figure 1.

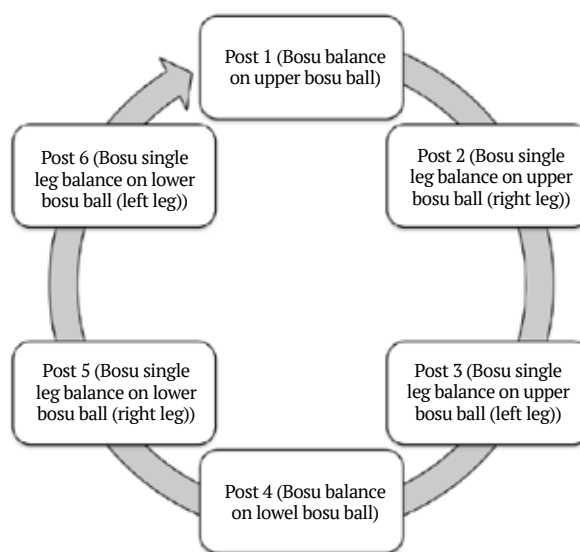


Figure 1. Circuit training bosu ball.

Statistical Analysis

The statistic used is the t-test. There are namely paired sample test, before being analyzed using the t-test, analyzing the prerequisite tests for normality and homogeneity. The statistical analysis technique used the Statistical Package for Social Science (SPSS) version 21 software.

Results

The results of the pretest and posttest of balance and archery accuracy of archery athletes at Bibis Archery Club Bantul Regency are presented in Table 1.

Based on Table 1, it shows that the pretest balance of archery athletes at Bibis Archery Club Bantul Regency averaged 44.12 seconds and increased during the posttest by 51.44 seconds, while the average archery accuracy pretest was 216.50 and increased during the posttest by 282.83.

Normality Test

Normality test is a way to determine whether the distribution of data in a sample can reasonably be ascribed to a given population with a normal distribution. Calculation of this normality test using Shapiro-Wilk. The results of the normality test are presented in Table 2.

The normality test results in Table 2, it can be seen that the pretest-posttest data for balance and archery accuracy of archery athletes have a p-value > 0.05 , so the variables are normally distributed.

Homogeneity Test

The homogeneity test is useful for testing the similarity of the sample, namely whether or not

the sample variants taken from the population are uniform. The results of the homogeneity test of this study can be seen in Table 3.

The homogeneity test results in Table 3, show that the pre-test-post-test data of balance and archery accuracy of archery athletes with p-value > 0.05 , so the data is homogeneous.

Hypothesis Test Results

The hypotheses in this study were tested using t-test analysis, namely paired sample t-test ($df = n-1$) for the analysis of hypotheses 1 and 2, while the independent sample test for hypothesis analysis 3 ($df = n-2$) using the SPSS version 21 software.

Based on the results of the analysis in Table 4, it can be seen that the t count is 7.894 and the p-value is $0.000 < 0.05$, then these results indicate there is a significant difference. Thus the hypothesis "There is a significant influence between training using bosu ball on the balance of archery athletes", is accepted.

Based on the results of the analysis in Table 4, it can be seen that t count 20.349 and p-value

Table 1. Pretest and posttest archery balance and accuracy.

No	Balance			Accuracy		
	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference
1	46.11	48.20	2.09	225	284	59
2	47.20	52.67	5.47	226	267	41
3	44.20	57.20	13.00	218	277	59
4	49.20	52.18	2.98	210	275	65
5	37.80	47.60	9.80	212	286	74
6	27.32	33.56	6.24	204	281	77
7	44.23	52.31	8.08	217	277	60
8	50.55	61.12	10.57	221	284	63
9	56.20	64.24	8.04	213	292	79
10	40.07	46.80	6.73	208	288	80
11	32.40	42.27	9.87	217	292	75
12	54.18	59.11	4.93	227	291	64
Mean	44.12	51.44	2.4	216.5	282.83	216.5

Table 2. Normality test results.

Data		Sig.	Description
Balance	Pre-test	0.834	Normal
	Post-test	0.900	Normal
Accuracy	Pre-test	0.792	Normal
	Post-test	0.468	Normal

Tabel 3. Homogeneity test results.

Data	df1	df2	Sig.	Description
Pre-test-Post-test Balance	1	22	0.992	Homogen
Pre-test-Post-test Accuracy	1	22	0.871	Homogen

Table 4. Analysis Paired Samples Test.

Paired Samples Test			
Group	t count	Sig. (2- tailed)	Difference
Pre-test–Post-test Balance	7.894	0.000	7.32
Pre-test–Post-test Accuracy	20.349	0.002	66.33

$0.000 < 0.05$, these results indicate that there is a significant difference. Thus the hypothesis “There is a significant influence between training using bosu ball on the accuracy of archery athletes”, is accepted.

Discussion

Based on the results of the analysis shows that there is a significant influence between training using bosu ball on the balance of archery athletes. The effect of bosu training on improving the balance of archery athletes. Bosu exercise applications are used for balance development [17, 18], strength development and postural control [19], motor skill development [20]. In addition, Bosu, which has a large area of use, can be used not only standing on it in a vertical position, but also by standing in a horizontal position [21]. Study results show that training using bosu ball for 8 weeks can improve balance [22, 23]. Studies show that rebounding exercises using trampolines and Bosu balls provide proprioceptive and vestibular stimulation and improve postural control and balance [24]. Bosu ball training for 10 weeks can improve balance (static and dynamic) [25]. Significant balance changes in 16-year-old basketball players after being given bosu ball exercise treatment [26].

The balance training method using bosu ball media has a significant effect on improving the balance of athletes [27]. Bosu ball training model for archery sports that is developed effectively and can improve optimal physical abilities. Utilizing the bosu ball in every session can help improve agility, balance, ability, and reactivity. Bosu balls are specifically designed to burn the most calories in the shortest amount of time, and can work for all stages of fitness. Bosu ball helps in the area of physical fitness affecting the development of (power) speed, agility, endurance, balance, flexibility, accuracy and coordination), which in turn leads to a clear significant effect on physical performance. Therefore affecting performance in mastering game skills [25].

A 4-week balance training program consisting of dynamic unstable surface exercises on a bosu ball improved dynamic postural control and ankle strength production in healthy young adults. The moderate instability of the bosu ball did not result in greater muscle activation compared to performing exercises on the floor, whereas the wobble board and stability ball increased muscle activity [28]. The authors suggest that trained individuals may already have sufficient stability and the less stable

surface of the bosu ball may be necessary for the neuromuscular system [29].

Increased athlete balance after training using bosu ball, so that archery accuracy is also getting better. The effect of bosu training on increasing the archery accuracy of archery athletes is 30.64%. Athletes with good balance will have the skills to maintain the attitude to maintain the desired posture. In the sport of archery balance is needed because it must be able to hold the body while on the other hand aiming to release the shot [6]. Balance is the ability to maintain body equilibrium when placed in various positions, the ability to maintain the center of gravity on the fulcrum especially when in an upright position and maintain equilibrium during a moving position [30]. Balance during archery is needed by an archer, especially when aiming at the target and releasing the bow, in the release process the balance must be maintained while shooting. to get a good technique, archers must train balance according to biomechanical guidelines so as not to spend a lot of energy in vain.

Balance is very important in archery. This is because in archery, balance plays a very important function when pulling the bowstring and holding the archery stance. The direction of the shot must be right on the desired target. Athletes maintain balance by using muscle arrangements to change the position of body parts, so that the center of gravity has been within the basic limits of support. Correct body posture greatly affects when performing holding techniques (bow holding attitude) and aiming, so that realise techniques can also be done correctly. Posture when performing these techniques must also be considered so that the body does not lean to the left or to the other side, so that when aiming can focus on the intended target.

Bosu Ball can be used for many exercises, such as endurance, strength, balance, and stability, upper and lower. One side of the ball is flat and the other is dome-shaped and the most important thing is known as balance [11]. The characteristic of the bosu ball is that when the dome side is facing up, this training medium provides an unstable surface, while the device remains stable. This combination of stable/unstable allows it to be practiced by many users, from young people, the elderly, or for the healing of elite athletes. With the dome on top, the Bosu Ball can be used for sports training and aerobic activities. In this position, the Bosu ball is highly unstable and can be used for other forms of exercise [27].

Conclusions

The conclusion of this study is that training using bosu ball can improve balance and archery accuracy, with a p-value of $0.000 < 0.05$. The implication of the results of the study is that the results of the study can be used as material for consideration for coaches in making appropriate training programs to improve balance and archery accuracy. Thus training will be effective and will get results in accordance with what is expected by the coach. For researchers who want to conduct further research in order to make this research as information material and can examine with more and different populations and samples.

Acknowledgement

This research is supported by Yogyakarta State University.

Conflict of interest

We know of no conflicts of interest associated with this publication, and there has been no significant financial support for this work that could have influenced its outcome. As the corresponding author, I confirm that the manuscript has been read and approved for submission by all the named authors.

References

- Lo Presti D, Romano C, Massaroni C, D'Abbraccio J, Massari L, Caponero MA, et al. Cardio-respiratory monitoring in archery using a smart textile based on flexible fiber Bragg grating sensors. *Sensors*. 2019;19(16):3581. <https://doi.org/10.3390/s19163581>
- Simsek D, Cerrah AO, Ertan H, Soylu AR. A comparison of the ground reaction forces of archers with different levels of expertise during the arrow shooting. *Sci Sports*. 2019;34(2):e137–45. <https://doi.org/10.1016/j.scispo.2018.08.008>
- Sarro KJ, Viana TDC, De Barros RML. Relationship between bow stability and postural control in recurve archery. *Eur J Sport Sci*. 2021;21(4):515–20. <https://doi.org/10.1080/17461391.2020.1754471>
- Ortiz J, Ando M, Miyazaki T. Numerical simulation of wind drift of arrows on the Olympic venue for Tokyo 2020. *Athens J Sport*. 2020;7(1):1–20. <https://doi.org/10.30958/ajspo.7-1-1>
- Tan SL, Koh KT, Kokkonen M. The perception of elite athletes' guided self-reflection and performance in archery. *Reflective Pract*. 2016;17(2):207–20. <https://doi.org/10.1080/14623943.2016.1146582>
- Kim D-K. The effects of the upright body type exercise program on body balance and record of archers. *Korean J Sport Biomech*. 2018;28(1):9–18. <https://doi.org/10.5103/KJSB.2017.28.1.9>
- Debnath S, Debnath S. Performance evaluation by image processing techniques in archery—a case study. *Int J New Technol Sci Eng*. 2016;3(1):1–6.
- Patil A, Koley S. Correlations of static balance and star excursion balance test with selected anthropometric variables in inter-university archery players. *Int J Heal Sci Res*. 2019;9(2):90–5. <https://doi.org/10.52403/ijhsr>
- Ziebell B, Feister J, Bosak A, Lowell R, Phillips M, Nelson H, et al. The Relationship Between BMI, Lean Mass, and Body Fat Percentage with Balance in Collegiate Archers. *Medicine & Science in Sports & Exercise*. 2019;51(6S): 914–914. <https://doi.org/10.1249/01.mss.0000563240.55805.37>
- Kümmel J, Kramer A, Giboin L-S, Gruber M. Specificity of balance training in healthy individuals: a systematic review and meta-analysis. *Sport Med*. 2016;46:1261–71. <https://doi.org/10.1007/s40279-016-0515-z>
- Turgut M, Akbulut T, İmamoğlu O, Çınar V. The effect of 3 month cardio bosu exercises on some motoric, physical and physiological parameters in sedentary women. *Sp Soc Int J Ph Ed Sp*. 2018;18(2):48–52. <https://doi.org/10.18662/rrem/169>
- Saeterbakken AH, Andersen V, Jansson J, Kveltestad AC, Fimland MS. Effects of BOSU ball (s) during sit-ups with body weight and added resistance on core muscle activation. *J Strength Cond Res*. 2014;28(12):3515–22. <https://doi.org/10.1519/JSC.0000000000000565>
- Sawant RA, Chotai K, Patil S, Rayjade A. Effectiveness of bosu ball exercises versus thera band exercises on core stabilization and balance performance. *Indian J Forensic Med Toxicol*. 2020;14(2):200–6. <https://doi.org/10.37506/ijfmt.v14i2.2788>
- Kalra S, Pal S, Pawaria S, Yadav J. Comparative study of wobble board and bosu ball along with strength training on lower limb strength, dynamic balance, agility and functional performance of runners with lateral ankle instability. *J Clin Diagnostic Res*. 2021;15(5). <https://doi.org/10.7860/JCDR/2021/46588.14820>
- Loh WP, Chong YY. Classifying the archery performance with conditional effects on angular and linear shooting techniques. *J Telecommun Electron Comput Eng*. 2018;10(3–2):95–9.
- Ndayisenga J. Circuit training intervention for adaptive physical activity to improve cardiorespiratory fitness, leg muscle strength static and balance of intellectually disabled children. *Sport Mont*. 2019;17(3):97–100. <https://doi.org/10.26773/smj.191019>
- Lubetzky A V, Price R, Ciol MA, Kelly VE, McCoy SW. Relationship of multiscale entropy to task difficulty and sway velocity in healthy young adults. *Somatosens Mot Res*. 2015;32(4):211–8. <https://doi.org/10.3109/08990220.2015.1074565>
- Rusanov R, Vostroknutov L, Ke S, Prusik K,

- Golenkova J. Physical fitness of young Greco-Roman athletes under the restrictions of the COVID-19 pandemic. *Pedagogy of Health*. 2022;1(2):48-53. <https://doi.org/10.15561/health.2022.0203>
19. Lyuchkova E, Nesen O, Bartik P, Skrobecki J. Increasing the level of coordination abilities of young taekwondo athletes aged 13-14 under martial law. *Pedagogy of Health*. 2022;1(2):59-64. <https://doi.org/10.15561/health.2022.0205>
 20. Zemkova E, Jelen M, Radman I, Svilar L, Hamar D. The effect of stable and unstable lifting conditions on muscle power and fatigue rate during resistance exercises. *Med Sport*. 2017;70:36-49. <https://doi.org/10.23736/S0025-7826.17.03026-5>
 21. Saeterbakken AH, Chaudhari A, van den Tillaar R, Andersen V. The effects of performing integrated compared to isolated core exercises. *PLoS One*. 2019;14(2):e0212216. <https://doi.org/10.1371/journal.pone.0212216>
 22. Gidu DV, Badau D, Stoica M, Aron A, Focan G, Monea D, et al. The effects of proprioceptive training on balance, strength, agility and dribbling in adolescent male soccer players. *Int J Environ Res Public Health*. 2022;19(4):2028. <https://doi.org/10.3390/ijerph19042028>
 23. Saikhanzul J, Jeong B-C, Yoo K-T. The Effect of ankle strengthening exercises using a bosu® ball on the hallux valgus angle, rear foot angle, balance, and pain of hallux valgus patients in their 20s. *Korean Soc Phys Med*. 2022;17(3):69-77. <https://doi.org/10.13066/kspm.2022.17.3.69>
 24. Abd-Elmonem AM, Elhady HSA. Effect of rebound exercises on balance in children with spastic diplegia. *Int J Ther Rehabil*. 2018;25(9):467-74. <https://doi.org/10.12968/ijtr.2018.25.9.467>
 25. Elfateh A. Effects of ten weeks of instability resistance training (bosu ball) on muscular balance and the learning level of fencing basics. *Ovidius Univ Ann Ser Phys Educ Sport Mov Heal*. 2016;16.
 26. Nugraha PD, Soegiyanto S, Kristiyanto A, Azam M. The effect of ankle strengthening exercise on balance in youth basketball players. *Pedagog Phys Cult Sport*. 2022;26(1):57-67. <https://doi.org/10.15561/26649837.2022.01.07>
 27. Iskandar FA, Rismayadi A. Penerapan latihan media bosu ball terhadap peningkatan keseimbangan atlet bolabasket [Application of bosu ball media exercises to improve the balance of basketball athletes]. *J Kepelatihan Olahraga*. 2019;11(1):51-8. (In Indonesian). <https://doi.org/10.17509/jko-upi.v11i1.16826>
 28. Cuğ M, Duncan A, Wikstrom E. Comparative effects of different balance-training-progression styles on postural control and ankle force production: a randomized controlled trial. *J Athl Train*. 2016;51(2):101. <https://doi.org/10.4085/1062-6050-51.2.08>
 29. Ratamess NA, Rosenberg JG, Klei S, Dougherty BM, Kang J, Smith CR, et al. Comparison of the acute metabolic responses to traditional resistance, body-weight, and battling rope exercises. *J Strength Cond Res*. 2015;29(1):47-57. <https://doi.org/10.1519/JSC.0000000000000584>
 30. Lengkana AS, Rahman AA, Alif MN, Mulya G, Priana A, Hermawan DB. Static and dynamic balance learning in primary school students. *Int J Hum Mov Sport Sci*. 2020;8(6):469-76. <https://doi.org/10.13189/saj.2020.080620>

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Cite this article as:

Prasetyo H, Siswantoyo, Prasetyo Y, Hartanto A. Circuit training bosu ball: effect on balance and accuracy of archery athletes. *Pedagogy of Physical Culture and Sports*, 2023;27(3):229-234. <https://doi.org/10.15561/26649837.2023.0307>

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Received: 01.04.2023

Accepted: 15.05.2023; Published: 30.06.2023