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 conducted 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 50 meters, how to calculate by means of an archer doing 56 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.

<table>
<thead>
<tr>
<th>No</th>
<th>Balance</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td>Post-test</td>
<td>Difference</td>
<td>Pre-test</td>
<td>Post-test</td>
<td>Difference</td>
</tr>
<tr>
<td>1</td>
<td>46.11</td>
<td>48.20</td>
<td>2.09</td>
<td>225</td>
<td>284</td>
<td>59</td>
</tr>
<tr>
<td>2</td>
<td>47.20</td>
<td>52.67</td>
<td>5.47</td>
<td>226</td>
<td>267</td>
<td>41</td>
</tr>
<tr>
<td>3</td>
<td>44.20</td>
<td>57.20</td>
<td>13.00</td>
<td>218</td>
<td>277</td>
<td>59</td>
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<tr>
<td>4</td>
<td>49.20</td>
<td>52.18</td>
<td>2.98</td>
<td>210</td>
<td>275</td>
<td>65</td>
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<tr>
<td>5</td>
<td>37.80</td>
<td>47.60</td>
<td>9.80</td>
<td>212</td>
<td>286</td>
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<td>6</td>
<td>27.32</td>
<td>35.56</td>
<td>8.24</td>
<td>204</td>
<td>281</td>
<td>77</td>
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<tr>
<td>7</td>
<td>44.23</td>
<td>52.31</td>
<td>8.08</td>
<td>217</td>
<td>277</td>
<td>60</td>
</tr>
<tr>
<td>8</td>
<td>50.55</td>
<td>61.12</td>
<td>10.57</td>
<td>221</td>
<td>284</td>
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<td>46.80</td>
<td>6.73</td>
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<tr>
<td>11</td>
<td>32.40</td>
<td>42.27</td>
<td>9.87</td>
<td>217</td>
<td>292</td>
<td>75</td>
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<tr>
<td>12</td>
<td>54.18</td>
<td>59.11</td>
<td>4.93</td>
<td>227</td>
<td>291</td>
<td>64</td>
</tr>
<tr>
<td>Mean</td>
<td>44.12</td>
<td>51.44</td>
<td>2.4</td>
<td>216.5</td>
<td>282.83</td>
<td>216.5</td>
</tr>
</tbody>
</table>

**Table 2.** Normality test results.

<table>
<thead>
<tr>
<th>Data</th>
<th>Sig.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>0.834</td>
<td>Normal</td>
</tr>
<tr>
<td>Post-test</td>
<td>0.900</td>
<td>Normal</td>
</tr>
<tr>
<td>Accuracy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>0.792</td>
<td>Normal</td>
</tr>
<tr>
<td>Post-test</td>
<td>0.468</td>
<td>Normal</td>
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</tbody>
</table>

**Table 3.** Homogeneity test results.

<table>
<thead>
<tr>
<th>Data</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test–Post-test Balance</td>
<td>1</td>
<td>22</td>
<td>0.992</td>
<td>Homogen</td>
</tr>
<tr>
<td>Pre-test–Post-test Accuracy</td>
<td>1</td>
<td>22</td>
<td>0.871</td>
<td>Homogen</td>
</tr>
</tbody>
</table>
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 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 50.64%. 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 [50]. 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

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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


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