Differences in the effects of plyometric squat jumps and bileg band training on leg strength increases in volleyball players of different gender

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

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Abstract

This study aims to determine differences in the effects of plyometric jumps, squats, and double leg band training on leg muscle strength gains in volleyball players of different genders.

Material and methods

This study was conducted at SMP Negeri 3 Karanganyar, Jalan Lawu No. 86, Ngarjosari, Karanganyar Regency, Central Java. This study was conducted over a six-week period, beginning February 5, 2024, and ending March 16, 2024, with meetings occurring three times per week on Mondays, Wednesdays, and Fridays. The experimental method is chosen to identify certain symptoms through an intervention carried out on a test sample. An experiment is a design that allows researchers to simultaneously study the effects of two or more types of experimental variables.

Results

After the analysis in the group of men, an increase in leg strength indicators was obtained as a result of the experiment by 2.468%. Meanwhile, in the group of women, an increase in leg strength indicators was obtained as a result of the experiment by 2.892%. Comparing the two female groups, there is a higher percentage increase than the male groups, which is 2.892% in females compared to 2.468% in males. Thus, the female group showed a more pronounced increase in results than the male group, with a significance of p < 0.05. Thus, hypothesis 2 «there is a difference in the growth of leg muscle strength as a result of training using plyometric exercises in male and female students» is accepted.

Conclusions

Significant differences in the indicators of leg muscle strength increase in male and female volleyball players as a result of the use of special training were revealed. This is evidenced by the average increase in leg muscle strength in men by 2.468%, and in women by 2.892% at p < 0.05.

Keywords

plyometric squat jump, gender, leg muscle strength, volleyball
Анотація

Медицаль Ади Прадана, М. Фуршон Хидаятуллах, Сри Santosо Сабарини, Сламет Риядibtсе. Відмінності у впливі пліометричних стрибків з присіду і тренування із застосуванням стрічки для двох ніг на збільшення сили м’язів ніг у гравців у волейбол різної статі

<table>
<thead>
<tr>
<th>Обґрунтування і мета</th>
<th>Це дослідження має на меті визначити відмінності у впливі пліометричних стрибків з присіду і тренування із застосуванням стрічки для двох ніг на збільшення сили м’язів ніг у гравців у волейбол різної статі.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Матеріал і методи</td>
<td>Це дослідження було проведено у SMP Negeri 3 Karanganyar, Jalan Lawu No. 86, Ngarjosari, Karanganyar Regency, Central Java. Це дослідження проводилось протягом шести тижнів, починаючи з 5 лютого 2024 року до 16 березня 2024 року, із періодичністю зустрічей трічі на тиждень у понеділок, середу та п’ятницю. Експериментальний метод вибрано для визначення певних симптомів шляхом втручання, проведеного на дослідному зразку. Експеримент – це модель, яка дозволяє дослідникам одночасно вивчати вплив двох або більше типів експериментальних змінних.</td>
</tr>
<tr>
<td>Результати</td>
<td>Після аналізу в групі чоловіків було отримано збільшення показників сили ніг результаті проведення експерименту на 2,468%. Тим часом у групі жінок було отримано збільшення показників сили ніг в результаті проведення експерименту на 2,892%. У порівнянні з двома групами жіночої статі спостерігається більший відсоток збільшення, ніж в групах чоловічої статі, який становить 2,892% у жінок у порівнянні з 2,468% у чоловіків. Таким чином, група жіночої статі показала більш виражений приріст результатів, ніж група чоловічої статі, з достовірністю р &lt; 0,05. Таким чином, гіпотеза 2 «існує різниця у зростанні показників сили м’язів ніг в результаті тренування із застосування пліометричних вправ у студентів чоловічої та жіночої статі» приймається.</td>
</tr>
<tr>
<td>Висновки</td>
<td>Виявлено достовірні розходження показників збільшення сили м’язів ніг у волейболістів чоловічої і жіночої статі в результаті застосування спеціального тренування. Про це свідчить середній приріст сили м’язів ніг у чоловіків 2,468%, а у жінок – на 2,892% при р &lt; 0,05.</td>
</tr>
<tr>
<td>Ключові слова</td>
<td>пліометричний стрибок з присіду, стать, сила м’язів ніг, волейбол</td>
</tr>
</tbody>
</table>
Introduction

Sports are forms of physical activity contained in games, competitions, and intensive physical activities in order to obtain recreation, victory and optimal achievement [1]. Some people tend to underestimate the meaning and importance of exercise for human life. But certain moments the importance of sports is recognized as something that has a certain function as well as meaning in human life always reappears. One of the sports favored by the public, both men and women, today is volleyball [2].

Volleyball is defined as a complex sport because not everyone can do it. In the sport of volleyball requires coordination of movements that play a role in carrying out all series of movements this [3]. game aims to drop the ball towards the opponent's court, so that the opponent cannot return the bole to the area we have. Volleyball, it is a group sport carried out by 2 teams that are blocked by a net / net that has a height of 2.43 meters for men and 2.24 meters for women consisting of 6 players, with a court measuring 18 x 9 meters. Volleyball is a game carried out by 2 teams and 6 people when playing in each set, with the aim of dropping the ball towards the opponent's court so that the opponent cannot return the ball.

Basic volleyball technique is a very important component in the game of volleyball, such as service, block, and jump service, bottom passing, top passing. Some basic volleyball techniques require leg muscle power to jump. A volleyball athlete is expected to master good basic techniques to support a good game. To master the basic techniques of volleyball, the right training method is needed to support maximum results [4].

The game of volleyball requires strength including arm muscles and leg muscles, endurance includes abdominal muscles, arm muscles, shoulder muscles, speed, flexibility, power covering the heart, lungs and good motion coordination. These aspects are needed in order to be able to move, jump and react to get points both attacking and defending every match. Physical conditions that are indispensable in volleyball games are leg muscle strength and leg muscle explosive power, leg strength is needed to carry out attacks and defenses in volleyball games [5].

Sports achievements, especially sports that require explosive power, explosive power is a component that can be able to contribute to several movement techniques and some specialization numbers in sports. Given that in motion skills in sports achievements require more effort (explosive power) to achieve maximum performance and performance, each athlete is required to have standards in explosive ability [6].

The training method is a scientific way by providing programmatic treatment to improve talent, skills, and physical condition in accordance with sports. There are several kinds of components of physical conditions that must be met in sports and their fulfillment is adjusted to the sport involved. Improving physical condition is one of the indicators for the achievement of better physical fitness [7].

In volleyball, the great opportunity to turn off the ball or get points is to make a smash punch, thus the player must be supported by the ability of vertical jumps and explosive power of leg muscles when they want to do repulsion. The explosive power of these leg muscles occurs due to mutual shortening and lengthening of the lower upper leg muscles supported by the push of the leg muscles with maximum strength and speed. [8]

In the implementation of vertical jump power, leg muscles are needed so that there is a need for efforts to increase exercise. To make it easier to do smash and block techniques, leg muscle power is needed to produce a good jump. To increase leg muscle power, one of the exercises is pliometric exercises. The thing that needs to be considered in increasing vertical jump training is the development of explosive power [9].

The plyometric training method is an exercise method that can be used to improve the biomotor freshness of athletes, including strength and speed which has a very wide application in sports activities. In particular, this exercise is very beneficial for increasing power [10].There are several kinds of pliometric exercises, the forms of pliometric exercises that will be studied in this study are squat jump and double leg bound. Pliometric squat jump exercises can strengthen leg muscle endurance and body balance. While double leg bound exercises are exercises to develop leg and hip muscle power.

Plyometric exercises help develop the entire neuromuscular system for power movements, not just contracting tissues. The plyometric exercise program should be given more recessive, temporal and special weights [11]. The exact excess load is determined by controlling the height of the athlete's descent or fall, the load used and the distance traveled. Improper overload can interfere with the effectiveness of exercise or even cause injury [12].
Material and methods

This research was be carried out in the courtyard of SMP Negeri 3 Karanganyar, Jalan Lawu No. 86, Ngarjosari, Karanganyar Regency, Central Java. The experimental method is chosen to determine certain symptoms through the treatment carried out on the experimental sample. An experiment is a pattern that allows researchers to simultaneously study the influence of two or more types of experimental variables.

A factorial experiment is an experiment that involves a number of factors of many levels. In this study, the experimental design was with two factors, each of which consisted of two levels. A factor is combined or crossed with all levels of each factor in the experiment. In factorial design two or more variables are manipulated simultaneously to determine the influence of each on the dependent variable, in addition to the influence caused by interactions between variables. The form of factorial design of this study can be described in the label matrix as follows:

<table>
<thead>
<tr>
<th>Gender</th>
<th>Exercise</th>
<th>Plyometric exercises</th>
<th>Squat jump (A1)</th>
<th>Double leg box bound (A2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (B1)</td>
<td>A1B1</td>
<td>A2B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woman (B2)</td>
<td>A1B2</td>
<td>A2B2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Information:
A1B1 : exercise Squat jump with a group of male students.
A2B1 : exercise Double Leg Box Bound with a group of male students.
A2b2 : exercise Double Leg Box Bound with female students.

This research was be carried out for six weeks starting on February 5, 2024 to March 16, 2024 with a frequency of meetings three times a week on Monday, Wednesday and Friday. As for the reason it is done three times a week that learning three times per week will provide an opportunity for the body to adapt to the load received. The meeting will be held outside school hours, namely in the afternoon at 15.30 – 17.00 WIB, with the aim of not disturbing the teaching and learning process. Overall, the treatment activities lasted for 18 meetings.

Results

The purpose of this study can be achieved by taking data on a predetermined sample. In this study to determine the increase in height achievement in volleyball games with squat jump training and double leg box bound exercises. In addition, the impact is also compared based on male and female gender. The summary of the results of the overall data analysis is presented in the form of a table 2.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Testing period</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man</td>
<td>Pretest</td>
<td>20</td>
<td>207</td>
<td>241</td>
<td>220.8</td>
<td>8.95</td>
</tr>
<tr>
<td></td>
<td>Posts</td>
<td>20</td>
<td>213</td>
<td>246</td>
<td>226.25</td>
<td>9.07</td>
</tr>
<tr>
<td></td>
<td>Difference</td>
<td>20</td>
<td>4</td>
<td>7</td>
<td>5.45</td>
<td>0.75</td>
</tr>
<tr>
<td>Woman</td>
<td>Pretest</td>
<td>20</td>
<td>210</td>
<td>239</td>
<td>216.1</td>
<td>7.00</td>
</tr>
<tr>
<td></td>
<td>Posts</td>
<td>20</td>
<td>216</td>
<td>244</td>
<td>222.35</td>
<td>6.69</td>
</tr>
<tr>
<td></td>
<td>Difference</td>
<td>20</td>
<td>5</td>
<td>12</td>
<td>6.25</td>
<td>1.55</td>
</tr>
</tbody>
</table>

The results of descriptive statistical testing in the table above show that the average value of the high pretest achievement in men is 220.8 cm with a standard deviation value of 8.95 cm. The high pretest minimum score in men was 207 cm and the maximum score was 241 cm.

The results of descriptive statistical testing in the table above show that the average value of high postes achieved in men is 226.25 cm with a standard deviation value of 9.07 cm. The high postes minimum score in men was 213 cm and the maximum score was 246 cm.

The results of descriptive statistical testing in the table above show that the average value of high difference in achievement in men is 5.45 cm with a standard deviation value of 0.75 cm. The minimum score of the high difference in men is 4 cm and the maximum value is 7 cm.

The results of descriptive statistical testing in the table above show that the average value of the high pretest achievement in women is 216.1 cm
with a standard deviation value of 7.00 cm. The high pretest minimum score in women was 210 cm and the maximum score was 239 cm.

The results of descriptive statistical testing in the table above show that the average value of high post-test achieved in women is 222.35 cm with a standard deviation value of 6.69 cm. The high post-test minimum score in women was 216 cm and the maximum score was 244 cm.

The results of descriptive statistical testing in the table above show that the average value of the high difference in achievement in women is 6.25 cm with a standard deviation value of 1.55 cm. The minimum score is a high difference in achievement in women of 5 and the maximum value of 12.

Table 3
Reliability Test of different between indicators of jump (cm) in men and women groups

<table>
<thead>
<tr>
<th>No</th>
<th>Variable</th>
<th>Alpha Cronbach</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pretest</td>
<td>0.974</td>
<td>Reliable</td>
</tr>
<tr>
<td>2</td>
<td>Post-test</td>
<td>0.995</td>
<td>Reliable</td>
</tr>
</tbody>
</table>

Reliability test results of pretest and postes questionnaires. calculated by the Cronbach Alpha Coefficient formula, the R-count values are 0.974 and 0.995, respectively. A questionnaire is said to be reliable if the r-count value > 0.60. The results of reliability calculations show that both have a calculated r value of > 0.60. Based on the above criteria, it can be concluded that the questionnaire pretes and postes. declared reliable.

To determine whether there is a significant increase in peak lactate treatment and lactate tolerance, a paired t-test is used. The results of the meeting are as follows:

Squat jump in men

Based on the information on the normality test to determine whether there was a decrease in the squat jump group in men, the statistical test used was the Wilcoxon test, the results of the meeting were as follows.

Table 4
Testing of jump increase (cm) in men group

<table>
<thead>
<tr>
<th>Squat Jump In Men (Cm)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase Of Testing</td>
<td>Mean</td>
<td>Z Count</td>
<td>Sig.</td>
</tr>
<tr>
<td>Pretest</td>
<td>227.5</td>
<td>-2.859</td>
<td>0.004</td>
</tr>
</tbody>
</table>

Based on the above testing, it is known that the initial high score of the squat jump group in men was 227.5 then increased to 233.1. An increase was obtained by 5.6. When compared, it is concluded that the postes value is higher than the pretest value, this means that there is an increase in the height of achievement in the squat jump group in men. Statistical testing using the Wilcoxon test obtained a Z count of -2.859 with a probability value of 0.004 probability value of < 0.05 which means there is a significant increase in the height of achievement in the squat jump group in men.

Double leg box bound in males

Based on the information on the normality test to determine whether there is a decrease in the double leg box bound group in men, the statistical test used is a paired t test. The results of the match are as follows.

Table 5
Testing of increased height of jumps (cm) in the double leg box bound group in men

<table>
<thead>
<tr>
<th>Double Leg Box Bound In Males</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase</td>
<td>Mean</td>
<td>t Count</td>
<td>Sig.</td>
</tr>
<tr>
<td>Pretest</td>
<td>214.1</td>
<td>-20.358</td>
<td>0.000</td>
</tr>
<tr>
<td>Postes</td>
<td>219.4</td>
<td>5.3</td>
<td></td>
</tr>
</tbody>
</table>

Based on the test above, it is known that the initial high score of the double leg box bound group achievement in men was 214.1 then increased to 219.4. An increase was obtained by 5.3. When compared, it is concluded that the postes value is higher than the pretest value, this means that there is an increase in the achievement height in the double leg box bound group in men. Statistical testing using paired t tests obtained t count of -20.358 with a probability value of 0 probability value < 0.05 which means there is a significant increase in achievement height in the double leg box bound group in men.

Squat jump in women

Based on the information on the normality test to determine whether there was a decrease in the squat jump group in women, the statistical test used
was the Wilcoxon test, the results of the study were as follows.

**Table 6**

Testing of increased height in the squat jump (cm) group in women

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mean</th>
<th>Z Count</th>
<th>Sig.</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>220.6</td>
<td>-2.842</td>
<td>0.004</td>
<td>Significant</td>
</tr>
<tr>
<td>Postes</td>
<td>226.4</td>
<td>6.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased</td>
<td>5.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on the above testing, it is known that the initial high score of the squat jump group in women was 220.6 then increased to 226.4. An increase was obtained by 5.8. When compared, it is concluded that the postes score is higher than the pretest value, this means that there is an increase in the height of achievement in the squat jump group in women. Statistical testing using the Wilcoxon test obtained a Z count of -2.842 with a probability value of < 0.05, which means there is a significant increase in achievement height in the squat jump group in women.

**Percentage increase**

**Table 7**

Results of testing of increased jump height (cm) in the double leg box bound group in women

<table>
<thead>
<tr>
<th>Testing phase</th>
<th>Mean</th>
<th>t count</th>
<th>Sig.</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>220.6</td>
<td>-10.579</td>
<td>0.000</td>
<td>Significant</td>
</tr>
<tr>
<td>Postes</td>
<td>218.3</td>
<td>6.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased</td>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on the above test, it is known that the initial high score of the double leg box bound group achievement in women was 211.6 then increased to 218.3. An increase of 6.7. When compared, it is concluded that the postes value is higher than the pretest value, this means that there is an increase in achievement in the double leg box bound group in women. Statistical testing using paired t tests obtained t count of -10.579 with a probability value of 0.000, a probability value of < 0.05 which means there is a significant increase in achievement height in the double leg box bound group in women.

**Table 8**

Increase of Jump height

<table>
<thead>
<tr>
<th>Cell</th>
<th>Label</th>
<th>Pretest</th>
<th>Postes</th>
<th>Difference</th>
<th>Percentage different (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Squat jump, cm</td>
<td>224.05</td>
<td>229.75</td>
<td>5.7</td>
<td>2.544</td>
</tr>
<tr>
<td>A2</td>
<td>Double leg Box Bound, cm</td>
<td>212.85</td>
<td>218.85</td>
<td>6.0</td>
<td>2.819</td>
</tr>
<tr>
<td>B1</td>
<td>man</td>
<td>220.8</td>
<td>226.25</td>
<td>5.45</td>
<td>2.468</td>
</tr>
<tr>
<td>B2</td>
<td>woman</td>
<td>216.1</td>
<td>222.35</td>
<td>6.25</td>
<td>2.892</td>
</tr>
<tr>
<td>A1B1</td>
<td>Squat jump in men, cm</td>
<td>227.5</td>
<td>233.1</td>
<td>5.6</td>
<td>2.462</td>
</tr>
<tr>
<td>A2B1</td>
<td>Double leg box bound in males, cm</td>
<td>214.1</td>
<td>219.4</td>
<td>5.3</td>
<td>2.475</td>
</tr>
<tr>
<td>A1B2</td>
<td>Squat jump in women, cm</td>
<td>220.6</td>
<td>226.4</td>
<td>5.8</td>
<td>2.629</td>
</tr>
<tr>
<td>A2B2</td>
<td>Double leg box bound in women, cm</td>
<td>211.6</td>
<td>218.3</td>
<td>6.7</td>
<td>3.166</td>
</tr>
</tbody>
</table>

The high result of achievement in the A1 group (squat jump) was obtained an initial average of 224.05, then after treatment the value became 229.75, an increase in achievement height was obtained by 5.7 if the percentage value was 2.544%.

The high achievement result in group A2 (double leg box bound) was obtained an initial average of 212.85, then after treatment the value became 218.85, an increase in achievement height was obtained by 6 if the percentage value was 2.819%.

The high result of achievement in the B1 group (male) was obtained an initial average of 220.8, then after treatment the value became 226.25, an increase in achievement height was obtained by 5.45 if the percentage value was 2.468%.

The high achievement result in the B2 group (women) was obtained an initial average of 216.1, then after treatment the value became 222.35, an increase in achievement height was obtained by 6.25 if the percentage value was 2.892%.

The high result of achievement in the A1B1 group (squat jump in men) was obtained an initial average of 227.5, then after treatment the value became 233.1, an increase in achievement height was
obtained by 5.6 if the percentage value was 2.462%.

The high result of achievement in the A2B1 group (double leg box bound in men) was obtained an initial average of 214.1, then after treatment the value became 219.4, an increase in achievement height was obtained by 5.3 if the percentage value was 2.475%.

The high result of achievement in the A1B2 group (squat jump in women) was obtained an initial average of 220.6, then after treatment the value became 226.4, an increase in achievement height was obtained by 5.8 if the percentage value was 2.629%.

The high result of achievement in the A2B2 group (double leg box bound in women) was obtained an initial average of 211.6, then after treatment the value became 218.3, an increase in achievement height was obtained by 6.7 if the percentage value was 3.166%.

After being given different treatments, both groups were given a final test, then the final test results of both groups were tested for differences. In this difference test, researchers used a 2x2 factorial ANOVA test. The result is as follows:

In the 2x2 factorial ANOVA test, the author tested 3 hypotheses, namely the influence of factor A, the influence of factor B, and the influence of interactions A and B. The test criterion is that if the probability value < 0.05, it is concluded that there is a difference between group 1 and other groups. Conversely, if the probability value > 0.05, it is concluded that there is no difference between group 1 and other groups. The test results are attached as follows:

**Table 9**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>10.9a</td>
<td>3</td>
<td>3.633</td>
<td>2.506</td>
<td>0.075</td>
</tr>
<tr>
<td>Intercept</td>
<td>1368.9</td>
<td>1</td>
<td>1368.9</td>
<td>944.069</td>
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</tr>
<tr>
<td>JK</td>
<td>6.4</td>
<td>1</td>
<td>6.400</td>
<td>4.414</td>
<td>0.043</td>
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<tr>
<td>Treatment</td>
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<td>0.900</td>
<td>0.621</td>
<td>0.436</td>
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<tr>
<td>JK * treatment</td>
<td>3.600</td>
<td>1</td>
<td>3.600</td>
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<tr>
<td>Error</td>
<td>52.200</td>
<td>36</td>
<td>1.450</td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
<td>1432.0</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>63.1</td>
<td>39</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

R Squared = 0.173 (Adjusted R Squared = 0.104)

In the observation of the male sex group, an increase of 5.45 was obtained while in women 6.25. When compared with the two, it is concluded that the increase in the female group of height increase is greater than the male group. The calculation results using the ANOVA test obtained a probability value of 0.043. Probability value = 0.043 < 0.05 which means there is a significant difference between the female group and the male group. Based on the average comparison and statistical test results, it was concluded that the increase in the height of the female group was significantly higher than the male group. So hypothesis 1 is accepted.

**Discussion**

Efforts to improve the ability or maturity for an athlete, must be held coaching from an early age. Coaching in sports is absolutely necessary in order to perform well in the future [13]. A maximum achievement is influenced by superior seeds, which when done well. Many examples of sports are done to maintain body fitness and also to develop achievements, one of which is the game of volleyball [14].

The different types and varieties of plyometric exercises designed and the understanding of the neuromuscular processes involved, allow us to develop useful plyometric exercises. However, it is not practical to analyze every movement of sports skills and every stimuli of this exercise for the sport performed [15]. Coaches and athletes are expected to know which training is better or right for their achievement needs [16].

Explosive power is one of the ten components of the physical condition. Explosive power is the ability to direct power quickly in a short time to provide the best momentum to the body or object in an explosive movement that is intact to achieve the desired goal [17]. Strength is the ability of a muscle or several muscle groups to optimize strength or movement under certain conditions, which is usually to resist or respond to pressure loads from outside the body [18].

Physical condition is an important element to achieve achievements [19]. Physical condition is related to posture, because having a good posture, body structure and physique is one of the supporting things that are very important for someone to become an athlete [20]. To become an athlete is not only based on high interest, but must meet certain
conditions such as motor, somatic, and good body or physical size so that the desired achievement can be achieved.

The physical conditions of men and women are certainly different in terms of anatomy and physiology, but in terms of physiology the differences are less clear [21]. This anatomical difference causes men to be more capable of carrying out physical activities and sports that require greater strength and other dimensions [22]. But many of these differences can be changed by physical training so that the physiological parameters of trained women can exceed those of less trained men. Women through the influence of the hormone estrogen develop with narrower shoulders, wider pelvis relative to their height compared to men.

Extracurricular activities at SMP N 3 Karanganyar really motivate students in moving and channeling talents in the world of sports. One of the extracurriculars that is in demand at SMP N 3 Karanganyar is volleyball. Researchers made observations and conducted interviews and observations to physical education teachers as volleyball extracurricular coaches with the results of exercises carried out twice a week on Tuesday and Thursday. The exercise that has been done is a jumping exercise up and down stairs. But in the process of training has not been done with a structured exercise program. The results found limb muscle power is still weak.

The plyometric training method has never been used in extracurricular coaching at SMP N 3 Karanganyar. Using appropriate and correct plyometric training methods will increase strength and speed in performing basic volleyball techniques. The plyometric training method, especially squat jump and double leg bound training, is thought to have an influence on leg muscle power. However, to find out how much influence there is and prove which exercises are better and which exercises are suitable for men and women, research is needed to compare, find out the interactions, and which exercises are appropriate for men and women.

In the male sex group, after analysis, a high increase in achievement between pretests and postes was obtained by 5.45 with a percentage of 2.468%. Meanwhile, in the female sex group after analysis, a high increase in achievement between pretests and postes was obtained by 6.25 with a percentage of 2.892%. When compared to the two, the female sex group has a higher percentage increase than the male sex group, which is 2.892% compared to 2.468%. So that the female sex group increased better than the male sex group.

The calculation is statistically obtained F count of 4.414 with a probability of 0.043. The probability < 0.05 which means there is a significant difference in height increase between the male and female sex groups. So that hypothesis 2 "there is a difference in height increase in volleyball games in SMP Negeri 3 Karanganyar students between male and female sex", is accepted.

**Conclusion**

There was a significant difference in height increase between the male and female sex groups. Evidenced by the average increase in the male sex group of 5.45 (2.468%) while in the female sex group of 6.25 (2.892%). As well as the results of the statistical test of the anova test obtained a probability value of 0.043 < 0.05.

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