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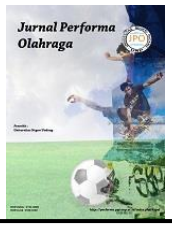

THE EFFECT OF PLYOMETRIC JUMP TO BOX TRAINING ON THE JUMP HEIGHT

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ABSTRACT

This study aimed to assess the impact of plyometric jump to box training on vertical jump height in female basketball athletes from Smandala Mutiara. The research method employed a quasi-experimental design with a one-group pretest-posttest design. The research sample consisted of 30 female basketball athletes from Smandala Mutiara with an average age of 16-18 years. Data analysis was conducted using a t-test with a significance level of 5% (0.05). The intervention in this study involved plyometric jump to box training for 6 weeks, conducted three times a week, aimed at improving vertical jump height. Vertical jump height plays a crucial role in every aspect of basketball, both in defense and offense, and enhances players' technical abilities in various on-court situations. Pretest and posttest data were normally distributed as indicated by the Shapiro-Wilk test (pretest: 0.2, posttest: 0.117). The pretest results for vertical jump test yielded a maximum score of 41, a minimum score of 27, and a mean of 35.47, while the posttest data showed a maximum score of 42, a minimum score of 28, and a mean of 36.30, with an average increase of 0.83. This indicates an improvement in vertical jump height before and after the intervention. The t-test result yielded a calculated t-value of 5.000 > t-table value of 2.045, with p-value of 0.000 < 0.05. The percentage increase in average height was 2.3%. The t-test results indicate that plyometric jump to box training significantly influences the improvement of vertical jump height in female basketball athletes from Smandala Mutiara. Thus, the alternative hypothesis (Ha) is accepted, and the null hypothesis (H0) is rejected. The implication of this research is that plyometric jump to box training affects vertical jump height in female basketball athletes, but the sample size and types of training should be enhanced to further improve athletes' performance.

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INTRODUCTION

Basketball is a continually growing sport globally, especially in the Western states, evident through frequent competitions like the British Basketball League (BBL) in the UK, the National Basketball Association (NBA) in the USA, and the Indonesia Basketball League (IBL) in Indonesia (Sanjaya & Iyakrus, 2022). In Indonesia, basketball is experiencing continuous development and widespread popularity across various regions, reflecting the increasing aspirations to enhance performance in this sport across different areas in the country. Basketball has experienced significant growth, making it a highly popular sport in Indonesia (Candra et al., 2020). The numerous benefits it offers, including physical, mental, and social advantages, as well as the abundance of local and international championships (Yenes et al., 2018), basketball is no longer an unfamiliar sport to the Indonesian community, particularly among students in junior high, senior high schools, college athletes, and even those who are married. This is due to the abundance of basketball competitions in Indonesia, such as the Campus League for college athletes, the Deteksi Basketball League (DBL) for students, and others. This aligns with the government's commitment to popularize sports and engage the community in physical activities, aiming to encourage people to enjoy exercising (Apifa et al., 2020).

Basketball is a team sport that requires team cohesion, played by five players aiming to score as many points as possible by shooting the ball into the opponent's hoop (Wendy Irwan Saputra, 2020). It is a rapidly evolving modern sport (Sari et al., 2017) known and enjoyed by various age groups. Early introduction to sports with proper handling is crucial for achieving peak performance (Iyakrus, 2018). Basketball achievements have seen improvements at regional, national, and international levels, necessitating a focus on good performance during games and mastery of basic basketball techniques (Victorian & Sari, 2019).

In addition to basketball techniques, physical components in basketball players need attention. Agility, power, endurance, speed, and strength significantly impact player performance (Lestari et al., 2021). A fundamental principle in basketball is developing players' physical abilities to the highest level tailored to the game's requirements. Physical components include strength, flexibility, agility, speed, balance, endurance, power, and coordination. In basketball, power plays a crucial role in basketball as it enhances leg muscle capabilities needed for highly essential in the sport. Power is vital for basketball players to develop a range of movements, including different types of jumps, movement acceleration, sudden changes in direction, stopping shooting ball, passing and executing jump shots (Aksović et al., 2020).

The significance of power in basketball, especially during actions like rebounding, layups, and jump shots, underscores the importance of well-developed leg muscles to achieve good jumping height. Training methods, systematically designed considering the training goals, play a key role in enhancing power for good jumping height (Azhar, 2017). Plyometric training is a complex form aimed at improving balance, coordination, reflexes, jumping height, and overall athlete performance (Ramirez-Campillo et al., 2022), commonly used in various sports, including basketball. Hartati (2020) explains that training is a systematic process aimed at preparing athletes for their highest level of performance, involving repetitive sessions with progressively increasing loads. The goal of training is to assist athletes in maximizing their skills and achievements, encompassing four aspects: physical, technical, tactical, and spiritual (Destriana et al., 2021). Heigh jump of players a crucial role in basketball as every technique in the game, whether it's for defense or offense, relies on a strong vertical jump. For instance, in situations like jump balls, rebounding, jump shots, layups, and blocks, a good heigh jump is essential for enhancing the effectiveness of these techniques in basketball game (Nugroho & Gumantan, 2020).

According to the research on the "Analysis of Defense Strategies of Women's Basketball Teams in the Jakarta Student Basketball League 2015" by SINAGA, (2015) employed a descriptive method with observational/survey data collection techniques. Purposive sampling was used to select the women's basketball teams participating in the LIBAMA 2015 championship, specifically the UNJ women's basketball team, comprising 12 players, from a total population of 72 participants representing 6 universities. The research instrument involved observing games and calculating the percentage of success and failure in defense tactics. In conclusion, the overall success rate of utilizing the entire defense system was 64%, with a failure rate of 36%. Man-to-man defense yielded a success rate of 69.8% and a failure rate of 30.1%, while zone defense resulted in a success rate of 58.4% and a failure rate of 41.5%.

Observations during the DBL South Sumatera Series Women's Basketball League in 2022 and 2023 revealed that Smandala Mutiara's team experienced defeat in the finals despite each player possessing good skills and physical endurance. The observations indicated that many players were not maximizing their performance in rebounding and layups due to insufficient jumping height and a lack of leg muscle power. Analysis of their training regimen revealed a deficiency in leg muscle strength training, indicating a lack of awareness of the crucial role of jumping height in basketball. To address this issue, a study is needed to enhance jumping height using plyometric jump to box training and understand its impact on the improvement of jumping height in Smandala Mutiara's women's basketball athletes. This research was conducted to serve as a reference source in the field of sports coaching, particularly in basketball, aiming to enhance vertical jump height through plyometric jump to box training.

METHOD

The research employed a quasi-experimental design, specifically a one-group pretest-posttest design. This design includes a pretest conducted before administering the treatment, ensuring more accurate results by comparing them to the pre-treatment condition. The objective of this study is to determine the presence of any influence between the independent and dependent variables (Sugiyono, 2019: 114). The researcher designated this research method as a quasi-experimental study because it is defined as an experiment involving the administration of treatment and the measurement of its impact, in accordance with the variables studied in the female basketball athletes of Smandala. This study aims to elucidate the cause-and-effect relationship by involving both experimental and control groups, although the allocation of these groups is not through random techniques (Hastjarjo, 2019). Sampling, according to Sugiyono (2018), is a part of the quantity and characteristics possessed by the population. The total sampling technique was used due to the population size being less than 100. According to Sugiyono, (2019)if the population is less than 100, the entire population is considered as the research sample. The sample in this research consisted of 30 female basketball players from

Smandala Mutiara. The research instrument used was the vertical jump test to measure jump height before and after the treatment.

 Vertical Jump Test

The purpose of the vertical jump test is to measure the explosive power of leg muscles (Pasaribu, 2020). The test involves jumping vertically using the full arm reach.

1. Equipment Needed
   a. A scaled board of dimensions 30 x 150 cm mounted on a flat wall or pole.
   b. Chalk powder.
   c. Writing tools.
2. Implementation Procedure
   a. Start by applying chalk powder to the participants' fingertips.
   b. Participants stand upright next to the wall, feet together, with the scaled board on the right or left side of the body. Lift the participant's hand and press it against the scaled board, leaving fingerprint marks.
   c. Participants initiate the test by swinging their arms backward.
   d. Participants then jump as high as possible while tapping the board with the nearest hand, creating chalk marks.
   e. Repeat this test for three attempts without breaks or can be interspersed with other participants.
3. Evaluation
   a. The difference between the achieved jump and the standing reach.
   b. Record the result of the largest difference in the jump test.

Table 1. Vertical Jump Data Norms

Score	Male	Grade	Female
5	>70	Excellent	>48
4	62-69	Good	44-47
3	53-61	Fair	38-43
2	46-52	Poor	33-37
1	38-45	Very Poor	29-32

Source: (Pasaribu, 2020)

Figure 1: Vertical Jump Test
Source: (Pasaribu, 2020)

Data analysis techniques are methods used to obtain and analyze acquired data. This analysis aims to test the validity of the formulated hypothesis, with the acceptance of a hypothesis depending on the data results. Data analysis techniques in this research utilize the assistance of IBM SPSS 29 software.

1. Normality Test
   The normality test serves to examine whether all variables used in the analysis have a normally distributed data spread. If the p-value > 0.05, the data is considered normal; however, if the analysis results show a p-value < 0.05, the data is considered non-normal.

2. Hypothesis Testing
   Hypothesis testing employs the t-test with the assistance of SPSS 29 software, comparing the means between the pretest and posttest. If the calculated t-value is greater than the critical t-value, then the alternative hypothesis (Ha) is accepted. The percentage increase after treatment is determined using the formula as follows (Sumirat & Fauzi, 2019):
   Percentage of Improvement = $\frac{\textit{Mean different}}{\textit{Mean pretest}}$ x 100%

    Mean Different = mean posttest-mean pretest

RESULT AND DISCUSSIONS

Research Result

This study is an experimental research aimed at determining the impact of plyometric jump to box training on the vertical jump height of Smandala Mutiara's female basketball players. The sample for this research consists of 30 female basketball players from Smandala Mutiara. The participants will undergo a pretest, specifically a vertical jump test, before receiving the intervention (jump to box training). The experiment will be conducted over a period of 6 weeks, comprising 16 sessions with a frequency of 3 sessions per week. Subsequently, after the intervention (jump to box training), a posttest, namely the vertical jump test, will be administered to assess any differences in jump height before and after the intervention.

Table 2. Description of Statistic Results Data

		Pretest Jump Height	Posttest Jump Height
N	Valid	30	30
	Missing	0	0
Mean		35.47	36.30
Std. Error of Mean		.709	.659
Median		36.00	37.00
Mode		36	34[a]
Std. Deviation		3.884	3.612
Variance		15.085	13.045
Range		14	14
Minimum		27	28
Maximum		41	42
Sum		1064	1089

Source: SPSS 29.

Based on table 2, the pretest results show a minimum value of 27, a maximum value of 41, a mean of 35.47, a median of 36.00, a mode of 36, with a standard deviation of 3.884, variance of 15.085, range of 14, and a sum of 1064. Meanwhile, the posttest results indicate a maximum value of 42, a minimum value of 30, a mean of 36.37, a median of 37.00, a mode of 34, with a standard deviation of 3.469, variance of 13.054, range of 14, and a sum of 1089.

 Results of Data Analysis

Data analysis is used to address the proposed hypotheses. Before conducting data analysis, it is essential to perform a prerequisite test, namely the normality test. The results of the normality test and hypothesis testing can be observed as follows:

Table 3. Normality Test

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	df	Sig.
Pretest Jump Height		.121	30	.200*	.951	30	.183
Posttest Jump Height		.144	30	.117	.959	30	.285

Source: SPSS 29.

Based on the findings in table 3, both pretest and posttest data have significance values greater than 0.05 (p > 0.05). Therefore, it can be concluded that both sets of data are normally distributed. The pretest and posttest data exhibit normal distribution as the significance values (p) are greater than the alpha level (α), with 0.2 for the pretest and 0.117 for the posttest.

Table 4. T-test Results

Group	Average	t-test for equality of means				
		T hitung	T tabel	Sig	Range	%
Pretest	35,47	5,000	2,045	0,000	0,83	2,3%
Posttest	36,30					

Tables 4, present the results of the t-test. From these results, it is evident that the significance value is 0.000, indicating a significant impact of the treatment on both pretest and posttest outcomes as the significance value is <0.05. Comparing the significant values from the pretest and posttest results to the alpha level (α) reveals that

both are lower. The t-test results show a calculated t-value of 5.000, while the critical t-value (df 29) is 2.045, with a significance value (p) of 0.000. Since the calculated t-value (5.000) is greater than the critical t-value (2.045), and the significance value (0.000) is less than 0.05, it can be concluded that there is a significant impact of plyometric jump to box training on the jump height of Smandala Mutiara's female basketball players. The percentage increase in jump height is 2.3%. Therefore, the alternative hypothesis (Ha) stating "There is a significant effect of plyometric jump to box training on the jump height of female basketball athletes at Smandala Mutiara" is accepted.

Table 5. Comparison of Pretest and Posttest Results

Result	N	Maximum Score	Minimum Score	Mean	Comparison and average increase of Pretest and Posttest
Pretest	30	41	27	35,47	0,83
Posttest	30	42	28	36,30	

Based on table 5, comparing the mean values of the pretest and posttest data, the highest value obtained in the pretest was 41, and the lowest was 27, whereas in the posttest, the highest value was 42 and the lowest was 28. The mean in the pretest data was 35.47, while in the posttest data, it was 36.30, resulting in a difference of 0.83 in the mean values between the pretest and posttest data.

Discussions

This research aims to determine the influence of plyometric jump to box training on the vertical jump height of female basketball athletes at Smandala Mutiara. The entire population of 30 female basketball players from Smandala Mutiara was used as the sample for this study. The participants underwent an initial test (pretest), specifically a vertical jump test, to measure jump height before the intervention. During the vertical jump test, participants had three attempts to achieve their best result. After receiving the plyometric jump to box training, the participants were required to undergo a final test (posttest) – the vertical jump test, with three opportunities to achieve their best result. The posttest aimed to assess the improvement and compare the results with the pretest.

Data analysis revealed that plyometric jump to box training significantly influenced the increase in vertical jump height among Smandala Mutiara's female basketball athletes. The analysis employed a t-test with the assistance of SPSS version 29. The average difference between pretest and posttest was 0.83 cm, indicating an increase in jump height. This suggests an enhancement in explosive power after six weeks of plyometric jump to box training, conducted three times a week. Training at this frequency, particularly for beginners, is deemed suitable and results in a meaningful improvement (Sumirat & Fauzi, 2019). Plyometric training aims to integrate speed and strength movements to generate explosive actions, allowing muscles to reach maximum strength in the shortest possible time. The training involves movements to strengthen muscle tissues and train nerve cells to produce contractions with specific patterns, enabling muscles to contract as strongly as possible in a brief period.

Statistical analysis was chosen for this study since the obtained data represent test scores from an experimental group using a pretest and posttest one-group design. The data for analysis were obtained from both the pretest and posttest. Based on the pretest data, the jump height had a minimum value of 27, a maximum value of 41, a mean of 35.47, a median of 36.00, a mode of 36, with a standard deviation of 3.884, variance of 15.085, range of 14, and a sum of 1064. The posttest results showed a maximum value of 42, a minimum value of 30, a mean of 36.37, a median of 37.00, a mode of 34, with a standard deviation of 3.469, variance of 13.054, range of 14, and a sum of 1089. The mean difference between pretest and posttest was 0.83 cm, indicating an improvement in jump height. The data analysis began with a normality test using the Kolmogorov-Smirnov formula as a prerequisite for the t-test. The normality test was conducted to determine whether the data distribution was normal. The results indicated that both pretest and posttest data were normally distributed, as the significance values (p) were greater than α (0.05), with 0.200 for the pretest and 0.117 for the posttest.

As the prerequisite for using the t-test, which is parametric and requires normal data distribution, was met, the hypothesis testing using the t-test proceeded. The research conclusion would be considered significant if the calculated t-value > the critical t-value at a 5% significance level. The t-test results showed a calculated t-value of 5.000, with a 5% significance level (0.05). The critical t-value with df = 29 at a 5% significance level (0.05) was 2.045. Since the calculated t-value (5.000) exceeded the critical t-value (2.045), and the significance value (p) was 0.00 < 0.05, it was concluded that the plyometric jump to box training had a significant effect. The pretest had an average of 35.47 cm, while the posttest had an average of 36.30 cm. The magnitude of the jump height increase was observed through the mean difference of 0.83 cm, with a percentage increase of 2.3%.

The alternative hypothesis (Ha) stating "There is a significant influence of plyometric jump to box training on the vertical jump height of Smandala Mutiara's female basketball athletes" is accepted, rejecting H0. The t-test results indicate a significant effect of plyometric jump to box training on the increase in vertical jump height for Smandala Mutiara's female basketball players. The jump to box exercise can enhance the vertical jump height for Smandala Mutiara's female basketball athletes by stimulating muscles to contract effectively in both

lengthening (eccentric) and shortening (concentric) phases, following the principles of plyometric training. With repetitive movements, this training improves the power of the leg muscles. Muscle power is the result of maximal muscle strength in the shortest possible time (Zakaria et al., 2018), allowing muscles to generate explosive movements.

Jump to box is a plyometric exercise designed to enhance leg muscle power. The box jump exercise entails executing a jump where both feet leave the ground simultaneously, propelling the body upward, with the aim of landing safely on a designated elevated surface, typically a box or platform (Zainuddin, 2022). Plyometric jump to box training influences vertical jump height as a physiological measure of muscle power. It triggers the stretch reflex, a rapid response to the level of muscle stretch, directly involving sensory receptors in the muscle (muscle spindle) with the spinal cord and the respective muscle (Abdillahtulkhaer, 2016). Arif & Alexander (2019) emphasize that plyometric jump to box training is a suitable alternative for improving leg muscle power, utilizing methods that effectively develop leg muscle power. This exercise is highly effective in increasing leg muscle power, resulting in improved jumps. Plyometric training is a complex exercise aimed at enhancing balance, coordination, reflex movements, increasing jump height, and overall athlete performance (Ramirez-Campillo et al., 2022).

Exercise is a systematic, regular, progressive, and repetitive sporting activity over an extended period aimed at improving physiological and psychological functions to achieve better performance than before (Kusuma et al., 2018). Regular and progressively intensified training enhances leg muscle power over time, leading to increased jump height. According to (Sumirat & Fauzi, 2019), consistent training over 6-8 weeks brings about physical improvements as the body adapts to the provided exercises. Physically applied training, when systematic and measured with appropriate frequency and duration, induces changes in the ability to produce greater energy and improves physical performance. The impact of training is noticeable within a 6-8 week timeframe, with a frequency of 3 sessions per week (Tyas et al., 2019). Plyometric jump to box training significantly influences the improvement of leg muscle power through disciplined training over 6 weeks with a frequency of 3 times a week. Regular and sufficiently timed physical training causes changes in the ability to produce more significant energy and enhances physical performance.

However, in this study, plyometric jump to box training did not entirely influence the overall sample. Some data did not show improvement due to factors such as a decline in athletes' physical conditions and external issues beyond the structured training program, such as being unable to attend training systematically, regularly, and progressively. This situation led to decreased results in the final test (posttest). Iyakrus (2018) emphasizes that consistent and continuous physical training within a program improves physical abilities significantly, but irregular training may not yield the same results. Training methods are systematically planned ways to present sports activities aimed at developing motor skills (Azhar, 2017). Aditya (2016) asserts that training programs and exercise methods can enhance athletes' physical condition. Therefore, maintaining good physical condition and regularly following a 6-8 week training program with a frequency of 3 sessions per week will yield specific results, as the body adapts to the provided training, influencing the given treatment. Effective training must be directed, systematic, and regular to achieve training goals (Juntara, 2019).

Thus, the data obtained from the research sample did not successfully prove the influence between the independent variable (X) and the dependent variable (Y). In other words, it does not mean that the independent variable (X) has no effect on the dependent variable (Y) because not all the data obtained showed improvement; there were instances of data that decreased, not supporting the hypothesis. Points out that the research's goal is to test whether existing theories can be applied to the research object within the predetermined research period. This implies a need for coaches and future researchers to pay more attention to maintaining the physical condition of their athletes, implementing treatments more discipline and systematically for 18 sessions.

Physical activities, such as exercises, aim to improve physical fitness, develop physical and motor skills, promote a healthy lifestyle, and enhance emotional intelligence (Destriani et al., 2019). The general goal of training is to assist coaches, sports educators in applying conceptual skills to help athletes reach their peak performance (Sanjaya & Iyakrus, 2022). Every basketball player is required to master techniques, physical fitness, and tactics, necessitating repeated training with increasing loads. The main principle in basketball is the development of players' physical fitness to the highest level tailored to the game's needs. Basic physical components include strength, flexibility, agility, speed, balance, endurance, power, and coordination. In basketball, power plays a crucial role in improving leg muscle abilities necessary for the sport (Yaqin & Wismanadi, 2013). Power is vital in basketball, especially when players engage in rebounding, layups, and jump shots, requiring excellent leg muscle power to achieve a good jumping height. Power is the muscle's ability to exert strength and speed maximally in the shortest possible time. Plyometric jump to box training is a suitable alternative for enhancing leg muscle power since this training method effectively improves power capabilities. Plyometric exercises are known to boost muscle explosiveness (Wanena, 2018). Based on this research, plyometric jump to box training, when applied systematically, repeatedly, and disciplined within a well-programmed structure, can enhance leg muscle power, resulting in improved jump height.

CONCLUSION

Based on the previously outlined research findings and data analysis, along with the conducted normality test and hypothesis testing using t-test, the obtained results show that the t-value is greater than the critical t-value (5.000 > 2.045), and the significance value (p) is less than 0.05 (0.00 < 0.05). The average difference between pretest and posttest data is 0.83 cm, indicating an increase, with a percentage improvement in jump height of 2.3%. Therefore, the alternative hypothesis (Ha) is accepted, leading to the conclusion that plyometric jump to box training significantly influences the improvement of jump height in Smandala Mutiara's female basketball athletes. For future researchers, it would be beneficial to incorporate a wider variety of training exercises and expand the sample size to ensure more precise findings. This approach would enable a closer alignment between the training objectives and the coach's targets. By including a broader range of exercises and a larger number of participants, researchers can gather more comprehensive data, leading to a more thorough understanding of the effectiveness of different training methods.

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