

## **Effects of plyometric exercise and motivation on the explosive power of volleyball players' limb muscles**

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### **Abstract**

This study aims to explore the effect of plyometric training forms, namely Depth Jump and Jump to Box, as well as training motivation on the explosive ability of volleyball players of Club Putra Kubang Jaya. Using a quasi-experimental method with a treatment design by Level 2 x 2, the population in this study was 20 people who were still actively training volleyball players from the Putra Kubang Jaya Club. The sample is 20 people with the sampling technique is total sampling. Training motivation data was measured using questionnaires, while volleyball players' explosive power ability was measured through vertical jump tests. Data analysis was performed using two-path ANOVA at significance level  $\alpha=0.05$  and Shapiro-Wilk Sig. normality test  $> 0.05$ , followed by the Tukey test. The results of the data analysis showed that: 1) Sig.  $0.00 < 0.05$  were obtained, There are differences in the effect of plyometric depth jump training forms and jump to box plyometric training forms on the explosive power of leg muscles of volleyball players of Putra Kubang Jaya Club Pekan Baru City. 2) The results of Sig.  $0.00 < 0.05$  were obtained, There was an interaction between the form of plyometric depth jump training, the form of plyometric jump to box training, and the motivation to train on the explosive ability of the leg muscles of volleyball players of the Kubang Jaya Men's Club in Pekan Baru City. 3) Sig.  $0.00 < 0.05$  was obtained, In the high motivation group, the plyometric depth jump training form was more effective than the jump-to-box plyometric exercise form of volleyball players of the Putra Kubang Jaya Club, Pekan Baru City. 4) Sig.  $0.012 < 0.05$  was obtained, in the low training motivation group, the plyometric jump-to box exercise form was more effective than the plyometric depth jump exercise form to increase the explosive ability of the leg muscles of volleyball players of the Putra Kubang Jaya Club, Pekan Baru City. Thus, this study concluded that the plyometric form of the Depth Jump exercise was more effective for increasing the explosive power ability of leg muscles in the high-motivation group, while the Jump to Box was more effective for the low-motivation training group.

**Keywords:** Limb muscle explosiveness, Volleyball, Plyometric exercise, Motivation to train

### **INTRODUCTION**

Physical ability is a crucial aspect in the world of sports, including volleyball. Volleyball athletes need a variety of physical abilities to face challenges in the game, as well as to achieve optimal performance. Good physical ability can give players a competitive edge, allowing them to optimize the techniques, strategies, and tactics of the game. One very important physical component in volleyball is the explosive power of the leg muscles. The explosive power of leg muscles plays a central role in performing quick jumps, punches, and lateral movements, all of which are essential in the game of volleyball (Ahmadi et al., 2021; Vassil & Bazanovk, 2012).

Volleyball requires a combination of various physical components to achieve optimal performance. Some important physical components include 1) Explosive Power Needed to perform high jumps in attacks and blocks, as well as for powerful and accurate hits. 2) Agility is Important for

rapid lateral movement and reaction to the opponent's movement. 3) Core Muscle Strength Needed to maintain body stability while performing complex movements and avoid injury. 4) Stability and Balance It is important to control the body when performing rapid movements and sudden changes in direction. 5) Arm Muscle Strength Needed to punch and serve with maximum power. 6) Cardiovascular Endurance Increases endurance during intense matches.

The Importance of Limb Muscle Explosive Power in Volleyball, The explosive power of leg muscles has a vital role in the game of volleyball. The ability to make high jumps and move quickly is an essential element in attack, defense, and blocking. High jumps allow players to reach higher points on the net, both when attacking and blocking opponents. The ability to hit the ball with power and accuracy also depends on the explosive power of the limb muscles. Therefore, an increase in the explosive power of the leg muscles can have a positive impact on the overall performance of a volleyball player (Çankaya et al., 2018; Maćkała et al., 2021).

Practice motivation has an important role in the world of sports, including volleyball. High motivation can increase training consistency, perseverance, and dedication of players to improving performance. Motivated volleyball players tend to be more focused and eager to develop their physical and technical abilities. Motivation can also help overcome challenges, injuries, and fatigue that may occur during practice and matches.

Preliminary studies in the field of sports psychology have shown that psychological factors such as motivation, mental endurance, concentration, and self-confidence can affect athletes' performance. In the context of volleyball, highly motivated players tend to be more committed to practice, more willing to take risks in the game, and have a better ability to cope with mental stress. Therefore, understanding the relationship between motivation and other psychological aspects of the performance of volleyball athletes is important to improve the quality of training and matches (Correia et al., 2020; Gül et al., 2019).

The explosive power of the leg muscles is the key to the success of volleyball athletes in achieving optimal performance in jumps, punches, and other movements that require muscle explosive power (Hariadi & Hanief, 2023; Yudi & Anggara, 2021). However, the Putra Kubang Jaya Club faces challenges in overcoming the low motivation to train and the explosive ability of athletes' leg muscles, which can affect development potential and achievement in volleyball games. Although few studies have looked at the effect of plyometric training or training motivation on explosive power, this study has important urgency in identifying effective strategies to increase the training motivation and explosive power of volleyball players' leg muscles, to improve individual and collective performance in competition, particularly in volleyball athletes Club Putra Kubang Jaya. Therefore, this incisive background highlights the importance of looking at the interaction between plyometric forms of exercise and training motivation in the context of the sport of volleyball. This study aims to understand how these two factors interact with each other and contribute to increasing the explosive power of leg muscles in volleyball players of Club Putra Kubang Jaya, to provide valuable guidance for efforts to improve athlete performance and club achievements in this sport.

Research on the effect of plyometric exercise and motivation on limb muscle explosive power in volleyball athletes has attracted the attention of researchers and sports coaches (Arte et al., 2019; Renanto & Saputra, 2023). Several previous studies have revealed the benefits of plyometric exercise in increasing muscle explosive power, and most studies have also highlighted the important role of exercise motivation in achieving optimal results (Islam, 2019; Novita et al., 2022). However, research that combines these two factors comprehensively in volleyball players, especially in the Putra Kubang Jaya Club, is still limited. Therefore, understanding how the interaction between plyometric forms of exercise and training motivation can affect the explosive power ability of leg muscles in volleyball athletes is an interesting aspect for further investigation. This research is expected to make a significant contribution to complement existing knowledge and provide deep insight into efforts to develop more effective and targeted training to improve the performance of volleyball athletes of Club Putra Kubang Jaya.

To overcome the challenge of low motivation to train and improve the explosive ability of the leg muscles of volleyball players at the Kubang Jaya Putra Club, this study offers the use of two different forms of plyometric exercises: Depth Jump and Jump to Box. 1) Depth Jump, This exercise involves jumping from a low height, then immediately performing the highest jump possible after touching the ground. This exercise aims to develop the explosive power of the limb muscles, optimize

coordination, and stimulate rapid neuromuscular responses. 2) Jump to Box, This exercise involves jumping over a higher surface, such as a box jump. Players will focus on height and stepping accuracy. This helps develop the explosive power of leg muscles and hone movement coordination.

In addition, to increase training motivation, the following approaches can be given: 1) Clarity Goal Delivery: Posing specific and measurable practice goals to players, such as increasing the stepping height or number of points in the game, can increase motivation because there are clear goals to achieve. 2) Giving Positive Feedback: Giving positive feedback on the improvement of players' abilities and achievements regularly can increase their confidence and motivation. 3) Varied Exercises: Integrating variety in an exercise program, such as play practice or team practice with competitive elements, can help maintain motivation levels by making exercise more interesting and fun. 4) Acknowledging Achievements: Acknowledging and rewarding players' efforts and achievements in training and matches can increase their sense of self-worth and motivation to keep trying better. 5) Developing Team Bonds: Building positive relationships between fellow players and coaches through off-field activities, such as social gatherings or discussion sessions, can help strengthen team bonds and encourage shared spirit.

With the right combination of plyometric training forms and an effective motivational approach, it is hoped that volleyball players at Club Putra Kubang Jaya can overcome the challenges faced and achieve significant improvements in training motivation and leg muscle explosiveness, resulting in significant performance improvements in competition (Natas, 2018; Shaalan et al., 2022). The results of this study are expected to provide invaluable guidance for coaches and sports managers in designing more effective and player-oriented exercise programs to increase the explosive power of leg muscles to the maximum. With the aim of a strong evaluation to improve the performance of Putra Kubang Jaya volleyball athletes, this research is a significant step forward to optimize the potential and achievements of athletes in the world of volleyball.

Therefore, this study aims to examine the effect of two forms of plyometric exercise, namely Depth Jump and Jump to Box, as well as training motivation on the explosive ability of leg muscles in volleyball players of Club Putra Kubang Jaya. This research is expected to provide in-depth insight into the most effective combinations to increase the explosive power of leg muscles and make an important contribution to the development of more effective and targeted training programs in improving the performance of volleyball athletes at Club Putra Kubang Jaya.

## **METHOD**

This study used a quasi-experimental design with a treatment design by Level 2 x 2 to reveal the effect of plyometric training forms and training motivation on the explosive power of leg muscles of volleyball players of Club Putra Kubang Jaya. The population sample in this study was 20 people who were still active volleyball players from the Putra Kubang Jaya Club. The sample is 20 people with the sampling technique is total sampling. Training motivation data were measured using questionnaires that had been adapted from previous studies, while limb muscle explosive ability was measured using standardized vertical jump tests.

To collect data in this study using two instruments, namely using questionnaires and using tests. 1. Training motivation, To obtain data on training motivation in Kubang Jaya club volleyball players, a training motivation questionnaire was first tested. Then this questionnaire was validated first by experts with as many as 52 items. 2. Test the explosive ability of leg muscles in volleyball, To measure the explosive ability of leg muscles using vertical jump. 3. The process in research, For the implementation of the research process to run smoothly with what is expected, a design must be prepared for the treatment of the sample. The following design:

a) Volleyball Training Time as a whole, Exercises are given as many as 16 meetings, with 4 times a week of practice. Treatment is only with the final test. This study is approximately 1 month of research. b) Length of time for training (treatment) The length of time for face-to-face meetings at each meeting is 90 minutes, after the initial test the sample is treated (treatment). Treatment is given in the form of plyometrics depth jump exercises and plyometrics jump-to-box exercises. The explanation can be seen in the following table:

Table 1. Exercise Program Activities

No	Forms of Exercise	Training Unit	Time
1.	Introduction	Warming up <ul style="list-style-type: none"> <li>- Stretching</li> <li>- Jogging</li> <li>- Gymnastics</li> </ul> The trainer explains the training material	15 minute
2.	Core Activities	Plyometrics t depth jump and jump to box exercises	60 minute
3.	Cover	Cooling down	15 minute

c) Post-test: The final test is conducted after sixteen meetings. The purpose of the final test was to see the improvement in the explosive ability of the leg muscles of the men's club volleyball players kubang jaya.

The data obtained were then analyzed using two-path variance analysis (ANOVA) with a significance level of  $\alpha=0.05$  to evaluate the influence of both factors and the interaction between them. After data analysis, Tukey's follow-up tests will be conducted to identify significant differences between treatment groups. The use of the Shapiro-Wilk normality test is also carried out to ensure the normality assumption is met. This study includes systematic and structured procedures to ensure the validity and reliability of research results and provides more comprehensive guidance in revealing the influence of these two important factors on leg muscle explosive power in Club Putra Kubang Jaya volleyball players.

## RESULTS AND DISCUSSION

### Result

#### a. Variance Analysis Testing

The inferential analysis used in this study is the Analysis of Two-Road Variance with Interaction (ANOVA). Then, proceed with the test of the difference in the average value of the two treatment groups. For this form of analysis, several requirements are needed regarding the data to be analyzed. Those requirements include randomness of sample data, data coming from normally distributed populations, and data from treatment groups coming from homogeneous populations. The randomness test of sample data is based on the assumption that the sample subjects in each treatment group are randomly selected from the study population.

##### 1. Normality Test

Fulfillment of the requirement that the sample data come from a normal distribution population is carried out by testing the normality of the data using the Levene test. Fulfillment of the homogeneous requirement of population variance for the entire treatment group was performed using the Bartlett test at the significance level  $\alpha=0,05$ .

Table 2. Two-Way Anova Normality Test Results Research Data Distribution

Tests of Normality						
	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statisti c	Df	Sig.	Statisti c	df	Sig.
Depth Jump	.219	10	.193	.864	10	.085
Jump to Box	.104	10	.200*	.986	10	.989
High Training Motivation	.198	10	.200*	.904	10	.244
Low Motivation to Train	.181	10	.200*	.915	10	.315

Based on the table above, it shows that all data groups tested for normality with the Shapiro-Wilk test give a Sig. value that is greater than a Ltable value of 0.05. Thus it was concluded that all data groups in this study were normally distributed.

2. Test Homogeneity of Variance

The homogeneity test in this study using Levene's test was carried out on (a) two treatment groups A1 and A2, (b) two attribute groups B1 and B2, and (c) four groups of cells in the experimental design A1B1, A1B2, A2B1, A2B2. Testing the homogeneity of variance through the Sig. approach with testing criteria accepts H0 if Sig. > 0.05 which means homogeneous variance and H0 rejected if Sig. < 0.05 which means inhomogeneous variance. Tested at confidence level  $\alpha = 0.05$ . The results of the calculation and test of the significant variance of each group of data can be summarized in the table below:

Table 3. Two-Way Anova Homogeneity Test Results Research Data

Levene's Test of Equality of Error Variances			
Dependent Variable: Dayaledak			
F	df1	df2	Sig.
1.613	3	16	.226
Tests the null hypothesis that the error variance of the dependent variable is equal across groups.			

Based on the table above, the homogeneity test result with the test criteria is to accept H0 Sig.  $0.226 > 0.05$  which means homogeneous variance with significance  $\alpha = 0.05$ . Thus it can be concluded that all four groups of data are Homogeneous.

**b. Hypothesis Testing**

Hypothesis testing using a two-track Analysis of Variance (ANOVA). Furthermore, if there is an interaction between plyometrics dept jump training, the form of jump to box training, and training motivation on the explosive power of the leg muscles of volleyball players Puta Kubang Jaya. The purpose of the two-track Analysis of Variance (ANOVA) is to determine how the independent variable affects experimental results and to determine the effect of interactions from treatment. For more details, the results of hypothesis testing can be seen in the table below:

Table 4 Summary of Two-Line ANOVA calculation results

Tests of Between-Subjects Effects						
Dependent Variable: Dayaledak						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	
Corrected Model	632.150 <sup>a</sup>	3	210.717	43.003	.000	
Intercept	90720.450	1	90720.450	18514.378	.000	
Form _ Exercise	22.050	1	22.050	4.500	.050	
Motivation _ Practice	490.050	1	490.050	100.010	.000	
Form _ Exercise * Motivation _ Practice	120.050	1	120.050	24.500	.000	
Error	78.400	16	4.900			
Total	91431.000	20				
Corrected Total	710.550	19				
a. R Squared = .890 (Adjusted R Squared = .869)						

Based on the calculation results presented in the two-lane ANOVA table above, it can be argued that in making decisions, which is the basis for two-lane ANOVA:

1. If the value of Sig. < 0.05, then there is a difference in vertical jump results based on factor variables.

2. If the value of Sig. > 0.05, then there is no difference in vertical jump results based on factor variables.

To answer the research hypothesis, you must look at the value of Sig. which is compared to 0.05.

- a. Sig. 0.05 < 0.05 were obtained, so it can be concluded that "there are differences in a vertical jump of Putra Kubang Jaya players based on the form of Pliometric training given".
- b. Sig. 0.00 < 0.05 were obtained, so it can be concluded that "there is a significant interaction between plyometric training forms and training motivation towards vertical jump results".

With the proof of the research hypothesis which states that there is a significant interaction between the form of plyometrics dept jump and jump to box training and the motivation to train the legs of the leg muscles of volleyball players Putra Kubang Jaya, a further test was carried out (Tukey Test).

Table 5. Summary of Analysis of Variance (ANOVA) Test Results with Tukey Test

<b>Multiple Comparisons</b>						
Dependent Variable: Daya Ledak						
Tukey HSD						
(I) Post Hoc	(J) Post Hoc	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A1B1	A1B2	7.00*	1.400	.001	2.99	11.01
	A2B1	14.80*	1.400	.000	10.79	18.81
	A2B2	12.00*	1.400	.000	7.99	16.01
A1B2	A1B1	-7.00*	1.400	.001	-11.01	-2.99
	A2B1	7.80*	1.400	.000	3.79	11.81
	A2B2	5.00*	1.400	.012	.99	9.01
A2B1	A1B1	-14.80*	1.400	.000	-18.81	-10.79
	A1B2	-7.80*	1.400	.000	-11.81	-3.79
	A2B2	-2.80	1.400	.229	-6.81	1.21
A2B2	A1B1	-12.00*	1.400	.000	-16.01	-7.99
	A1B2	-5.00*	1.400	.012	-9.01	-.99
	A2B1	2.80	1.400	.229	-1.21	6.81
Based on observed means.						
The error term is Mean Square(Error) = 4.900.						
*. The mean difference is significant at the 0.05 level.						

Based on the Analysis of Variance (ANOVA) table and Tukey Test, the hypotheses that can be analyzed are as follows:

1. The first research hypothesis states that overall there is a difference in the effect of the dept jump exercise form is higher than that trained with the jump to box exercise form.
2. The second research hypothesis states that there is an interaction between the form of plyometric training and training motivation on the explosive ability of the leg muscles of volleyball players Putra Kubang Jaya, accepted. This means that the increase in the explosive power ability of the leg muscles is determined by the interaction between the plyometric form of exercise used and the motivation of the training sample that follows the exercise process.
3. The third research hypothesis states that the dept jump training form with training motivation is better than the jump to box exercise form with high training motivation on the leg muscle explosive power of volleyball players Putra Kubang Jaya. The hypothesis is accepted, because (sig value 0.00 < 0.05)
4. The fourth research hypothesis which states that the average form of dept jump exercise with low training motivation compared to jump to box exercise form with low training motivation results in a more effective jump-to-box exercise with low training motivation, the hypothesis is accepted (sig value 0.012 < 0.05).

**Discussion**

The results of this study highlight the importance of selecting plyometric forms of exercise that correspond to the level of motivation to practice with volleyball players. It was found that the plyometric form of the Depth Jump exercise was more effective in the group of players who had high training motivation, while the Jump to Box form of exercise was more effective in the group of players with low training motivation. This suggests that training motivation may influence players' response to plyometric exercise and their ability to achieve increased limb muscle explosive power (Anggara, 2018; Gustiawan et al., 2021).

The significant interaction between plyometric forms of exercise and training motivation also highlights the importance of an individualized approach in sports training. Every player has a different level of motivation, and there is no one-size-fits-all approach when it comes to designing a training program. By considering each player's training motivation level, the coach can identify the most appropriate form of plyometric training to help the player achieve optimal explosive power enhancement (Alamsyah et al., 2018; Salahuddin et al., 2022).

The interaction between plyometric forms of exercise and training motivation may also indicate individual differences in players' responses to physical exercise (fajri, 2017; miftahudin et al., 2022). Players with high training motivation tend to be more committed and eager to follow a training program and actively try to improve their abilities. As a result, they are more responsive to the plyometric form of Depth Jump exercise which can provide a more intense stimulus and focus on developing the explosive power of leg muscles (Febrianto et al., 2022; Fernanda & Yunus, 2020).

On the other hand, players with low training motivation may require a more cautious and more accessible approach to achieve optimal results. The Jump to Box form of exercise, which may have a lower difficulty than the Depth Jump, can be better suited for this group of players. Psychological factors such as training motivation can affect a player's level of involvement in practice and their willingness to challenge themselves. Therefore, an individualized approach and considering the player's training motivation are essential in designing an effective plyometric training program (Jufrianis et al., 2021; Luhung, 2021).

In the context of sports development and athlete coaching, the results of this study make an important contribution to understanding the factors that can affect plyometric exercise results and the explosive power ability of leg muscles (Nurdin & Aminullah, 2020; Romadhoni & Irianto, 2018). The use of quasi-experimental methods in this study provides strong validity and reliability in evaluating the influence of two important factors, namely plyometric exercise form and practice motivation. The findings of this study can be a reference for coaches, sports managers, and decision-makers in the development of more effective and efficient exercise programs (Akalin et al., 2016; Dell'Antonio et al., 2022).

In addition, the study highlights the importance of an individualized approach in sports training, where a player's level of training motivation needs to be considered in designing an exercise program that suits each player's needs and potential. Using the right plyometric exercises with the appropriate approach can help players achieve optimal leg muscle explosive power enhancements, which will have a positive impact on their performance on the field. Further, the study's findings could form the basis for further research in the field of sports training and athlete development, focusing on the psychological and physiological factors that influence exercise response and exercise outcomes (Handayani, 2018). With a deeper understanding of these factors, efforts to improve sports performance and athlete coaching can be more effective and effective (Parlindungan, 2018; Zuhro, 2018).

Several previous studies have also looked at the effect of plyometric forms of exercise on the explosive power ability of volleyball players' leg muscles. The results of this study are in line with several previous studies that found that plyometric exercises can increase the explosive power of leg muscles. For example, research by Smith et al., (2018) evaluated the effects of plyometric exercise on adolescent volleyball players and found that both forms of plyometric exercise, namely Depth Jump and Jump to Box, can improve the explosive power ability of leg muscles. However, the study did not investigate the motivational factors of exercise about response to plyometric exercise. The results of this study add to the understanding of the importance of the role of training motivation in the effect of plyometric training on the explosive ability of volleyball players.

As another comparison, research by Park et al., (2019) Also investigated the effect of plyometric forms of exercise on adult volleyball players taking into account the level of motivation to train. Their results showed that individuals with high levels of training motivation tended to have a more significant increase in the explosive power ability of the leg muscles after undergoing plyometric Depth Jump exercise. On the other hand, individuals with low training motivation showed better improvement after undergoing plyometric Jump to Box exercises. These findings are in line with the results of our study, which emphasized the importance of considering training motivation factors when designing plyometric exercise programs for volleyball players (Fauzi, 2020; Pamungkas, 2021).

Overall, the results of this study provide a deeper understanding of the interaction between plyometric forms of exercise and training motivation in influencing the explosive power ability of volleyball players' limb muscles. These results are not only consistent with previous research on the positive effects of plyometric exercise on explosive power ability but also provide new insights into how responses to plyometric exercise may differ based on an individual's training motivation. The implications of these findings could be to assist coaches and sports professionals in designing exercise programs that are more effective and appropriate to the needs and characteristics of each player. With a better understanding of the relationship between training motivation and plyometric forms of exercise, coaches can be more precise in choosing the optimal exercise program to increase the explosive power of volleyball players, as well as motivate and optimize their potential on the court.

## CONCLUSION

This study concluded that plyometric forms of exercise, such as Depth Jump and Jump to Box, have a significant influence on the explosive power ability of the limb muscles of Putra Kubang Jaya volleyball players. A significant interaction between plyometric forms of exercise and training motivation was also revealed. In the group with high training motivation, the Depth Jump exercise form was more effective in increasing explosive power ability, while in the group with low training motivation, the Jump to Box exercise form was more effective. These results emphasize the importance of paying attention to the level of training motivation in designing plyometric training programs to achieve optimal performance of volleyball players and have a positive impact on improving overall sports performance.

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