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Original Article Research

The Effect of Plyometric Training Methods on Athlete Smash Ability Volleyball for Physical Education Students at Insan Budi Utomo University Malang

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Abstract

Study This aim for now influence method plyometric training against athlete's smash ability volleyball college high. The research method used is experiment with pre-test post-test design. Research sample consists of 20 athletes' volleyball student. The Department of Physical Education and Health Recreation was given a 6-week plyometric training program. Instrument study in the form of test measured smash ability through accuracy and power blow. The results of the data analysis show existence improvement significant on the group's smash ability experiment compared to group control. Plyometric training is proven effective increase Power explosion muscle legs and coordination movement, so that impact positive to smash quality. Conclusion from study This is method plyometric exercises can made into alternative training strategies for increase performance athlete volleyball, in particular in smash skills.

Keywords: plyometric, smash, volleyball

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1. INTRODUCTION

Sport encompasses all forms of physical activity or competitive games, whether casual or organized, with the goal of improving physical skills and providing enjoyment. From a health perspective, sport is any physical activity aimed at maintaining physical and mental health, ranging from simple movements like walking to intense activity (Nurfalah et al., 2019).

Sport volleyball is one of the branch sport a popular team among students , especially in the Physical Education, Health, and Recreation study program (Heriyansah et al., 2024).

Volleyball is a sport played by two teams of six players each, separated by a net. The objective is to send the ball over the net to land on the opponent's court and prevent it from landing on your own cour (Charlton et al., 2017). Games volleyball demand skills technique good fundamentals, including passing, serving, blocking, and smashing. Smashing is one of the technique attack the main determining factor success team in get points (Fallis, 2013). Therefore that the increase smash ability becomes focus important in the training and coaching process athlete volleyball (García-de-Alcaraz et al., 2020). Training is a process of physical activity carried out systematically, planned, and continuously with the aim of improving a person's physical, technical, tactical, and mental abilities in sports (Nugroho et al., 2021). Training is carried out based on correct training principles to ensure physiological adaptations in the body, thus optimally improving athlete performance (Ariestika & Aofal, 2024). According to exercise is a long-term process designed length in a way systematic For develop performance athlete through improvement capacity physical and motor skills (Azizi et al., 2024). Meanwhile that state that exercise is a process of improvement ability sports that are done in a way repeatedly with burden increasing training increase (Kusuma et al., 2024).

Based on expert opinion the can concluded that exercise is something activities carried out in a way programmed and structured with objective increase abilities and achievements sports, in particular in support achievement performance athlete volleyball (Amali et al., 2021). In the context of study this, the exercise in question is purposeful skipping exercises for increase jump power athlete. Volleyball smash is blow hard and fast done by the player with objective drop the ball to area game against for get points (Effendy et al., 2020). Smash usually done with leap high, swing strong arms, and contact with the ball on point highest so the ball moves sharp and difficult returned by the opponent (Salahuddin et al., 2022). Definition of Smash According to smash is technique the attack carried out with hit the ball from over the net with movement explosive and good coordination between jump , swing arm , and contact with the ball (Azizi et al., 2024).

Elements of a good volleyball smash influenced by several element following prefix step approach, push (jump), swing arm, ball contact, landing Smash goal scoring points pressing defense against end attack with effective optimal smash ability is greatly influenced by strength muscle legs, coordination movemen, and power explode (Sheppard et al., 2010). One of the method believed exercises effective for increase power explosion muscle is plyometric exercises (Wahyudi, 2018). Plyometric is form exercises that emphasize contraction muscle in a way explosive through movement jump, leap, and refuse, so can increase strength at a time motion speed (Broto, 2015). Plyometrics is method purposeful exercise for increase power muscle power through movements that combine contraction eccentric and contraction concentric in a way fast (Febryana et al., 2025). Plyometric exercises utilise cycle stretch shortening stretch-shortening cycle in the muscles, so allows muscle produce strength maximum in short time (Yani et al., 2020).

According to exercise plyometrics is designed exercises for increase ability muscle in produce strength explosive through stretching fast muscle before occurrence contractions (Grueva-Pancheva, 2021). While that state that plyometrics is method effective exercise for increase power, speed, and neuromuscular coordination. Based on expert opinion said, can concluded that exercise plyometrics is form exercise highly relevant explosive in sport volleyball , especially for increase ability jump, smash, and block (Ridwan et al., 2024). In this research this, skipping exercises include in form exercise plyometrics simple focused on increasing jumping

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power athlete volleyball (Ricky, 2020).

PJKR students at Insan Budi Utomo University as candidate educator at a time athlete potential need get proper coaching so that skills play volleyball, they develop in a way maximum. However, in in practice Still found limitations in variation method exercises used, so smash ability is not optimal. Therefore, that study this done for test in a way scientific influence method plyometric training against athlete's smash ability volleyball PJKR student at Insan Budi Utomo University. Athlete's smashing ability volleyball PJKR students at Insan Budi Utomo University are still not optimal. The training method used during This Not yet in a way special develop muscle power legs and power explosive role important in smash. Plyometric exercises are known effective increase power, but not yet known in a way empirical its influence to smash ability in athletes volleyball PJKR student at Insan Budi Utomo University. Research this expected can give contribution for development knowledge coaching sports, in particular in branch volleyball, as well as become reference for lecturers, trainers, and students in design more exercise programs effective.

2. METHOD

2.1 Participants

Students of the Physical Education, Health, and Recreation (PJKR) Study program at Insan Budi Utomo University, Malang. The focus was on students who actively participate in volleyball activities, both in class and extracurricular activities. The sample was selected using purposive sampling (based on specific criteria) or random sampling. The ideal sample size is 20–30 individuals to ensure the data is sufficiently representative of the experimental group receiving plyometric training.

2.2 Research Design

Research methods used in the research this is study experiment with use one group pretest–posttest design (Wibowo et al., 2023). In this design this one group subject given test initial (pretest), then given treatment in the form of plyometric exercises, and so on given test final (posttest) for now influence treatment to smash ability. Variables Study: Variables free (X): Plyometric training method, Variable bound (Y): Volleyball smash ability. With Thus, the design study can show in the image below This as following.

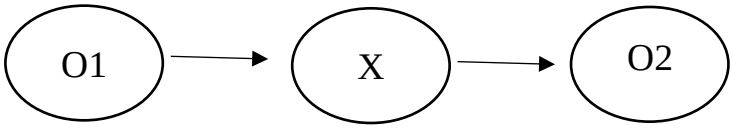

Figure 1. Research Design

Information:

O1 = Test beginning smash ability

X = Treatment plyometric training

O2 = Test end smash ability

2.3 Instruments

Instrument research used for measure smash ability is test volleyball smash skills, which include accuracy direction of smash, power, speed hit, smash success goes in to the target area procedure study do test initial (pretest) smash ability provide treatment plyometric training for ±6–8 weeks in Frequency 2–3 times per week exercise forms squat jump, box jump, depth jump, tuck jump after that do test final (posttest) smash ability (Nugroho et al., 2021).

Construct validity establishes a theoretical relationship between plyometric training, which trains leg and arm muscle power, and smashing ability (requiring explosive power). The reliability of the smash test, if performed twice under the same conditions, should yield relatively consistent results. The reliability of plyometric training requires that the training program be implemented in the same manner in each session, so that the results are independent of coach variations.

2.4 Prosedurs

Preparation develops a training schedule, prepare the smash test instrument, conduct outreach to participants. Pretest measure smash ability before treatment, record scores for smash accuracy, power, and effectiveness. Treatment the experimental group performed plyometric exercises (e.g., box jumps, squat jumps, lateral jumps, depth jumps) for 6–8 weeks, 3 times per week, the control group continued their regular volleyball training without plyometrics.

Post-test after the training period, the smash test was administered again, and the results were recorded for comparison with the pre-test.

2.5 Data Analysis

Data Analysis Techniques analyzed use normality test statistical test for know whether the data is normally distributed or not no. This test important Because Lots analysis parametric (t-test, ANOVA, regression) requires normally distributed data. Homogeneity test statistical test for know whether variance of two or more the same data group (homogeneous). This test is condition analysis parametric, such as independent t-test and ANOVA. Paired sample t-test for now difference pretest and posttest results with level significance $\alpha = 0.05$.

The research design refers to the overall strategy that you choose to integrate the different components of the study coherently and logically, thereby, ensuring you will effectively address the research problem; it constitutes the blueprint for the collection, measurement, and analysis of data (Karisman & Supriadi, 2022). If the design of the study is complex or the stimuli require detailed description, additional subsections of subheadings to divide the subsections may be warranted to help readers find specific information.

3. RESULTS

To determine the extent to which plyometric training methods affect volleyball athletes' smashing abilities, a statistical analysis was conducted on the pre-test and post-test test data. This analysis aimed to describe the mean, standard deviation, and difference in improvement in students' smashing abilities (Charlton et al., 2017). The following statistical analysis results table presents a summary of the data, including the mean, standard deviation, and t-test results with a significance level (p-value). This table is intended to allow readers to clearly see the difference in smashing abilities before and after plyometric training and to determine whether the difference is

statistically significant. The following table presents the results of the study.

Table 1.

Analysis Results Statistics

Descriptive Test Statistics						
Variables Study	**N**	***Mean***	***Elementary School***	***Min***	***Max***	***Sum***
Pretest Data Volleyball Smash Ability	20	60.95	2,564	59.74	62.15	121.89
Posttest Data Volleyball Smash Ability	20	78.50	3,000	77.09	79.90	156.90

In accordance exposure table 1 above there is change volleyball smash ability before do exercise plyometric on the pretest, obtained mark average 60.95, standard deviation 2,564 minimum value 59.74, value maximum 62,15 amount overall 121,89. Meanwhile, in volleyball smash ability after performing plyometric exercises on the posttest, obtained mark average 78.50 standard deviation 3,000, minimum value 77,09. value maximum 79,90 amount overall 156,90.

Table 2.

Normality Test Results

Variable study	**Asymp P > 0.05**	**Information**
(Initial Data) Volleyball Smash	0.5734	Normal
(Final Data) Volleyball Smash	0.6708	Normal

Table 2 above obtained normality test results on initial data volleyball smash test before Plyometric exercises are performed to obtain namely 0.5734 > 0.05. This is to explain that the initial data the normally distributed. Meanwhile, the final data for volleyball smashes before done plyometric test obtained namely 0.6708 > 0.05. In the results the proven that in the final data normally distributed. Furthermore, it is obtained hypothesis test results under This as following.

Table 3.

Test Results Independent sample t test

Pretest- posttest data	Treatment	Mean	Elementary School	T-test	P < 0.05	Information
	Initial data	60.95	2,564			
	Final data	78.50	3,000			
Smash Ability				106.2	0,000	Significant

Table 3 above obtained results that show that value 106.2 with P value = 0.000 < 0.05 concluded that existence significant difference between change smash ability before and after plyometric training treatment was carried out on athletes volleyball UIBU PJKR students. This matter, seen from average value of 60.95 and standard deviation 2.564 on initial data smash changes, and an average value of 78.50, also a value standard deviation 3,000).

4. DISCUSSIONS

Research result show that implementation method plyometric exercises provide influence positive to improvement volleyball smash ability PJKR students at Insan Budi Utomo University, Malang. This seen from existence improvement the average value of smash ability in the posttest was compared with pretest after subject given treatment plyometric training. In a way physiological plyometric exercises emphasize contraction fast and explosive muscles, so that capable increase Power explosion muscle power, especially in the muscles legs (Wiewelhove et al., 2022).Explosive power muscle legs is component physique main in do a volleyball smash Because determine tall jump, speed rejection, and strength ball hitting (Fitrah et al., 2024). With increased muscle power legs, students capable do smash movement with more effective and optimal. In addition to improving Power explosion muscles, plyometric exercises also play a role in increase coordination neuromuscular. Plyometric movements are performed in a way repetitive with intensity controlled can repair ability system nerve in coordinate Work muscle in a way fast and precise (Febryana et al., 2025). This is impact on quality smash movement that becomes more coordinated, both in the phase prefix, repulsion, until ball hit (Salahuddin et al., 2022).

Research result This in line with theories and findings study previously stated that effective plyometric training in increase ability movement explosive on the branch sport games, including volleyball. Improvement The smashing ability of PJKR students shows that method plyometric exercises can implemented in a way effective in the training program learning and coaching performance sports at college tall. Although thus, research these own limitations, including the number of relative samples limited and time giving short treatment. Other factors such as level fitness beginning, motivation exercises and techniques basic smash can also be influence results research. Therefore that, research furthermore recommended for involving amount more samples large, duration more practice long, and combine plyometric training with method exercise technique for get more optimal results.

The main findings of the study indicate that plyometric training significantly improved the smashing ability of PJKR students. This was evident in the increased jump height, resulting in a more optimal contact point for the ball. The power of the shot increased, making the smash

faster and more difficult for the opponent to anticipate, and the accuracy of the smash improved due to improved body movement coordination. Therefore, the research hypothesis that plyometric training influences smashing ability is accepted. Theoretically the results of this study align with the stretch-shortening cycle theory, which states that muscles trained explosively through plyometrics are able to generate greater power in a shorter period of time. Plyometrics have been shown to increase leg and arm muscle power, which are key components in volleyball smashing (Rufron et al., 2021). These findings support previous research suggesting that plyometrics are effective for sports requiring explosive movements such as volleyball, basketball, and athletics. The main findings of this study titled plyometric training demonstrated significant improvements in the smashing ability of PJKR students. Improvements were seen in the explosive power of the leg muscles, aiding in higher jumps during smashes. Coordination between the arm swing and the leg push became more synchronized, and students' shot timing improved, allowing them to hit the ball at the highest point. Compared with previous research, these results align with previous studies that found plyometric training effectively increases leg muscle power and the performance of explosive sports skills such as smashes, spikes, and jump shots.

However, this study confirms that the application of plyometrics to PJKR students not only improves physical performance but also improves confidence in smashing during matches. Practical implications: The plyometric training program can be used as an alternative learning method in volleyball practical courses. Lecturers and coaches can systematically integrate this training to improve students' smashing technique. Plyometric training is also relatively simple and does not require expensive equipment, making it suitable for implementation in a campus environment. The limitation of this study is that it was conducted at only one university, so the generalizability of the results is limited. Other factors such as motivation, playing experience, and the students' initial physical condition were not fully controlled.

The study duration was relatively short so longterm effects were not yet measurable. Recommendations for further research include expanding the sample to other universities or volleyball clubs. It should be combined with other training methods weight training or agility drills to assess synergistic effects. Long term evaluation is needed to determine whether improvements in smashing ability persist beyond competition. This study confirms that plyometric training effectively improves the smashing ability of PJKR students at Insan Budi Utomo University, Malang, both physically and psychologically. Although there are limitations that require further research.

5. CONCLUSIONS

Based on the research results, plyometric training methods have been shown to have a positive effect on improving smashing skills. Plyometric training increases leg and arm muscle power, enabling students to jump higher and hit more powerfully and accurately. Research implications for Physical Education (PJKR) students this study provides empirical evidence that plyometric training can be used as an alternative training method to improve smashing skills. For coaches and lecturers: Plyometrics can be included in volleyball curricula or training programs as an efficient method for developing explosive power, for the development of sports science: This study streng thens the theory that plyometrics are directly related to improving sports skills that require explosive power, for sports practitioners: It provides a practical basis for designing more varied, evidence-based training programs.

Limited subjects the study was conducted only on PJKR students at Insan Budi Utomo University, Malang, so generalization to other populations professional athletes is limited. Training duration the training program may have been relatively short, so long-term effects have not been tested. Theoretical Contribution: Adds to the literature on the effectiveness of plyometric methods in improving sports technical skills, particularly the volleyball smash. Practical contribution provides recommendations for training methods that can be implemented by coaches, lecturers, and students to improve smash performance. Academic contribution serves as a reference for further research in physical education and sports, particularly regarding the influence of physical training on technical skills. Institutional contribution supports the development of the Physical Education and Sports (PJKR) study program in producing applicable research relevant to the needs of the sports world.

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The author realizes that this research is far from perfect. Therefore, constructive criticism and suggestions are greatly appreciated for future improvements. Hopefully, this research will benefit the development of sports science, particularly in the field of volleyball training methodology.

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