



THE EFFECT OF ROTATIONAL PLYOMETRIC TRAINING METHODS ON THE SMASH ACCURACY OF VOLLEYBALL EXTRACURRICULAR STUDENTS

Reka Diah Pratiwi¹, Fajar Ari Widiyatmoko², Pandu Kresnapati³

¹Universitas PGRI Semarang, Physical Education Health and Recreation, Semarang, Indonesia

¹Universitas PGRI Semarang, Physical Education Health and Recreation, Semarang, Indonesia

¹Universitas PGRI Semarang, Physical Education Health and Recreation, Semarang, Indonesia

*Coressponding Author. Email: rekadhpratiwi@gmail.com

*Email Author: rekadhpratiwi@gmail.com, fajarariwidiyatmoko@upgris.ac.id,
pandukresnapati@upgris.ac.id

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Abstract

Smashing is an important technique in volleyball. However, the accuracy of smashing remains a challenge for students in volleyball extracurricular activities. Muscle strength plays an important role in improving volleyball smashing skills. For this reason, core rotation plyometric exercises were chosen to improve smashing accuracy because they can increase muscle power. This study used a quasi-experimental method with a two-group pretest-posttest design, using an experimental group and a control group as a comparison. This study was conducted at MTS Sultan Fattah Gaji with a population of 8 students participating in volleyball extracurricular activities. The research sample used purposive sampling. The training program was conducted for 4 weeks with 3 meetings per week. Data were collected using the Smash Attack Test instrument and analyzed using a t-test with a significance level of 0.05. The results of the study concluded that there was no significant effect of core rotation plyometric training on the accuracy of volleyball smashes, with a mean value of -3.250, a t-value of -2.030, and a p-value of 0.135. Thus, $p = 0.135 > 0.05$, so H_0 is accepted and H_1 is rejected. Although there was an improvement from the pretest to the posttest, it was not strong enough to indicate a significant difference.

Keywords: Plyometric Core, Smash, Volleyball, Muscle Power, Accuracy

INTRODUCTION

Sports are often associated with physical activities that usually consist of a series of movements that can improve quality of life and maintain physical fitness. Sports are a tangible and conscious form of physical activity that emphasizes various physical conditions with responses as a reflection of the changes that occur during exercise. Sports are also associated with physical and mental development through games that can foster a sense of sportsmanship and creativity through physical activity (Bangun, 2016).

Physical education is inseparable from the goals of education itself, even though it involves physical activity. Positive character traits supported by effective leadership and good coaches can



be used as a means of shaping individual character (Musa, Musripah, & Annur, 2022). In education, it is not only intelligence that must be developed, but there are many other things that must be developed, such as physical skills, emotional intelligence, and character building. Extracurricular activities play a role in helping students practice motor skills and character building outside of class hours. Extracurricular activities include non-academic activities that help students expand their knowledge and skills, which can be chosen according to the interests of the students.

Volleyball is a team sport played by six players with a maximum of three touches on the ball. The simple equipment makes this game accessible to all groups and can be played indoors or outdoors with a net separating the two teams on the court (Hidayat et al., 2023). Among young people and adults, this sport has become popular, both among the upper class and the middle to lower class, as a way to enjoy leisure time and even achieve success. As a platform for identifying young talent, schools often organize extracurricular activities to develop skills or simply enjoy hobbies (Safitri, Sulistyarto, Subagio, Widodo, & Hidayat, 2025).

There are several basic techniques used in volleyball, namely serving, passing, blocking, and smashing (Pramudya, Hidayat, & Tuti Ariani, 2022). Volleyball requires not only mastery of basic techniques but also muscle strength and good coordination (L, 2020). A smash is performed by hitting the ball towards the target, which plays an important role in attacking the opponent and looking for opportunities to score points (Niken Yolanda, Boy Indrayana, 2024). A precise and powerful smash makes it very difficult for the opponent to return the ball. Accuracy of movement, strength, push, and jump are crucial in executing a good smash. Therefore, a player must pay attention to these aspects to achieve a good jump and smash push (Komariyah, Saputra, & Rusmiati, 2020).

Volleyball games often attract attention with their smash techniques. However, volleyball players often experience difficulties when performing smashes. Some players have good strength but lack accuracy in their smashes, often sending the ball out of bounds or even failing to clear the net (Al Iman Bokingo, Sarjan Mile, 2024). Accuracy and power are crucial for executing a smash (Tongge, Yunitaningrum, Pranata, Haetami, & Ali, 2024). The height of the jump during a smash also affects the outcome of the smash.

According to (SETIAWAN, 2018), the core is the part of the body that maximizes activity in providing local strength and balance efficiently by optimally controlling the hips and legs. Plyometric exercises can be used to improve accuracy and strength. Plyometric exercises are exercises that use muscle explosive power to improve the relationship between speed and strength (Kurniawan & Ramadan, 2016). The strength of the inner body muscles plays a role in the smash that will be performed because the muscles help balance the body and provide explosive power so



that the ball has strength and can be directed at the target position of the attack (Abdulloh Sarmadan Fittaqi, 2025). Arm muscle strength helps a spiker perform a smash to deliver a deadly blow. Therefore, arm muscle strength plays a crucial role in controlling the force exerted and the intensity of the blow delivered.

In the study ", there are similarities in discussing smash accuracy with significant results showing the effect of plyometric bench dip training on smash accuracy in the boys' volleyball extracurricular activities at MTS Negeri 7 Tulungagung. What distinguishes this study is its variables, as there have not been many studies that specifically examine the effect of plyometric training methods with a focus on core rotation on the accuracy of smashes among students in the volleyball extracurricular activity at the junior high school/MTS level.

Based on the results of observations from most previous studies, many refer to plyometric exercises to increase strength. As for studies that refer to accuracy with exercises that combine core rotation elements, they can affect the accuracy of smash shots in junior high school and MTS levels, but are few in number in the context of extracurricular activities. Given the importance of training, the researcher will examine the "Effect of Core Rotation Plyometric Training Methods on the Accuracy of Smashes in Junior High School/MTS Extracurricular Volleyball Students" with the aim of determining the effect of plyometric training with core muscles on the accuracy of smashes in volleyball among MTS extracurricular volleyball students.

METHODOLOGY

The method used in this study employed a quantitative approach and quasi-experimental research design. It used a Two Group Pretest-Posttest research design with an experimental group and a control group as a comparison. According to Sugiyono (2019:64) in (Niken Yolanda, Boy Indrayana, 2024), the Two Group Pretest-Posttest design makes it easier to identify the effects before and after treatment, resulting in more accurate results. This research was conducted over 12 meetings, with 3 meetings per week at MTS Sultan Fattah Gaji, with a population of students who actively participated in volleyball extracurricular activities and a sample size of 8 research subjects. The sample was selected using purposive sampling with the criteria of actively participating in volleyball extracurricular activities, being male, and being in grades 8 and 9. The dependent variable in this study was the accuracy of volleyball smashes, and the independent variable was the plyometric training method.

The test instrument used in this study, namely the smash attack test, was used to determine the accuracy of volleyball smashes. The main data was collected through tests given to students as respondents. A pretest was conducted before students received treatment using an assessment



instrument, then they were given treatment in the form of core rotation plyometric exercises conducted 12 times. A posttest was then conducted after the plyometric exercise treatment to measure changes in students' ability to accurately smash a volleyball (Setiawan, Setiawan, & M, 2018).

RESULTS

The results of the pretest and posttest in the study of the effect of plyometric training on smash accuracy, which was given treatment in the form of plyometric training conducted 12 times, were analyzed using SPSS with the following results.

Table 1. Descriptive Analysis Results for the Control Group

	N	MIN	MAX	MEAN	Std.Dev
Pretest	4	3	7	4.50	1.732
posttest	4	2	5	3.00	1.414

The results of the data analysis above indicate that the students' initial smash accuracy ability was in the low category with a relatively small increase. The pretest average score of 4.50 was higher than the posttest score of 3.00 with a pretest standard deviation of $1.732 > 1.414$.

Table 2. Descriptive Analysis Results of the Experimental Group

	N	MIN	MAX	MEAN	Std.Dev
Pretest	4	2	6	4.25	1.708
posttest	4	6	10	7.50	1.916

The table above shows the results of descriptive statistical analysis, which indicate that the initial smash accuracy of the research participants was in the low category. After training, the posttest average score increased. The statistical mean value was 4.25, then increased to 7.50 with a standard deviation in the pretest and posttest of $1.708 < 1.916$, which indicates a uniform increase in the participants.

Table 3. Normality Test

	Shapiro-Wilk	
	statistic	Sig.
Pretest	.963	.840
Posttest	.932	.534

The table above shows the analysis of normally distributed data using Shapiro-Wilk, which obtained a significance value of 0.840 for the pretest data and 0.534 for the posttest data, where both values are indicated to be greater than 0.05. Thus, both the pretest and posttest values are normally distributed and can be analyzed further.



Table 4. Homogeneity Test

Levene Statistic	<i>Test of Homogeneity of Variance</i>		
	df1	df2	Sig.
.750	1	6	.420

From the homogeneity test attached to the table above using Levene's Test, a significance value of $0.420 > 0.05$ was obtained. This shows that the variance between the experimental group and the control group is homogeneous or the same. Thus, the data of the two groups have equal variance, so they meet the requirements for further analysis using parametric tests.

Table 5. T-test for the Control Group

<i>Paired Samples Test</i>				
Pretest-posttest kelompok kontrol	Mean	t	df	Sig.(2-tailed)
	1.500	3.000	3	.058

Based on the table of statistical test results comparing pretest and posttest scores in the control group, there was no statistically significant difference between the average scores before and after treatment. The average difference between the pretest and posttest is 1,500, with a t value of 3,000 and a df of 3, resulting in a significance value (2-tailed) of $p=0.058$. Because the p value is > 0.05 , H_0 is rejected and H_1 is accepted.

Table 6. t-test for the experimental group

<i>Paired Samples Test</i>				
Pretest-posttest kelompok eksperimen	Mean	t	df	Sig.(2-tailed)
	-3.250	-2.030	3	.135

Based on statistical analysis of the table above, the results of the paired sample test in the experimental group show an average difference of -3.250, but the t-value is -2.030 with $p=0.135$, which is not significant because $p > 0.05$. Thus, there was an improvement from the pretest to the posttest, but it was not strong enough to indicate a significant difference, so H_0 was accepted and H_1 was rejected.

Table 7. ANOVA Test

	Sum of Squares	df	Mean Square	Sig.
Between Groups	40.500	1	40.500	.009
Within Groups	17.000	6	2.833	
Total	57.500	7		



Based on the ANOVA test results table, the significance value is 0.009, which is below the significance threshold of 0.05. This indicates that there is a significant difference between the experimental group and the control group after treatment. The variation between groups $SS=40,500$ is much greater than the variation within groups $SS=17,000$, so the effect of the treatment can be considered to have a significant effect on the posttest results.

DISCUSSION

Volleyball is a sport that requires a combination of physical abilities, technical skills, and tactical understanding to achieve optimal performance. One of the most decisive techniques in volleyball is the smash, which plays a crucial role in scoring points. Smash accuracy is influenced by various factors, including muscle power, coordination, balance, and proper technique execution. Therefore, training programs aimed at improving smash performance must be carefully designed to address both physical and technical components.

Based on the results of statistical data analysis conducted to determine the effect of core rotation plyometric training on the accuracy of smashes among students participating in the volleyball extracurricular activity at junior high schools/MTS, the results show no significant effect with an average of -3.250, a t-value of -2.030, and a p-value of 0.135. Thus, with a p-value of 0.135 > 0.05, it can be concluded that there was no significant effect after the core rotation plyometric training. Although there was an increase in the average score between the pretest and posttest, it was not large enough to be considered statistically significant.

Plyometric exercises utilize maximum muscle speed and strength to produce explosive movements (Sudarmanto, 2019). Plyometric exercises can enhance muscle power, which can be utilized to achieve specific goals (Dimas Anggara, 2019). It is not only strength that influences smash accuracy; proper smash technique is fundamental to improvement, enabling strength to be directed effectively. In the study (Riyanto & Mulyana, 2024) states that to achieve progress, the right training method is needed, using a consistent and structured drill method repeatedly to effectively improve volleyball skills.

Research by (Dimas Anggara, 2019) states that there is a significant effect on the smash ability of volleyball athletes from the Guntur 1000 Kota Padang club. This study used hurdle hops and knee-tuck exercises, which focus more on the explosive strength of the leg muscles. In my study, however, I used rotational core plyometric exercises to train the core muscle strength of the arms, abdomen, and legs. Therefore, the difference in focus and frequency of the exercises produced different results.

From the study (Imandaqurani & Pratama, 2025), significant results were obtained with a



duration of 6 weeks, 18 meetings, 3 times a week, with 20 samples. This study mentions that to achieve good results, 6-8 weeks of training with 3 meetings per week are required. This differs from my study, which was conducted over 4 weeks with 3 meetings per week, using a sample of 8 boys.

My research findings are consistent with the study ", which states that there is no effect of plyometric box jump training on the jumping smash of extracurricular volleyball athletes at SMPN 2 Karanggayan. This indicates that plyometric training does not always have a significant impact. The duration and relatively small sample size are suspected to have influenced the results. It is also possible that the training program did not emphasize technical aspects that were not specifically trained.

These findings indicate that improving smash accuracy requires specific training that balances physical and technical exercises with sufficient training duration. Thus, plyometric training remains relevant for improving physical capacity, but to improve smash accuracy, technical training and repetitive exercises must be considered. Therefore, it is hoped that this study can serve as a basis for further research to maximize the duration and combination of appropriate exercises.

The findings of this study are also consistent with research stating that plyometric box jump training had no significant effect on jumping smash performance among extracurricular volleyball athletes at SMPN 2 Karanggayan. These results indicate that plyometric training does not always produce significant improvements, particularly when training duration and sample size are limited. Additionally, it is possible that the training program did not sufficiently emphasize technical aspects of smashing, which were not specifically targeted during the intervention.

Overall, these findings suggest that improving smash accuracy requires training programs that integrate physical conditioning with technical skill development and are implemented over a sufficient duration. While plyometric training remains relevant for enhancing physical capacities such as muscle power, it should be complemented by technical drills and repetitive skill-based exercises to optimize smash accuracy. Therefore, future research is expected to explore longer training durations, larger sample sizes, and more comprehensive training combinations to maximize the effectiveness of volleyball smash training interventions.

CONCLUSION

Based on the analysis results, leg muscle explosive power was proven to play a significant role in improving the smash skills of volleyball athletes. The better an athlete's leg explosive power, the greater their chances of executing a powerful, sharp, and difficult-to-anticipate smash. Therefore, coaches and athletes need to emphasize explosive leg training as an important part of



the volleyball training program. Additionally, it also contributes positively to understanding the link between sports, holistic well-being, and the implementation of sports policies.

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