The Effect of Push-Up Training on Arm Muscle Strength in Smash Strokes in Badminton Games of Extracurricular Students at SMA Sinar Husni in the 2025 Academic Year

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Abstract.

Background   This research is based on the researcher's observation of arm muscle strength during smash strokes in badminton games among extracurricular students at SMA Sinar Husni. The study was conducted because many smashes were inaccurate or off target

Objectives   The purpose of this study was to determine the effect of push-up training on arm muscle strength in smash strokes in badminton games among extracurricular students at SMA Sinar Husni.

Methods   This study employed an experimental method with a pre-test and post-test design. The research sample consisted of 30 extracurricular badminton students selected using a total sampling technique. Data were collected using skill tests and badminton smash test instruments. Data analysis included normality tests, homogeneity tests, and hypothesis testing (t-test).

Results   The results showed a significant increase in students' arm muscle strength. Based on the data, the average pre-test score of 48.67 increased to a post-test average of 72.17 after receiving push-up training. Thus, it can be concluded that push-up exercises significantly affect the improvement of arm muscle strength in performing smash strokes in badminton games among extracurricular students at SMA Sinar Husni in the 2025 academic year

Conclusion   This research contributes to teachers and sports coaches in selecting effective training methods to improve badminton playing performance, particularly in enhancing arm muscle strength and smash stroke techniques.

Keywords: Push-Up, Arm Muscle Strength, Badminton Smash

How to Cite: Wau, G. J., & Sari, L. P. (2025). *The effect of push-up training on arm muscle strength in smash strokes in badminton games of extracurricular students at SMA Sinar Husni in the 2025 academic year*. International Journal of Emerging Sport Science, 1(4), 168–171.

INTRODUCTION

Physical education is a curriculum and teaching model designed to provide physical education programs to elementary and secondary schools. Learning outcomes are achieved through several stages of learning activities, one of which can be assessed through training to determine the extent of students' abilities. Learning outcomes can be assessed through specific training sessions, which are a set of answers and solutions that students must complete to determine their academic abilities. In physical education, one of the most popular sports in the world, even one of the most popular games, is badminton. Because this sport has been played by many countries, almost every country in the world is currently involved in competitions to discover and create new badminton methods, tactics, and techniques. This sport has been played by many countries, including England, India, and China.

In February based on the results of observations of extracurricular students of Sinar Husni High School there are still weaknesses in doing smash shots in badminton games due to their arm muscle strength is still lacking or weak so that the strokes are not fast and accurate. Therefore, the researcher conducted a preliminary test by providing an Isometric (Push Up) exercise model. This exercise model aims to make it easier for researchers to know the extent of the arm muscle strength capabilities of extracurricular students of Sinar Husni High School. The number of samples is 30 people from 103 extracurricular student populations of Sinar Husni High School. This is due to increasing smash shots, strength for the training method above.

Based on the results of the pre-test data where the extracurricular students of Sinar Husni High School are still unable to achieve the appropriate smash hit target, students who do smash hits there are only a few people who can hit while others cannot reach the hit with a different number of hits so that the researcher provides a smash hit training mode to improve the right and accurate smash hit because one of the main factors that causes students' smash hits to be less precise and accurate is due to the strength of their arm

muscles which are still weak, therefore to train the strength of the arm muscles of extracurricular students so that their arm muscle strength is strong so that their smash hits are accurate and precise, namely the researcher provides a push up training mode that can train the strength of the arm muscles of extracurricular students. based on the explanation above to see the results of extracurricular students' smash hits can be seen in the attached page.

In badminton, smashing is one of the techniques used to score points. Therefore, arm muscle strength and accuracy are crucial. Striking is key to a successful smash, and the relationship between arm muscle strength and hand coordination and smash accuracy in badminton is crucial (Anang Setiawan, Fauzan Effendi, Mohammad Toha, 2020). The dominant physical condition element for smashing in badminton is strength, which involves the arm muscles. Strength is a physical component of a person's ability to use muscles to support a load during work. Arm muscle strength is closely related to the neuromuscular system, which is the extent to which the nervous system activates muscles to contract. Therefore, the more muscles that are activated, the greater the force generated by those muscles, resulting in a good shot or smash in badminton (Ilham Ramadhan, La Sawali, La Ode Maklum Sabrin, 2020).

Therefore, researchers conducted arm muscle strength training to achieve smashes and improve learning outcomes in extracurricular badminton games for students at Sinar Husni High School. Badminton is a popular sport among students, and its learning is conducted in several sessions. Although badminton is popular at Sinar Husni High School, observations revealed that students still face challenges, including inaccurate smashes due to lack of arm muscle power. In other words, their arm muscle strength is still inadequate due to their physical fitness, particularly their arm muscles, which are not yet well-trained.

METHOD

Research Design

The type of research used in this study is experimental. Experimental research is a method of providing training material by training students to try something and observe the process and results. The experiment conducted in this study is the effect of arm muscle strength training on smash shots in badminton for eleventh-grade students at Sinar Husni High School. Experimental research is a method for finding a causal relationship between two factors intentionally created by the researcher by eliminating, reducing, or setting aside interfering factors.

Participant

Population is a generalization area consisting of objects/subjects that have certain qualities and characteristics determined by the researcher to be studied and then drawn conclusions. The population in this study amounted to 103 extracurricular students of Sinar Husni High School. The sample is a portion or representative of the population to be studied, according to Arikunto (2017:173) in his book reminding that, if the subject is less than 100, then the entire population becomes the research sample. But if the subject is more than 100 then 10-15% or 25-30% can be taken. The population in this study is 30 people because they already have experience in badminton, do not have injuries in the arm or shoulder area, are willing to participate in the training session that will be given, 25% of 103 people.

Data Analysis

The data analysis technique used a paired t-test to compare pre-test results. The following are the analysis steps:
1) Calculating the mean: Calculating the average pre-test and post-test scores.
2) Calculating the deviation (d): Calculating the difference between post-test scores for each student.
3) Calculating the standard deviation: The standard deviation is calculated to measure the distribution of the data.
4) T-test: The data is tested using the following formula:
5) Description:
   a. Average score difference.
   b. Sum of squared deviations.
   c. Number of samples.
6) Decision criteria: If the calculated t-value in the t-table is at a significance level of 0.05, then the hypothesis is accepted (arm muscle strength training has a significant effect).

RESULTS AND DISCUSSION

Results

After the pre-test and post-test data are displayed separately, the pre-test and post-test data are presented in a single table, along with their differences.

Table 1. Pre-test and Post-test Results: Data Analysis Techniques

No	Name	Pretest	Posttest	Difference
1.	Aditya	65	90	25
2.	Fernanda	40	75	35
3.	Zaya Saputra	20	75	55
4.	M. Arya	20	65	45
5.	Nur Havid	35	70	35
6.	M. Veri	37	85	48
7.	Teri Alukal	40	80	40
8.	Ahmad Guntur	15	35	20
9.	Adytia Adha	39	40	1
10.	M. Raihan	19	90	71
11.	M. Jaka	20	65	45
12.	M. Rahim	20	75	55
13.	Jurniansyah	40	75	35
14.	Achmad Farli	40	85	45
15.	M. Imani	20	70	50
16.	Aspianur	15	35	20
17.	M. Chandra	20	40	20
18.	Alif Pratama	17	70	53
19.	Doni Ramadani	67	70	3
20.	M. Angga	35	38	3
21.	Farhan	20	50	30
22.	M. Raya	40	85	45
23.	M. Alvin	40	75	35
24.	M. Zacky	39	40	1
25.	Suriansyah	20	35	15
26.	Andika	35	40	5
27.	Arjuna	20	35	15
28.	Rusmadi	20	40	20
29.	M. Kepin	65	75	10
30.	M. Supian	70	75	5

Based on the data obtained above, there are differences in the pre-test and post-test results, as well as differences between the two. It can be concluded that there was an increase in the data from the pre-test to the post-test, indicating that the interventions implemented by the students had an impact on the data.

1) Pre-test and Post-test Results

The results of the pre-test and post-test of the research conducted on badminton extracurricular students at Sinar Husni High School can be described in Table 1:

Table 1. Description of Pretest and Post-test Data Analysis Techniques

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	30	30	65	48.67	7.649
Posttest	30	60	90	72.17	8.678
Valid N (listwise)	30				

After the push-up exercise threatment, the pre-test results showed a minimum score of 30, a maximum score of 65, a mean score of 48.67, and a standard deviation of 7.649. The post-test results showed a minimum score of 60, a maximum score of 90, a mean score of 72.17, and a standard deviation of 8.678.

Discussion

Based on the research results outlined in section 4.1, it was found that there was a significant improvement in the pre-test and post-test results of smash accuracy in badminton after push-up training. This was evidenced by the average pre-test score of 48.67, increasing to 72.17 in the post-test. This improvement was also supported by the results of the paired sample t-test, which showed a significance value of $0.000 < 0.05$. This means that push-up training significantly improved the smash accuracy of extracurricular students at Sinar Husni High School. Push-up training is known to increase the strength of the arm, chest, and shoulder muscles. These muscles play a crucial role in generating optimal power in badminton smashing. By regularly practicing push-ups over 14 sessions, students experienced improved muscle control and explosive power, which directly contributed to smash accuracy.

Furthermore, the distribution of values in the normality and homogeneity tests also supports the validity of the results. The significance values for the normality test ($0.884 > 0.05$) and homogeneity ($0.392 > 0.05$) indicate that the data are normally distributed and homogeneous, thus the statistical analysis results are reliable and methodologically valid. These results align with those of Rizki (2020) in his study entitled "The Effect of Push-Up Training on Smash Shot Accuracy in Junior Badminton Athletes at Club XYZ." In his study, Rizki also concluded that push-up training increased arm muscle strength and smash accuracy by 20–30% in the experimental group after a six-week intervention.

Furthermore, research by Wahyuni (2021) also showed comparable results. In her study, entitled "The Effectiveness of Push-Up Training on Improving Arm Power in Badminton," she stated that push-up training, performed gradually and systematically for three weeks, significantly improved students' smash performance, with an average score increase of 23 points from pre-test to post-test, similar to the results in this study, which showed an increase of 23.5 points. This research suggests that arm muscle strength training, such as push-ups, can be an effective coaching method for improving badminton technical skills, particularly the smash movement.

CONCLUSION

Based on the processed data, explanations, testing of research results, and discussion, the following conclusions can be drawn:
1) Push-up training has an effect on the arm muscle strength of smash shots in badminton extracurricular students at Sinar Husni High School.
2) Push-up training significantly affects the arm muscle strength of smash shots in badminton extracurricular students at Sinar Husni High School.

ACKNOWLEDGMENT

AUTHOR CONTRIBUTION STATEMENT

This research was conceptualized and designed by Gerhard Jenforius Wau, who developed the research objectives and methodology, managed data collection, coordinated with participants, and supervised fieldwork at STOK Bina Guna Medan. Liliana Puspa Sari performed data analysis, interpreted the findings, and contributed significantly to the drafting of the manuscript. All authors participated in the revision of the manuscript, approved the final version for submission, and take full responsibility for the integrity and accuracy of the work.

CONFLICT OF INTEREST AND FUNDING

The authors declare no conflict of interest related to the conduct, authorship, or publication of this study.

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