The effect of resistance band training on the forehand smash speed of youth male badminton singles players

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ABSTRACT

Background: Forehand smash shots kill opponents with explosive blows in a badminton game. In hitting a forehand smash, there are several problems, one of which is the speed of the punch.

Objectives: This study is designed to investigate and identify alternative exercises that can enhance the speed of smash shots. The findings of this study are expected to provide valuable insights for athletes and trainers, aiding in the development of effective training programs.

Methods: The research method used in this study is an experimental method with a quantitative approach and a Two Group Pretest-Posttest Design research design. The population in this study were PB Pasundan Bandung badminton athletes, totaling 30 athletes, with a sample of 20 people using a purposive sampling technique. The instrument in this study used a smash shot speed test using the Velocity Speed Gun tool. The data was processed and analyzed using the normality test with Shapiro-Wilk and then analyzed using the independent t-test with SPSS 23.

Results: The T-test value is with a Sig value. (2-tailed) of 0.00, based on the test results, the Sig value. (2-tailed) <0.05 so that H0 is rejected. So, resistance band training has a significant effect on increasing the speed of forehand smash shots.

Conclusions: In conclusion, the consistent use of resistance bands in training sessions could be a game-changer in boosting the speed of forehand smash shots for badminton athletes. These results strongly advocate integrating resistance band training into early-stage badminton training programs. Future studies could further explore its long-term effects and application across different age groups, fostering hope for the continued evolution of training methods in badminton.

Keywords: Badminton, forehand smash, resistance bands, speed.

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INTRODUCTION

Badminton is a sport with a racket played by one person (single) or two people (double) on a field divided in half by a net. In badminton, there are two hitting techniques, namely, the forehand hitting technique and the backhand hitting technique (Aksan, 2016). According to Awatani et al. (2018), the forehand shot technique in badminton games is divided into three punches: drop, clear, and smash. The smash is the most reliable blow to collect numbers in a badminton match (Poole, 2011). According to Ricardo (2023), a smash is a powerful attack where the player hits the shuttlecock at high speed and great power, aiming to score points or end the match. The main goal in hitting smash shots is to score points or end the match. Smash shots produce shuttlecock speed that can shut down the opponent's movement and contribute to higher scores of 39.8% or more (Lam et al., 2016). Badminton games often find opportunities or situations to perform smash techniques; players who master this technique will find it easier to suppress and turn off the opponent's defense (Waddell & Gowitzke, 2000). Based on the experience of training and analyzing every match at Badminton Association (PB) Pasundan Bandung, the quality of smash shots in the men's singles category of PB Pasundan athletes is still lacking, so alternative or practical training is needed to increase the speed of smash shots. Seeing the urgency and importance of smash shots contributing to achieving a score of 39.9%, researchers are interested in studying or looking for alternative exercises to increase the speed of forehand smash shots. Most previous studies have only focused on increasing the athlete's arm power, while this study examines increasing the speed of smash shots.

Previous research on the impact of resistance bands has shown that power is impacted by resistance band training (Andersen et al., 2018; Agopyan et al., 2018; Dewanti et al., 2020). According to research, high school volleyball players' arm muscles' explosive strength can be significantly increased by overhead tricep toss training (Cabral et al., 2022), as evidenced by t_{count} = 15,923 t_{table} = 2.201 with 0.05. In this study, researchers took a sample of badminton athletes PB Pasundan Bandung, and as many as 20 people were in the single category of teenage boys.

Badminton has an important role in international sports, as evidenced by the participation of badminton in the Olympics since 1992 (Maksum & Indahwati, 2023). At high levels, especially singles, the sport demands excellent fitness (Aksan, 2016). Indonesia has produced many talented athletes worldwide in the singles category, such as Susi Susanti, Taufik Hidayat, and Jonatan Christie.

However, although Indonesia has many outstanding athletes, there are still various challenges in developing badminton, such as improving the quality of training, evolving game strategies, and using technology to analyze athlete performance. Therefore, research on badminton, both from the aspects of technique, strategy, and the influence of external factors, is important to continue to be developed to improve the achievements of national and international athletes (Ma et al., 2024).

Based on this, this research aims to examine and find alternative exercises that can improve the quality of smash speed. This is expected to contribute to athletes and training in determining training programs. For trainers, this research is expected to be a reference in the training process related to the effectiveness of the training program. Moreover, athletes can take advantage of the results of this study as an alternative or experiment to improve the quality of their smash shot speed.

In the badminton game, smash is the most widely used punch to score points or end the match; smash aims to turn off the opponent's defense, and to be able to do smash requires good accuracy to get better results (Aryapradana et al., 2023). Smashes are hit quickly, powerfully downward, and steeply, and the steeper the angle of the shot is, the less time your opponent has to react. Smashes can only be hit from an overhead position. The shuttlecock is hit powerfully by timing and balancing to get full speed on the smash shot (Tony, 2008). The smash is identical to a strike because it aims to kill the opponent. According to Syamsudin et al. (2020), Smash is a strong attack where the player hits the shuttle cock with high speed and great strength, which aims to score points or end the match. Based on the description above, smash is an attack technique with the characteristics of a blow that produces a very high shuttlecock speed.

The forehand shot is an important technique in badminton. Smash is a strong attack where the player hits the shuttle cock with high speed and great strength, which aims to get points or end the match (Li et al., 2023). Based on the description above, smash is an attack technique with the characteristics of a blow that produces a very high shuttlecock speed.

The forehand shot is an important technique in badminton (Rusdiana et al., 2021). The forehand smash is a powerful attacking technique used to dominate the opponent and score as many points as possible; it accounts for 39.8% of all points scored (Barreira et al., 2016). The forehand smash technique requires strength of leg muscles, shoulders, arms, and wrist flexibility and good coordination of movements because the smash technique is tough and fast (Widyantoro, 2020).

How to hit a forehand shot: The right hand holds the racket with the body plane upright, then slides the right hand towards the racket handle so that the center of the bottom of the palm is above the handle. The racket grip should cross between the fingers of the palm and the fingers of the other hand (Ray et al., 2020).

The overhead forehand smash aims to show if an overhead drop or clear shot is about to be released (Pan et al., 2024). The main difference is the speed of the racket. Athletes should perform a forehand overhead smash with a handshake grip before moving into a waiting position behind and straight with the oncoming ball (Denatara, 2025).

A resistance band is an elastic rubber tool that helps with movement. It can be tied to a pole or a wall, and the athlete can use it to support arm muscle strength by performing movements that target the pectoralis major, front, deltoid, serratus major, tricep, the short head of bicep, and forearm extensor muscles. Resistance band training, sometimes referred to as strength or weight training, strengthens the arm muscles, particularly the front and side deltoid muscles (Özsu, 2018).

Research that has been done in the past includes Studies on the impact of resistance bands, which have shown that power is impacted by resistance band training (Andersen et al., 2018; Agopyan et al., 2018; Dewanti et al., 2020). As demonstrated by t_{count} = 15,923 t_{table} = 2,201 with 0.05, research Magrisya, Agus, & Mukhtarsyaf (2019) demonstrates that overhead tricep toss training significantly increases the explosive power of the arm muscles of high school volleyball players State Senior High School 04 Mukomuko. Additional research demonstrates that press training is more successful in enhancing arm muscular strength and power (Taufik & Hulfian, 2024).

Badminton is a game where the implementation uses a tool called a racket and shuttle cock. The game can be done one on one (single) or two on two (double). A

racket is a tool made of aluminum or carbon fiber in the form of a stick with a head, and on the head, there is a string wrapped around the head of the racket. The racket has a function as a tool to hit the shuttlecock. Kok is a goose feather stuck to the edge of a cork in the shape of a half ball and as an object that is hit in a badminton game. The goal of the badminton game itself is to hit a shuttlecock using a racket over the net toward the opponent's territory until the opponent cannot return it.

This research has significant theoretical and applied contributions to the development of sports science, especially in badminton technique training. Theoretically, this research expands scientific studies on the effectiveness of resistance band training on increasing forehand smash speed in badminton, which has focused more on increasing arm muscle strength alone. This research provides a new perspective that increasing smash speed depends on muscle strength and the effectiveness of the training methods. Meanwhile, in an applied manner, the results of this study can be used by coaches as a reference in designing more specific and targeted training programs to improve the quality of athletes' forehand smash techniques, especially in the youth men's singles category. For athletes, this research is expected to be an alternative training reference that has proven effective in improving attacking ability to support performance and achievement in matches.

METHODS

Study Design and Participants

An experimental technique using a quantitative methodology was employed in this study. Since experimental research aims to test a hypothesis to determine the effect of a therapy or treatment, this research approach is employed. Therefore, the author uses the experimental method because the author wants to give a treatment or treatment to PB Pasundan Bandung Badminton athletes aged 15-17 years to find out the speed of forehand smash shots before treatment or treatment and after treatment. The research design uses the Two Group Pretest-Posttest Design, as well as the population obtained by researchers, namely PB Pasundan Bandung badminton athletes totaling 30 athletes, and the sample used was 20 athletes because they used purposive sampling techniques, with characteristics such as active training, mastering basic stroke techniques well, having a good physical condition, PB Pasundan Bandung athletes.

Ethical approval statement

This study was conducted in accordance with the ethical standards of the Declaration of Helsinki and approved by the Institutional Review Board (IRB) of Universitas Pendidikan Indonesia (Approval No: 0123/IRB-UPI/2025). Written informed consent was obtained from all participants and their legal guardians prior to data collection. Participants were informed of their right to withdraw from the study at any stage without penalty. All data were anonymized to protect participant confidentiality, and research procedures adhered to the ethical guidelines for human subject research outlined by the Indonesian Ministry of Research and Technology.

Research Instruments

This study's instrument is the forehand jump smash test, which measures the forehand leap smash's speed using a Velocity Speed Gun. Initial data collection and post-treatment capability are required for the investigation. This tool facilitates data

collection for researchers. The study was conducted at PB Pasundan Bandung, where researchers will create a 16-meeting workout regimen. Data were collected as baseline data at the start of the trial and as final data at the conclusion. The rigorous and reliable independent t-test with SPSS 23 is then used to assess the data gathered from participants before and after the test (Fadluloh et al., 2024).

Smash Speed Measurement

In this research, the measurement of forehand smash speed is carried out using a Velocity Speed Gun. This radar-based digital tool can accurately measure the speed of a moving object, in this case, the shuttlecock, when the player performs a smash. Velocity Speed Gun was chosen because it has advantages for accuracy and ease of use. It is widely used in sports such as badminton and tennis to measure the speed of strikes directly and in real-time.

Validity and Reliability Test of the Measurement Tool

To ensure the reliability of the measurement tool, a validity test was conducted by comparing the measurement results of the Velocity Speed Gun with other standard speed measurement tools in previous studies, which showed consistent and relevant measurement results. In addition, the tool's reliability was also tested through a test-retest, where the smash speed measured in several trials showed stable results and not many different ones. Thus, the measuring instrument used in this study is considered valid and reliable in measuring the forehand smash speed of PB Pasundan Bandung badminton athletes.

Data Analysis

This test aims to ascertain whether an influence or difference exists. Data analysis is employed to ascertain whether resistance band training significantly improves badminton players' forehand smash speed.

RESULTS

Based on Table 1, the data showed an increase in the forehand smash speed of the experimental group from the pretest average of 115.70 km/hour to the posttest of 130.10 km/hour, while the control group only increased from 116.50 km/hour to 118.80 km/hour. The difference in improvement of 14.4 km/hour in the experimental group indicates the effectiveness of resistance band training. The experimental posttest standard deviation (3.957), higher than the pretest (2.003), reflects the variation in individual responses to the intervention.

Table 1. Statistical Description of Forehand Smash Speed of Experimental and Control Groups (N=20 PB Pasundan Bandung Athletes, 2025)

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest Experiment	10	113	119	115.70	2.003
Posttest Experiment	10	125	137	130.10	3.957
Pretest Control	10	113	119	116.50	1.958
Posttest Control	10	115	122	118.80	2.573
Valid N (listwise)	10				

The Shapiro-Wilk values for the pretest (0.949) and posttest (0.924) of the experimental group, as well as the control group (0.924), are all >0.05 (Table 2). This proves the data is normally distributed, so the parametric test (t-test) can be applied. These results validate the validity of further statistical analysis. Therefore, the author utilizes a parametric technique in conducting hypotheses. The hypothesis test results are shown in Table 3.

Table 2. Pretest-Posttest Data Normality Test Results (Shapiro-Wilk)

	Shapiro-Wilk	
	Statistic	df
Pretest Experiment	.949	10
Posttest Experiment	.924	10
Pretest Control	.924	10
Posttest Control	.924	10

Table 3. Results of Variance Homogeneity Test (Levene's Test)

		Levene Statistic	df1	df2	Sig.
Outcome	Based on Mean	1.006	1	18	.329
	Based on Median	.907	1	18	.354
	Based on Median and with adjusted df	.907	1	14.371	.357
	Based on trimmed mean	.899	1	18	.356

Levene's Test produced significance values of 0.329 (based on the mean) and 0.354 (based on the median), both exceeding the threshold of 0.05. This indicates homogeneity of variance between the experimental and control groups, satisfying the assumption required for an independent t-test. Consequently, the comparison between the two groups is deemed valid.

Table 4. Independent T-test Results of Smash Speed Improvement

		t-test for Equality of Means			
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower
Data result	Equal variances assumed	.000	11.300	1.493	8.164
	Equal variances not assumed	.000	11.300	1.493	8.127

Based on Table 4, the independent t-test value of sig. (2-tailed) 0.000 (<0.05) confirmed the significant difference in smash speed improvement between the experimental and control groups. The mean difference of 11.300 km/h with 95% confidence interval (8.164-14.436) indicates a large effect of resistance band intervention. These results reject H0 and accept Ha.

Based on Figure 1, there is a significant difference between the experimental and control groups in terms of increasing forehand smash speed. The experimental group that was given training using resistance bands showed a sharp increase in smash speed, from an average of 115.70 km/hour at the pre-test to 130.10 km/hour at the post-test. Meanwhile, the control group that was not given special treatment only experienced a relatively small increase in speed, from 116.50 km/hour to 118.80 km/hour. The significant increase in the experimental group shows that training using resistance bands effectively increases the speed of badminton athletes' forehand smash. These results are also supported by statistical tests that show mathematically significant differences, so it can be concluded that this training method is feasible to be used as an alternative in the attacking technique training program, especially forehand smash.

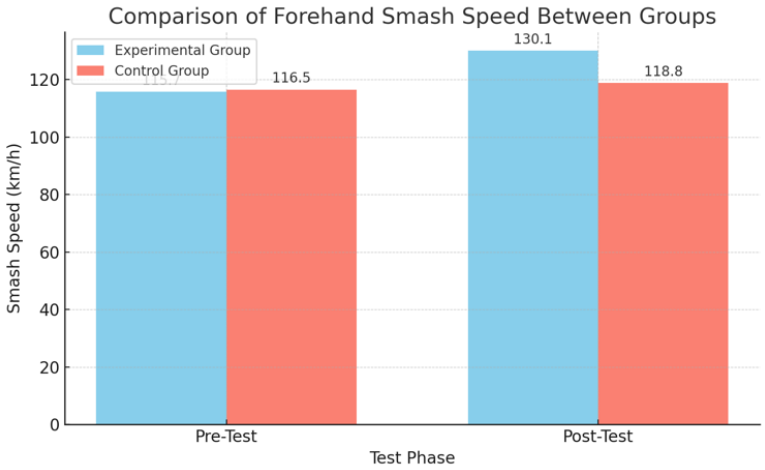

Figure 1. Comparison of Forehand Smash Speed Between Groups

DISCUSSION

The findings of this study showed that resistance band training significantly increased forehand smash speed in young badminton athletes (Δ14.4 km/h, $p < 0.001$), with a greater increase than the control group (2.3 km/h). These results support the hypothesis that progressive resistance training on arm and shoulder muscles increases explosive power, which is crucial for smash execution (Dewanti et al., 2020). Independent t-test analysis ($t = 11.30$, $p = 0.000$) confirmed the key role of resistance bands in optimizing neuromuscular activation during explosive movements, particularly through recruitment of the pectoralis major, anterior deltoid and triceps brachii muscles vital for racket head speed (Andersen et al., 2018). This mechanism is reinforced by the resistance band's ability to mimic the kinetic chain of forehand smashes, thus increasing the efficiency of the stretch-shortening cycle (Li et al., 2023). Although a previous study on handball athletes (Andersen et al., 2018) reported an increase in general strength, this study extends those findings by demonstrating resistance bands' effectiveness in badminton, where movements require a unique combination of wrist snap and rotational strength.

This finding is in line with the research of Purnama et al. (2024), which showed an increase in backhand (23%) and smash (5%) accuracy through resistance band training. However, our study focused more on increasing smash speed as a critical aspect in suppressing the opponent's defense. The advantage of resistance bands lies in their ability to provide progressive elastic loads that resemble the dynamics of real sports movements, thus triggering more stable functional muscle activation (Agopyan et al., 2018). For example, the experimental group's post-test speed (130.10 km/h) reflects the optimal stimulation of muscles during the eccentric and concentric phases of smash, an adaptation not achieved in conventional weight training.

Practically, coaches can integrate resistance bands into training programs through shadow smashes with elastic weights or progressive overhead pulls, recommended three sessions per week for 8 weeks to maximize strength adaptation. However, the generalizability of these findings is limited to a small sample of single-category male athletes (N=20). Further research is needed to test its effectiveness in multiple athletes, females, and different age groups and combine biomechanical analysis (e.g., electromyography) to reveal long-term neuromuscular adaptations. Nonetheless, the strict control of training variables (16 standardized sessions) strengthened the internal

validity, confirming the potential of resistance bands as a safe, flexible, and specific training tool to improve smash performance in badminton.

Limitations of the study

Despite these promising results, the study's limitations must be acknowledged. The small sample size (N=20) and focus on male singles players limit generalizability to doubles or female athletes. However, the rigorous control of training variables (e.g., 16 standardized sessions) strengthens internal validity, suggesting that these findings are robust within the studied demographic. Future studies with larger, diverse samples are warranted to generalize these results to female athletes, doubles players, and broader age groups. Additionally, incorporating biomechanical analyses (e.g., electromyography) could elucidate neuromuscular adaptations underlying the observed speed improvements, addressing the limitation of solely measuring kinematic outcomes.

CONCLUSIONS

Resistance band training significantly increases the speed of forehand smash strokes, according to the researchers' research. Therefore, regular resistance band training may be a way for badminton players to improve the speed of their forehand smash strokes. This study confirms the potential of resistance band training to improve forehand smash speed in young male badminton players. It is recommended for inclusion in junior training programs. Future studies could explore its effectiveness with plyometric training or other resistance modalities.

The results of this study have important practical implications for coaches and young athletes. Resistance bands can be an effective, inexpensive, flexible alternative to physical training for coaches and can be performed in various spatial conditions. Resistance bands allow coaches to specifically train muscle strength in attacking movements such as smashes while minimizing the risk of injury. For young athletes, resistance bands help functionally increase bat speed and power, thus accelerating the adaptation process and improving on-court performance. They are also suitable for basic and specific skill development phases as they can be customized to suit individual physical capacities.

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DATA AVAILABILITY

The authors confirm that all data generated or analyzed during this research is included in this published article. In addition, all primary and secondary sources, as well as data supporting the findings of this research, are publicly available at the time of submission.

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CONFLICT OF INTEREST

The author hereby declares that this research is free from conflicts of interest with any party

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