

## The Effect of Arm Muscle Strength Training and Eye-Hand Coordination on Top Service Results in Volleyball Junior Athletes

Marini<sup>1A-E\*</sup>, Alek Oktadinata<sup>2B-D</sup>, Bangkit Yudho Prabowo<sup>3B-D</sup>

<sup>1,2,3</sup> Universitas Jambi, Jambi, Indonesia

[mrini1572@gmail.com](mailto:mrini1572@gmail.com)<sup>1\*</sup>, [alek\\_oktadinata@unja.ac.id](mailto:alek_oktadinata@unja.ac.id)<sup>2</sup>, [yudhoprabowobangkit@unja.ac.id](mailto:yudhoprabowobangkit@unja.ac.id)<sup>3</sup>

### ABSTRACT

This study aims to analyze the effect of arm muscle strength training and eye-hand coordination on improving overhand serve results in junior volleyball athletes. The novelty of this research lies in the combination of two specific types of exercises (push-ups and catching ball throws) that are adapted to the characteristics of early adolescence, as well as their programmed application to groups of junior female athletes. This study used an experimental method with a one-group pretest-posttest design conducted at the Kanaya Volleyball Club, Jambi City. The sample consisted of 12 female athletes aged 12-15 years who were selected through a quota sampling technique. Data collection was carried out using push-up tests, ball catching throws, and overhand serve tests (AAHPER). The results of the paired sample t-test showed a significant increase after being given treatment, with a significance value of 0.000 ( $p < 0.05$ ). This shows that arm muscle strength training and eye-hand coordination have a positive effect on the overhand serve results of junior athletes.

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A. Conception and design of the study;  
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## INTRODUCTION

The game of volleyball is a team sport that is loved by all people, regardless of age. Sports play an important role in maintaining body stamina so that it remains optimal (Widodo & Subekti, 2024). Currently, sports have become part of people's daily lives, both as a hobby and as a means to achieve well-being, for example, in the form of sports achievements, education, or the sports industry. Therefore, the government needs to design a sustainable sports coaching program (Fachrezi et al., 2024).

According to (Ikhsanto & Aswara, A. Y. Ahmad, 2023), Exercise goals include maintaining physical health, improving immunity, preventing illness, and improving mental health. In addition, sports play a role in character development, improvement of discipline, and the formation of a sportsmanlike spirit in individuals.

The various benefits of exercise include improved heart health through improved blood flow, reduced risk of obesity by burning calories, and increased muscle strength and flexibility (Azwan & Candra, 2023). In addition, exercise also helps improve mood, reduce symptoms of depression and anxiety, improve sleep quality, and strengthen the body's immune system, thus supporting overall health (Faridhatunnisa & Kurniawan Pratama, 2019).

According to (Qosim, 2017) Volleyball is popular with all people regardless of age or gender, and can be played in various regions, both cities and villages. (Muttaqin et al., 2016) Said that Volleyball is a team sport that can be played by two teams, each consisting of six players, who compete against each other on a court separated by a net. Each team has a maximum of three touches before returning the ball to the opponent to score points. Volleyball matches can last up to five sets, which usually take around 90 minutes, depending on the dynamics of the game. To be able to win the game, the technical component is one of the most important because it is directly related to the theoretical foundation, the law, and the concept of the game. Players must master the physical, technical, tactical, and mental components (Tantio & Putra, 2021).

According to the quote, two teams, each consisting of six players, competed in the sport of volleyball. The goal of the team in this game is to score 25 points to win two rounds. To win, each team member must work together and stay united.

The basic techniques of volleyball include: serving, passing, blocking, and smashing. (Indo et al., 2021) Mentioning that the service technique is an important basic skill used to start the game. Serve was initially used to pass the ball, but as the game strategy developed, serving also became a way of attacking. An effective serve can make it difficult for your opponent to return the ball and open up opportunities to score points. One type of service used is the top serve, which is a technique of hitting the ball from the top of the head to create a fast and swooping ball rate (Evionora et al., 2020). The game starts with a serve, which must be done with the right strength and skill for the ball to pass through the net.

To play volleyball well, especially when performing service techniques, you need to be in good physical condition. Effective servicing requires proper technique, arm muscle strength, and hand-eye coordination. Muscle strength plays an important role in the performance of volleyball athletes. (Pasaribu, 2018) Stating that power is the ability to produce the maximum power needed in the game. Meanwhile, Pasurnay in (Qosim, 2017) It is mentions that push-ups are done with the body lying on its knees, hands next to the chest, and then pushing the body up. This exercise focuses on the use of arm muscles to support weight.

To improve upper serving ability, junior athletes at the Kanaya Jambi Club need special exercises that prioritize arm muscle development and hand-eye synchronisation. One of the exercises that can be used is push-ups (Rohmah & Purnomo, 2018). They explain that to do push-ups, a person must lie on their stomach, press both hands on the floor, fold both arms to the sides of the body, and straighten them so that the body is

lifted. To maintain your weight, push-ups are done up and down by concentrating energy on both arms.

There are many volleyball athlete clubs in Jambi City, one of which is the Kanaya Volleyball Club. The Kanaya Volleyball Club was formed in 2023, and the Kanaya Volleyball Club is coached by a coach named Setiawan. The training carried out by the Kanaya Volleyball Club in Jambi City is 4 times a week on Mondays, Wednesdays, Fridays and Sundays.

Based on observations made by researchers and interviews with coaches conducted on January 25, 2025, it is known that coaches do not yet have a physical exercise program. During the interview, the coach said that to train the athletes, the coach only gave directions before training started; the athlete was required to jog 30 rounds. However, for other physiques such as barbell lifting, pipe jumping and push-ups, it is not mandatory because they feel that if they are done, it will make athletes lazy to practice. At the time of observation in the field, the researcher also saw that the athlete's serve still made many mistakes so that the ball did not pass through the net when doing the top serve, this happened because the position of the hands when performing the serve was still not right, the service required poor arm muscle strength, poor eye-hand coordination, and improper ball throwing.

## METHODS

This study is a quantitative study with an experimental method using a one-group pretest-posttest design, which aims to determine the effect of arm muscle strength training and eye-hand coordination on upper serve results in junior volleyball athletes (Pasaribu, 2018). This design was chosen because it follows the purpose of the study to measure the changes that occur before and after treatment.

The subjects in this study were 12 junior female athletes aged 12–15 years who were actively training at the Kanaya Volleyball Club in Jambi City. Subjects were selected using the quota sampling technique based on criteria: actively participating in exercises, having weaknesses in upper serve techniques, as well as arm muscle strength and eye-hand coordination that were still not optimal. The selection of this sampling technique is based on the limited number of junior athletes in the club (No, 2025).

Research instruments consist of three types:

1. A 60-second push-up test to measure arm muscle strength
2. Tennis ball throw-catch test to target from a distance of 2.5 meters to measure eye-hand coordination
3. Upper serve test with the AAHPER method, which provides a value based on the drop zone of the serving ball

The research procedure began with the implementation of a pretest to measure arm muscle strength, eye-hand coordination, and upper extremity skills. After that, the subjects were given treatment in the form of an exercise program consisting of two main components, namely arm muscle strength training using push-ups and resistance band

chest press (Rachman, 2018), as well as hand-eye coordination exercises using tennis ball toss and catches (Hanif, 2017). The training was given in as many as 16 meetings during one month. After the entire series of exercises is completed, a posttest is carried out with the same instrument as during the pretest.

The data from the pretest and posttest results were analysed by the Shapiro-Wilk normality test and the Levene homogeneity test. To test the hypothesis, a paired sample t-test with a significance level of 5% ( $\alpha = 0.05$ ) was used, which was processed using SPSS software.

## RESULTS AND DISCUSSION

### Result

The results showed an improvement in upper serve performance in athletes after being given arm muscle strength training and eye-hand coordination. This can be seen from the comparison of pretest and posttest results, which are analyzed descriptively and inferentially.

Before getting instruction on arm muscle strength and hand-eye coordination, junior volleyball players conduct a pre-test to measure their upper hand serving proficiency. The results of the first test showed that athletes' upper-hand service abilities varied, with some athletes outperforming others. The effectiveness of the training will be assessed by comparing the data with the results of the final test, which provides a first impression of the level of upper-hand service skills before receiving treatment. The results are displayed in the following table.

**Table 1.**  
Preliminary Test Results

No	Evaluation	Category	Fi	Persentation
1	30-40	Excellent	0	0%
2	20-29	Good	1	8.33%
3	10-19	Enough	5	41.67%
4	0-9	Very Less	6	50%
<b>Total</b>			<b>12</b>	<b>100%</b>

The pre-test results showed that the service ability of junior volleyball athletes was mostly in the categories of "Sufficient" (41.67%) and "Very Poor" (50%). Only one athlete (8.33%) was in the "Good" category, and none were in the "Very Good" category. This indicates that their service performance is still not optimal, likely due to a lack of strength in the arm muscles and also coordination in the eyes. If exercises focused on these two aspects are applied, it is expected that there will be a significant improvement in the results of the upper serve in the post-test, which will prove the effectiveness of the exercise in improving the service skills of junior athletes.

After being given arm muscle strength training and eye-hand coordination, a final test was carried out to measure the development of ability in the serve of junior volleyball athletes. Final test results showed an improvement in athletes' performance, with most athletes achieving higher categories than in the initial test. This data gives an idea that

the exercises provided contribute positively to the improvement of upper service skills. A comparison of the results of the initial and final tests will show the effectiveness of the exercises in improving the serviceability of junior athletes, which can be seen explicitly in the following table.

**Table 2.**  
Final Test Data Description

No	Evaluation	Category	Fi	Persentation
1	30-40	Excellent	0	0.00%
2	20-29	Good	4	33.33%
3	10-19	Enough	4	33.33%
4	0-9	Very Less	4	33.33%
<b>Total</b>			<b>12</b>	<b>100%</b>

After being given arm muscle strength training and eye-hand coordination, the final test results showed an improvement in service ability over the junior volleyball athletes. Based on post-test data, as many as 33.33% of athletes are now in the "Good" category, 33.33% in the "Sufficient" category, and 33.33% are still in the "Very Less" category. Although the increase has not been evenly distributed to all athletes, this change in distribution reflects significant progress when compared to the pre-test results, where 50% of athletes were in the "Very Poor" category and only 50% in the "Sufficient" category, with not a single athlete reaching the "Good" or "Very Good" category.

These changes suggest that hand-eye coordination and arm muscle strength affect the quality of the upper serve. Athletes can create stronger, steadier shots with stronger arm muscles, and they can set the direction and precision of their serve with better hand-eye coordination. Therefore, the service skills of junior volleyball players can be improved through exercises that emphasize these two areas.

## Discussion

From the results of the data analysis, it can be understood that arm muscle strength is a significant factor in facilitating the success of volleyball service techniques. One of the fundamental methods for the ball to pass through the net and land in the opponent's area successfully is the top serve, which requires strength and accuracy (Ertanto et al., 2021). To produce strong and accurate serves, players need to have optimal arm muscle strength, especially in the upper arm, shoulder, and wrist muscles.

With good arm muscle strength, players can produce higher ball speed when performing top serves. This speed makes the ball more difficult for opponents to receive due to the shorter reaction time (Juita, 2013). In addition, the power from the strong arm muscles also helps in controlling the direction and height of the ball, thus allowing players to perform more effective variations of serves, such as a floating serve or jump serve.

On the other hand, if the strength of the arm muscles is suboptimal, then the resulting upper serve tends to be weak and easy to read by the opponent. This certainly gives an advantage for the opposing team to counterattack quickly. A lack of power in the arm can also lead to technical errors, such as the ball not going through the net or going out of the field, which will be detrimental to the team itself (Santoso, 2020).

Therefore, arm muscle strengthening exercises are an important part of the volleyball player's training program, especially for those who want to improve the quality of their upper serve. Exercises such as push-ups, light weight lifting, and muscle resistance exercises will help improve arm strength and stability (Kuncoro, 2021). Players can improve their overall effectiveness in the game and serve the ball more effectively if they have strong arm muscles.

Because it allows players to set movements accurately and promptly, good eye-hand coordination is essential to improve accuracy and strength when serving the ball in volleyball (Sari & Guntur, 2017).

In sports like volleyball, eye-hand coordination is an important skill. Players can move their hands according to what their eyes see thanks to this skill (Sari & Guntur, 2017). This synchronisation is very important in volleyball, especially when serving the ball. If the coordination of eyes and hands is good, then players can manage time and movement more precisely. This will make the serve more accurate, strong, and difficult for the opponent to return (Ramadani et al., 2024). Conversely, if coordination is not trained, the service can deviate or even fail.

Eye and hand coordination has a great effect on the upper serving ability in volleyball (Marwan et al., 2023). By continuing to practice, players can improve this coordination so that they can play better and help the team achieve victory.

Technical training theory has an important role in improving volleyball service results. By understanding the correct theory, players can know how to make effective and efficient moves (Malau & Azandi, 2021). This helps them avoid technical errors when serving.

Without exercises based on proper theory, service results are often inconsistent. The ball can be too weak, soaring, or out of the game area (Agustian et al., 2023). Therefore, exercise theory is very helpful in forming correct movement habits and improving the consistency of the player.

Without the application of good technique training theory, players risk developing improper movement habits. For example, incorrect hand position or an unbalanced arm swing can cause the ball to go off the court or not go through the net (Agustian et al., 2023). In addition, technical errors can also increase the risk of injury. Therefore, technique training should not be neglected and should be a major part of a player's skill development program.

Technique exercises that are carried out in a directed manner and according to theory will improve posture, hand position, and swing movements during service (Malau & Azandi, 2021). If all the elements of technique are done correctly, then the ball will slide more accurately and powerfully towards the opponent. This certainly gives an advantage in the match.

Confidence is one of the psychological factors that greatly affects the performance of athletes in various sports, including volleyball. In performing top serves, players are required to rely not only on physical abilities and techniques but also on strong mental abilities (Nur Husen, 2019). Players who have high confidence tend to be calmer and more



focused when serving, so the chances of producing an accurate and effective serve are greater.

When a player believes in his abilities, he will be able to cope with the pressure in the match, such as when facing a tough opponent or when he is in a crucial moment (Nasution, 2015). Good confidence makes players more courageous to take risks, such as trying a variety of serves or directing the ball to areas that are difficult for the opponent to reach. This will certainly improve the quality of the service performed.

Conversely, low confidence can negatively impact upper service ability. Players who feel doubtful or afraid of making mistakes often serve poorly or untargeted. In addition, feelings of anxiety or uncertainty can interfere with concentration, which ultimately leads to technical errors such as the ball not going through the net or going out of the court (Adila et al., 2023). This shows that confidence is an important aspect in supporting technical skills.

Therefore, coaches and players need to pay attention to mental development, not just focusing on physical training and technique. Visualization exercises, self-motivation, and enough gaming experience can help boost player confidence (Ramadani et al., 2024). With strong confidence, players will appear more stable and consistent in performing top serves, which has a positive impact on the team's overall performance.

## CONCLUSION

Arm muscle strength training and eye-hand coordination have been shown to have a significant influence on improving upper serve outcomes in junior volleyball athletes. A systematic training program with a focus on these two aspects can be recommended as part of a service technique development program. The results of the paired sample t-test showed a significant increase with a significance value of 0.000 ( $p < 0.05$ ), which indicates that the research hypothesis is accepted.

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