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The Effect of Arm Power Training On Upper Service Ability In Volleyball Games of Extracurricular Students of Palu Salvation Army Christian Junior High School

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ABSTRACT

This study aims to determine whether there is an effect of arm power training on the ability of upper service in volleyball games in extracurricular students of the Palu Christian Salvation Army Middle School. The problem in this study is: Is there an effect of arm power training on the ability of the upper limb service? This study uses a quantitative approach, involving extracurricular students of the Palu Christian Salvation Army Middle School as the population, and 20 students as samples using total sampling. This data collection technique was carried out by providing service treatment for the initial test and final test to students who were in the sample. The results of this study indicate that the average value before being given arm power training was 8.25, and after being given arm power training, 13.55, so that there was an increase of 5.3. Based on the results of the test sample calculation where t count = 12.33 while t table at the 5% level with degrees of freedom (db) = n-1 = 19 is 1.729 so it can be concluded that Ho is rejected and Ha is accepted because the t count value is greater than t table, which is 12.33> 1.729. The results of the study indicate that there is an effect of arm power training on the ability of upper service in volleyball games in extracurricular students of the Palu Salvation Army Christian Middle School. Arm power training can be used as an alternative exercise that can increase arm muscle strength, increase endurance, and increase upper body stability.

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INTRODUCTION

Volleyball is a globally recognized sport that demands a unique combination of technical skill, tactical awareness, and physical attributes, among which upper-body power is critical. The serve, in particular, is a decisive skill in match play, initiating each rally with precision, velocity, and strategic placement (Sekulić et al., 2021). Coaches and players alike acknowledge that serving efficiency relies heavily on arm strength and rapid neuromuscular activation, particularly within the shoulder and upper limb musculature (Sekulić et al., 2021).

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Upper body conditioning plays a pivotal role in reducing injuries and enhancing functional performance across volleyball skills (Jeevan Kumar, 2023). Strength and conditioning research has underscored the importance of integrating arm power development into volleyball training to optimize serve velocity, control, and consistency (Prabhu Jeevan Kumar, 2023).

Arm power training often targets the shoulder girdle, triceps, pectoral muscles, and core to support explosive upper-limb movements. Common exercises include medicine ball throws, resistance band work, overhead pressing, and plyometric drills—all shown to enhance serve effectiveness (Jeevan Kumar, 2023; Silva et al., 2022). Indeed, studies have documented that dedicated upper-limb strength programs lead to improvements in serve speed and accuracy among volleyball athletes (Silva et al., 2022; Tsepis et al., 2021).

Research indicates a strong correlation between arm power and service speed: players with higher upper-limb explosiveness tend to achieve faster and more consistent serve execution (Tsepis et al., 2021; Sekulić et al., 2021). Recent Indonesian studies affirm that empirical arm power training positively affects technical volleyball skills among school-level players (Silva et al., 2022; Wijaya et al., 2021).

At Palu Salvation Army Christian Junior High School, extracurricular volleyball players often exhibit service inconsistency, characterized by variable velocity, reduced control, and occasional inaccuracies. Anecdotal observations from coaches point to underdeveloped upper-limb power and immature neuromuscular coordination as potential bottlenecks in serve performance. Such deficiencies not only undermine match readiness but also discourage student engagement and reduce self-efficacy in game situations.

Despite clear physical limitations, the school's extracurricular program lacks a structured arm power development plan. Sessions often emphasize general gameplay and technical drills with limited focus on physical conditioning, leaving players with technical skill gaps that training alone cannot address.

While international studies document significant performance benefits of arm power training in volleyball, there remains a dearth of empirical research focused on mid-adolescent students in Indonesian schools, particularly within extracurricular contexts. Most investigations have centered on senior athletes or elite youth programs (Silva et al., 2022; Silva et al., 2022), leaving a gap in understanding how upper-limb power training could support technical skill development among junior high participants.

Moreover, few studies have explored the link between structured arm conditioning and actual serve performance in extracurricular settings. Insights are needed to determine whether targeted power training can enhance service speed and accuracy among younger or less experienced players.

This study addresses that gap by implementing and evaluating a specific arm power training protocol designed for the extracurricular volleyball team at Palu Salvation Army Christian Junior High School. To our knowledge, this is one of the first studies in Indonesian school settings to: (1) Integrate arm power training into routine volleyball

sessions, (2) Measure its direct impact on upper-service speed and accuracy among junior high students, and (3) Use both performance metrics (e.g., serve velocity, consistency) and functional fitness tests (e.g., medicine ball increments) to assess outcomes.

This research adds to the literature by providing empirical evidence of how arm conditioning affects technical execution in real-world educational sport contexts, rather than elite athlete programs.

This study aims to evaluate the effect of arm power training on upper-service ability among extracurricular volleyball players at Palu Salvation Army Christian Junior High School. The primary research questions are: (1) Does a structured arm power training regimen significantly improve serve velocity in mid-adolescent volleyball players? (2) What impact does the training have on serve accuracy and consistency? (3) How do measurable upper-limb power improvements relate to actual in-game service outcomes?

To address these questions, we employ a quasi-experimental pre-test/post-test design. Students will undergo an eight-week arm power training program—including resistance and plyometric exercises—alongside regular volleyball practice. Outcomes will be measured through standardized serve tests (velocity radar, accuracy charts) and functional fitness assessments (medicine ball throw test), before and after the intervention.

The findings are expected to inform coaches, educators, and sports development practitioners about the practical value of integrating targeted physical conditioning into extracurricular volleyball training. Such insights will help improve service performance, athletic growth, and student motivation, while guiding future program development in school sports.

METHODS

The population in this study was all students who participated in extracurricular volleyball activities at the Palu Salvation Army Christian Middle School, totalling 50 students. This population was chosen because it is a group that is directly involved in volleyball training and match activities in the school environment.(Sugiyono, 2019), So it is relevant to study in measuring the influence of arm power training on basic upper service technique ability.

The data collection technique in this study was carried out through tests and measurements of upper service abilities in volleyball games. The test was carried out twice, namely the initial test (pre-test) before being given arm power training treatment, and the final test (post-test) after the training was given for six weeks (T. Bompa & Buzzichelli, 2015).

Each student is allowed to perform six overhead serves in one test session. Scores are given based on the accuracy of the ball hitting the target area on the opponent's court. The assessment follows the scoring guidelines based on the level of difficulty and

accuracy of the service, with the following provisions: the ball passes through the net between the two high ropes: score multiplied by 3, the ball passes through the net above the lower rope: score multiplied by 2, the ball enters without touching the specific target: score according to the zone number, the ball touches the target boundary line: counted as the highest score in the zone, Balls that are not valid or do not enter the opponent's court: score 0.

The data analysis technique used in this study is descriptive and inferential statistical analysis, with a t-test approach (paired sample t-test). This test is used to test the significant difference between the pre-test and post-test values of students' upper service ability after being given treatment in the form of arm power training.

RESULTS AND DISCUSSION

Result

This study aims to determine the effect of arm power training on the ability of upper service in volleyball games in extracurricular students of SMP Kristen Bala Keselamatan Palu. This study used a pre-experimental one-group pre-test and post-test design, where initial measurements were taken (pre-test), then given treatment in the form of arm power training for six weeks, and continued with final measurements (post-test) to see the difference.

The subjects in this study were 20 female students who were members of the volleyball extracurricular activity. This study was conducted in the field of the Palu Christian Middle School. All participants were given arm power training with training methods consisting of push-ups, pull-ups, and dumbbell curls. The training activities were carried out for six weeks with a training frequency of three times a week, as stated in the training program that had been previously designed by the researcher.(Sutriawan, 2022).

Before being given treatment, participants were given a pre-test to measure their upper limb service ability. The test was conducted by giving six service opportunities towards the court that had been divided into value zones. The results of this pre-test showed that the average value of students' upper service ability was 8.25. This value reflects the level of basic upper service skills of students before being given special training to strengthen their arm muscles.

After six weeks of arm power training, participants were retested using the same procedure. The posttest showed that the average score for overhead serve ability increased to 13.55. Thus, there was a difference of 5.3 points between the pre-test and post-test results. This increase indicates a significant change in students' ability to perform overhead serves after being given the training treatment.

Furthermore, to ensure whether the increase is statistically significant, data analysis was conducted using the t-test (paired sample t-test). The calculation results show that the t-value = 12.33, while the t-table value at a significance level of 5% with degrees of freedom (df) = 19 is 1.729. Because t-value > t-table (12.33 > 1.729), it can be

concluded that there is a significant difference between the pre-test and post-test values. Thus, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted, which states that arm power training affects students' upper arm service ability.

These findings suggest that the training program designed by the researchers can improve arm muscle strength, which is an important factor in the execution of the overhead serve technique in volleyball. During the training process, students were actively involved in arm muscle strengthening exercises, such as push-ups that train the chest and triceps muscles, pull-ups that target the back and biceps muscles, and dumbbell curls that focus on increasing bicep muscle strength.

The improvement in post-test results was not only seen from the aspect of the score, but also from the quality of the upper service movement demonstrated by the participants. During the post-training observation process, students showed consistency in hitting techniques, increased ball delivery strength, and better accuracy when the ball was directed to the opponent's area. This strengthens the assumption that arm power training contributes directly to improving the basic technique of the upper service.

From the individual participant data, almost all students experienced an increase in their scores in the final test. There was no decrease in performance or regression from the initial to the final test results. This consistency of improvement indicates that the training provided is not only effective, but can also be applied generally to similar groups. In addition, there were no reports of injuries or physical disorders during the training process, indicating that the training program is safe for adolescent students with appropriate supervision.

From a practical perspective, the results of this study provide positive implications for physical education teachers and extracurricular coaches in schools. Simple arm power training that does not require complex equipment can provide effective results in improving students' upper arm performance. This also opens up opportunities to design simple physical training programs that are efficient, affordable, and can be carried out in various school environments.

In general, the results of this study indicate that there is a strong relationship between arm muscle strengthening exercises and increased upper serve technique ability in volleyball. Therefore, it is recommended for coaches and PJOK teachers to include arm power training elements into the curriculum or extracurricular programs routinely in order to improve basic volleyball technique performance, especially in upper serves.

Discussion

This study aims to determine the effect of arm power training on the ability to serve overhead in volleyball games in extracurricular students of SMP Kristen Bala Keselamatan Palu. Based on the results of the study, it was found that there was a significant increase in the value of the upper service ability after students were given

arm power training for six weeks. The average pre-test score of 8.25 increased to 13.55 in the post-test, with a difference in increase of 5.3 points. The results of the statistical test showed that the t-value of 12.33 was greater than the t-table of 1.729, which means that the increase was significant at a confidence level of 95%.

This improvement shows that arm power training significantly contributes to improving students' upper serve performance. Upper serve in volleyball is a basic technique that requires upper body coordination, especially the strength and stability of the arm, shoulder, and chest muscles. Therefore, training that focuses on increasing the strength of these muscles can help students perform upper serves more effectively and accurately. The arm power training used in this study consisted of three main forms of exercise, namely push-ups, pull-ups, and dumbbell curls. Push-ups train the chest muscles, triceps, and core muscles, which are very important in generating power for the serve. Pull-ups strengthen the back muscles and biceps, which play a role in the stability of the upward arm swing movement. Meanwhile, dumbbell curls specifically target the strength of the biceps muscles, which help control the direction and power of the ball when serving.

The significant increase in post-test scores also indicates that the exercise program has been designed with intensity, volume, and frequency appropriate for the age and physical abilities of junior high school students. The exercises were conducted three times a week with direct supervision, ensuring that each student could perform the movements correctly and safely. This is in line with the principles of exercise according to (Bompa & Haff, 2009), which states that training should be done gradually, systematically, and individually in order to achieve optimal results without causing injury or excessive fatigue. From a physiological perspective, increased muscle strength due to weight training or resistance training (such as push-ups and dumbbell curls) occurs through the process of muscle adaptation. Repeated training will stimulate muscle fibre growth (hypertrophy), increase muscle contraction, and improve movement efficiency. This follows the opinion (Harsono, 2015) that muscle strength is a major component in supporting sports skills, especially those that require explosive power, such as overhead serves. In addition to the strength aspect, regular implementation of training also trains students' physical endurance.

During the training process, students learn to control their breathing, body rhythm, and maintain stable movements. Observation results show that in addition to strength, students' concentration and hitting techniques also increase, as indicated by the increased accuracy of the ball towards the target area on the opponent's field. This indicates that physical training also indirectly affects the technical and psychological aspects of the game.

This research is also in line with previous research, such as that conducted by (Yogo et al., 2013), which states that arm muscle training has an effect on the results of overhead serves in extracurricular volleyball participants. Likewise with the findings (Abdelkarim et al., 2017) state that push-up exercises can significantly increase arm muscle strength. This shows consistency between research results and strengthens that arm muscle strength

training does provide an important contribution to improving basic volleyball technique skills.(Purwanto et al., 2023). From a practical perspective, the results of this study provide direct benefits for schools, coaches, and students. For schools, improving students' ability in overhead serves can support achievements in inter-school volleyball matches. For coaches, this study shows the importance of a structured and technique-based training program. For students, this training not only improves volleyball skills but also forms exercise habits that can improve overall physical fitness.

However, this study has several limitations. First, the sample size was relatively small (20 female students) and was only conducted in one school, so the results cannot be generalized to a wider population. Second, this study only focused on arm power training without measuring other factors such as coordination, basic techniques, or mental factors that can also affect the results of the overhead serve. Therefore, it is recommended that further research include other variations of training and involve more schools or different age groups to get a more comprehensive picture.

CONCLUSION

Based on the results of the research and discussion that have been conducted, it can be concluded that arm power training has a significant effect on improving the ability to serve overhead in volleyball games in extracurricular students of SMP Kristen Bala Keselamatan Palu. Theoretically, the increase in the ability to serve overhead is influenced by the muscle adaptation process that occurs through weight training such as push-ups, pull-ups, and dumbbell curls, which directly strengthen the muscles of the arms, shoulders, and chest—parts of the body that play an important role in the movement of the serve overhead. In addition, training that is carried out consistently also trains endurance, stability of movement, and body coordination. The results of this study strengthen previous findings that arm muscle strength training can be an effective training method in improving basic volleyball skills, especially the serve overhead technique.

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