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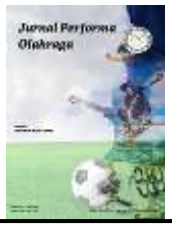

THE EFFECTIVENESS OF DUMBBELL TRAINING ON VOLLEYBALL OVERHEAD SERVICE ABILITY

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ABSTRACT

Volleyball requires mastery of basic techniques, one of which is the overhead serve, which requires coordination, arm and shoulder muscle strength, and upper body stability. However, in practice, many players, especially beginners or school students, struggle to produce a powerful, accurate, and consistent serve. This highlights the need for a training approach that can improve the strength and accuracy of the serving motion. One form of training that is thought to be effective is dumbbell training, as it can increase the strength of the specific muscles used in the serving motion. The purpose of this study is to explore the effectiveness of dumbbell training on the ability to serve over the top of the volleyball game. Sampling was carried out using the total sampling technique so that a sample of 30 male people aged 16 to 19 years was obtained, who actively practiced volleyball.. The research instrument was the upper service ability test, the training method used was dumbbells. By applying statistical analysis, the t-test was carried out using SPSS version 25 software, it was revealed that there was a positive influence between arm muscle strength and upper service ability, with a value (t count) of 2.218 and a value that had a significant level of 0.000 <0.05. It was proven that there was a percentage increase of 20.05% in the pre-test and post-test after doing arm muscle strength training. These results mean the effectiveness of dumbbell training on the ability to serve over the top of the volleyball game. Recommendations for further research are suggested to examine the effects of dumbbell training not only on overhead serves, but also on other abilities such as smashes, passing, or blocking, in order to provide a comprehensive picture of the benefits of this training in the context of volleyball.

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INTRODUCTION

Volleyball is one of the most popular team sports in the world and is widely played across all age groups, both competitively and recreationally (Maliki, 2017; Martono et al., 2017). Among the basic skills in volleyball, the overhead serve plays a vital role as it initiates play and often determines the course of play (Rusli et al., 2018; Panjaitan, 2020). An effective overhead serve combines elements of power, coordination, timing, and accuracy, and often distinguishes skilled players from novices (Ningsih et al., 2020). Despite its importance, the development of serving skills, particularly the overhead serve, remains a persistent challenge in physical education programs and school-level training environments. In educational institutions, volleyball training for students primarily focuses on game simulations and general technique drills (Rusli et al., 2022; Sari & Guntur,

2017). While this is important, such an approach may overlook the importance of developing certain physical attributes, particularly upper limb strength, which has a direct impact on the power and consistency of the serve (Panjaitan, 2020; Marsuna, 2023). Arm and shoulder muscle strength contribute to the speed, height, and accuracy of the volleyball serve, indicating the need for targeted strength training to support technical skill development (Andibowo, 2018).

Dumbbell training provides stimulation to the muscles of the arms, shoulders, chest, and back which play an important role in the execution of the upper serve movement. By increasing the strength and explosive power of these muscles, athletes become more able to produce strong, accurate, and stable strokes when performing upper serves. In addition, dumbbell training also helps improve motor coordination and upper body stability. This is very important in upper serves which require a balance between strength and movement control. Thus, the use of dumbbells in volleyball physical training provides comprehensive benefits, not only in terms of strength, but also in terms of technique and movement consistency (Fauzi, 2024). These results are in line with the theory of weight training which states that resistance training such as dumbbells can increase muscle power, which is one of the main components in upper serve performance. This study also supports previous findings which state that increasing muscle strength through weight training has a positive effect on technical skills in sports, including volleyball.

Dumbbell training, known for its practicality, affordability, and adaptability to varying strength levels, presents a promising intervention to improve upper body strength (Ardi et al., 2019). Unlike machine-based strength training, dumbbells allow for functional, multidirectional movements that mimic sport-specific actions (Saputra et al., 2023). However, despite dumbbell training being widely used in professional sports and fitness contexts, its applicability and effectiveness in improving volleyball serving skills especially among high school students are under-explored in the current literature.

Research by Maliki, (2017), has explored the effects of general strength training on sport performance, but few have isolated the effects of light-resistance dumbbell training on specific skills such as the overhead serve. Additionally, the majority of existing research has been conducted at the collegiate or elite athlete level, with limited empirical data focused on school-age populations. This creates a gap in the literature regarding the practical implementation of strength-focused interventions in secondary education settings. To address this gap, the current study investigated the effectiveness of a structured dumbbell training program in improving overhead serve performance in volleyball among high school students. Using a quasi-experimental design involving pre-test and post-test measurements, this study sought to determine whether dumbbell-based strength training could serve as a practical and impactful method for improving volleyball serving skills in young athletes.

The novelty of this study lies in its specific focus on the integration of targeted upper limb strength training using dumbbells into the physical education curriculum and the direct measurement of its effects on fundamental volleyball skills. This study offers a cost-effective and replicable training model that can benefit physical education instructors, school coaches, and sports development programs. Therefore, the main objective of this study was to test the effectiveness of dumbbell strength training on overhead serve ability in volleyball, providing empirical evidence to support its application in school-based sports training. The results of this study are expected to contribute to the development of evidence-based training strategies to improve students' volleyball performance and promote more scientific physical education practices.

METHOD

This study is intended to investigate the impact of dumbbells on the quality of volleyball service through a field experiment research method. Sampling was carried out using the total sampling technique so that a sample of 30 male people aged 16 to 19 years was obtained, who actively practiced volleyball. The sample used a total sampling method where the entire population of 30 people was sampled. The number of participants in this study was 30 individuals. The instruments used in this study were the upper service skill test (Nurhasan, 2001), and the dumbbell training method. The descriptive analysis intended is to calculate the value, standard deviation, mode, median, average, maximum value, and minimum value. Then a t-test will be conducted to assess the level of influence between the pre-test and post-test. Before analyzing the t-test, the initial step is to conduct a prerequisite analysis test, including normality testing and homogeneity testing.

RESULT AND DISCUSSIONS

Table 1. Descriptive Statistical Analysis

Variable	*Mean*	Standard Deviation	Maximum	Minimum
Pretest	18,81	2,858	24	14
Posttest	22,56	2,329	26	16

Based on table 1 which presents the results of descriptive statistics before being given treatment in the form of dumbbell training, the students' upper service ability showed an average of 18.81, which shows that in general students were able to do around 19 serves correctly or according to the criteria in the test. The Standard Deviation of 2.858, shows that there is a fairly large variation or spread of values from the average. This means that there is a fairly striking difference in ability between one student and another. The Maximum Value is 24, meaning that students with the best results are able to do up to 24 serves that meet the criteria. The Minimum Value of 14, shows that students with the lowest results are only able to achieve 14 serves that meet the criteria. After students underwent dumbbell training, the average results increased to 22.56, which indicates an increase in overall service ability. This shows that the training given has a positive impact on students' abilities. The Standard Deviation decreased to 2.329, which shows that the variation in values between students was slightly smaller than during the pretest. This could mean that the increase in ability occurred more evenly among students. The Maximum Score increased to 26, meaning that the highest ability achieved by students after training also increased from the pretest. The Minimum Score also increased to 16, indicating that the ability of students with the lowest results also increased compared to before training. There was an increase in the average upper serve score from pretest to posttest, an increase in the maximum and minimum scores, and a decrease in the standard deviation. This indicates that dumbbell training has a positive impact on improving students' volleyball upper serve abilities, both individually and in groups. In addition, this increase also shows that the training program is effective and able to improve students' performance in performing upper serves in volleyball games.

Table 2. Pretest Interval Class Frequency

Number	Class interval	Frequenc	Percentage
1	14 - 15	4	13%
2	16 - 17	9	30%
3	18 - 19	7	23%
4	20 - 21	3	10%
5	22 - 23	4	13%
6	24 - 25	3	10%
	Total	30	100%

Based on the frequency distribution table of students' volleyball upper service ability scores divided into interval classes, the following explanation can be given, namely the interval class 16-17 has the largest number of students, namely 9 students (30%). This shows that most students get upper service scores in this value range, making this class the mode (the most frequently appearing value) in the data distribution. The interval class 18-19 is followed by 7 students (23%), also showing that many students are in the middle to upper value category, indicating fairly good service ability. The lowest value class, namely 14-15, is followed by 4 students (13%), indicating that there are still some students who need further coaching. Likewise, there are 4 students (13%) in class 22-23, indicating that there is also a group of students with better upper service ability. The highest class, namely 24-25, is occupied by 3 students (10%), indicating students who stand out in upper service ability. The value in class 20-21 is also obtained by 3 students (10%). The conclusion is that most students (53%) are in the 16–19 grade range, meaning their upper serve ability is in the fair to good category. A small number of students (10%) managed to achieve the highest score (24–25), indicating an improvement or very good result from the training that has been given. This distribution also shows that only a small number of students are still in the low category (14–15), indicating that the training program is starting to have a positive impact, although further guidance is still needed for this group.

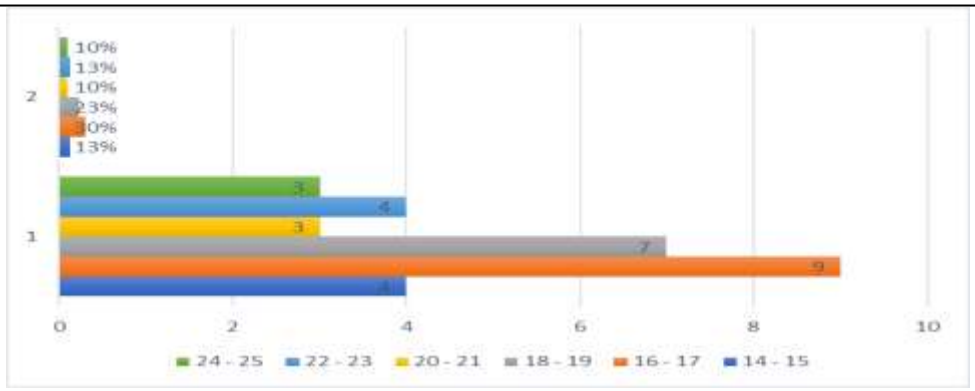

Figure 1. Histogram of Pretest Volleyball Overhead Service Ability

Table 2. Posttest Interval Class Frequency

Number	Class interval	Frequenc	Percentage
1	16-17	1	3%
2	18-19	2	7%
3	20-21	7	23%
4	22-23	9	30%
5	24-25	8	27%
6	26-27	3	10%
	Total	30	100%

Based on the frequency distribution table of the results of volleyball upper service ability after being given treatment, the majority of students (30%) are in the 22-23 interval class, which means that most students show good upper service ability after following the arm muscle strength training program. The 24-25 interval class was attended by 8 students (27%), indicating that students' abilities are increasing and approaching the very good category. As many as 3 students (10%) are in the 26-27 class, which is the group with the highest score. This shows that there are students who have experienced a significant increase in ability and have reached a very optimal level. The 20-21 interval class was also quite widely attended, namely by 7 students (23%), indicating that many students are already at the middle to upper ability level. Only 1 student (3%) and 2 students (7%) are in the 16-19 class, indicating that the number of students with low service ability is decreasing after the training is carried out. This is a positive sign of the success of the training. The conclusion is that the distribution of values is shifting towards high values, compared to the previous pre-test table. There was a significant increase in students' upper service ability after being given arm muscle strength training. Only 3 students (10%) were in the highest score category (26–27), but the majority of students (80%) were in the 20–25 range, indicating that the practice had an effective impact on improving the performance of the majority of students.

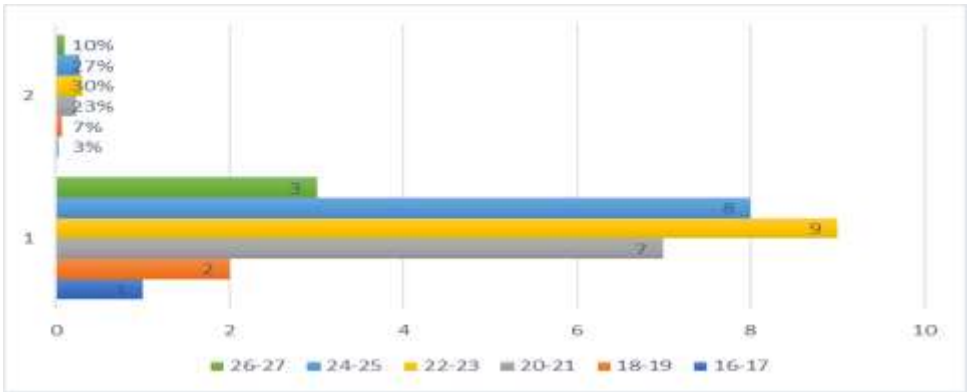

Figure 2. Histogram of Posttest Volleyball Overhead Service Ability

The normality test is used to determine whether the data in the pretest and posttest variables are normally distributed or not. Normal distribution is one of the requirements in the use of parametric statistical tests such as the t-test. Asymp. Sig is the significance value of the normality test (Kolmogorov-Smirnov). The Alpha level (α) is the significance limit, usually set at 0.05. Decision Making Criteria: If Asymp. Sig > 0.05, then the data is normally distributed. If Asymp. Sig ≤ 0.05, then the data is not normally distributed.

Table 3. Normality of Research Data

Number	Variable	Asymp. Sig	Alpha Level	Conclusion
1	*Pretest*	0,127	0,05	Normal
2	*Posttest*	0,134	0,05	Normal

The pretest results obtained an Asymp. Sig value of 0.127, greater than 0.05. Therefore, the pretest data is normally distributed. While the posttest data obtained an Asymp. Sig value of 0.134, also greater than 0.05. Therefore, the post-test data is normally distributed. Both pretest and posttest data have a normal distribution, so parametric statistical tests such as paired t-tests can be used to test the difference in results before and after treatment.

Table 4. Homogeneity of Research Data

Statistical results	S	S^2	t_{hitung}
Pretest	18,71	353,44	
Posttest	22,55	509,4	1,43

Based on the data, the distribution of data from the average pretest value is 18.71, while the posttest is 22.55. This shows that the test results after training are slightly more spread out, but also reflect an increase in performance (because the average increases, see the previous table). The pretest variance is 353.44. Posttest is 509.4. The posttest variance is higher, indicating that although there is an increase in results, the distribution is more diverse. The t-count value is 1.43. This is the value of the t-test results used to determine whether the difference between the pretest and posttest values is significant or not.

Table 5. Hypothesis with t-test

Variable	Pretest And Posttest Results	t_{table}	*Sig.* 0,05
Pretest and posttest	2,218	2,042	0.00

Based on the table of the difference test between pre-test and post-test, here is an explanation of the results of the statistical analysis, namely t count of 2.218, t table of 2.042. Because t count > t table, there is a statistically significant difference between the results of the pretest and posttest.

Discussions

This study aimed to evaluate the effectiveness of dumbbell strength training in improving the performance of upper serve in volleyball players. The findings showed a statistically significant increase in the posttest score compared to the pretest, indicating that dumbbell training effectively increased the upper body strength of the participants, which in turn contributed to the improvement of the technical execution of the upper serve. Dumbbell training provides a stimulus to the muscles of the arms, shoulders, chest, and back that play an important role in the execution of the upper serve movement. With the increase in strength and explosive power of these muscles, athletes become more capable of producing powerful, accurate, and stable strokes when performing an upper serve. In addition, dumbbell training also helps improve motor coordination and upper body stability. This is very important in an upper serve that requires a balance between strength and movement control. Thus, the use of dumbbells in volleyball physical training provides comprehensive benefits, not only in terms of strength, but also in terms of technique and movement consistency.

These results are in line with the theory of weight training which states that resistance training such as dumbbells can increase muscle power, which is one of the main components in upper service performance. This study also supports previous findings stating that increasing muscle strength through weight training has a positive effect on technical skills in sports, including volleyball. These results are in line with previous studies that emphasize the role of upper limb strength in volleyball performance. For example, a study by Saputra et al., (2023), showed that weight training with dumbbells significantly improved the service ability of male volleyball extracurricular participants at SMKN 3 Seluma, with a t-count of 9.576 which exceeded the t-table value of

2.048, indicating a substantial effect of the training intervention. In addition, a study by Kurniawan et al., (2024), found that dumbbell training had a positive effect on upper service ability among junior high school students, with a t-count of 10.318 which exceeded the t-table value of 2.131, which further strengthened the efficacy of the training method in improving volleyball service skills.

The underlying mechanism for these improvements may be attributed to the increased muscle strength and neuromuscular coordination resulting from resistance training. Dumbbell training specifically targets the deltoid, triceps, and forearm muscles, which are critical for generating the force and control required during the overhead serve. The repetitive nature of the training likely contributes to muscle hypertrophy and increased motor unit recruitment, leading to more powerful and accurate serves. Furthermore, a study by Iskandar & Wirno, (2021), highlighted the benefits of an 8-week dumbbell circuit strength training program on the volleying and digging skills of collegiate volleyball players, indicating that the training not only improved serving ability but also other important volleyball skills. However, it is important to note that while dumbbell training has shown positive effects, other training modalities offer additional benefits. While training methods can produce comprehensive performance improvements, the findings of this study suggest that dumbbell-based strength training is an effective method for improving overhead serve performance in volleyball players. Coaches and physical educators are encouraged to incorporate such training regimens into their programs to improve serving ability and overall athlete performance.

CONCLUSSION

Based on the results of data analysis, statistical processing, and discussion of the effect of dumbbell training on overhead serve ability in volleyball, several conclusions can be drawn. This is demonstrated by the significant increase in post-test results. This means that providing resistance training stimulus through the use of dumbbells can improve the strength of the muscles directly involved in the overhead serve movement, such as the upper arm, shoulder, and upper back muscles, as well as upper body coordination. Overhead serve ability is strongly influenced by the strength and explosive power of the arm and shoulder muscles. Dumbbell training, with the appropriate intensity and volume, can provide muscle stimulation that can strengthen these muscles. With increased strength, volleyball players become more capable of producing powerful, accurate, and stable serves, which are indicators of successful overhand serve technique. Dumbbell training not only plays a role in physical strength but also contributes to improved motor control and postural stability. Regular and structured training can improve basic overhand serve technique, both in the initial phase, at ball contact, and in the follow-up movement. This also influences the accuracy and effectiveness of a player's serve. While this study yielded significant and useful results, there are several limitations that should be considered for further research. Therefore, the researchers recommend further research with varying dumbbell weights and training durations. This study used only one type of weight and limited training duration. Further research is recommended to explore the use of light, medium, and heavy weights to determine their effects on muscle strength and overhead serve performance. Furthermore, a longer training duration (8–12 weeks) may yield more optimal and sustainable results. The research sample should be expanded to include a variety of ages and skill levels. This study only involved adolescent/student subjects with basic skills.

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