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The Effect Of Overhead Dumbbell Exercises On Improving Lob Shots In Badminton Games

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ABSTRACT

This study was motivated by the need to improve students' badminton lob stroke performance through a simple, structured, and applicable training method in school-based physical education. The lob stroke is an important basic technique in badminton because it allows players to direct the shuttlecock high and deep into the opponent's backcourt area. However, many students still experience difficulty producing a strong, controlled, and accurate lob due to limited arm strength, shoulder stability, wrist control, and overhead movement coordination. Therefore, this study aimed to determine the effect of overhead dumbbell training on improving badminton lob strokes among students of SMK Negeri 6 Makassar. This research used a quantitative experimental method with a control group pretest–posttest design. The sample consisted of 20 students, divided into two groups: 10 students in the overhead dumbbell training group and 10 students in the control group. The experimental group received overhead dumbbell training, while the control group followed regular badminton learning activities without the specific training intervention. Data were collected using a badminton lob stroke test before and after the treatment. The data were analyzed descriptively and inferentially using an independent sample t-test. The results showed that the experimental group improved from a pretest mean score of 15.4000 to a posttest mean score of 21.6000, with an increase of 6.2000 points. Meanwhile, the control group improved from 15.4000 to 18.5000, with an increase of 3.1000 points. The independent sample t-test showed a t-count value of 2.175, higher than the t-table value of 2.093, with a significance value of 0.043 < 0.05. It can be concluded that overhead dumbbell training has a significant effect on improving badminton lob stroke performance among students of SMK Negeri 6 Makassar.

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INTRODUCTION

Physical Education, Sports, and Health is an integral component of the educational system because it does not merely develop students' physical fitness, but also strengthens motor competence, critical thinking, social interaction, emotional stability, discipline, moral action, and healthy lifestyle awareness through structured physical activity. In vocational school settings, physical education should function as a learning space where students develop sport-specific skills through measurable, progressive, and pedagogically relevant training programs. However, in practice, badminton learning is often still dominated by general

technical instruction, while physical conditioning that supports stroke quality is not always systematically integrated into the learning process. This condition may limit students' ability to perform technically demanding strokes, especially the lob stroke, which requires coordinated upper-limb strength, shoulder stability, wrist control, timing, and accuracy.

Badminton is one of the most popular small-ball sports in Indonesia and is widely taught in school physical education because it is accessible, competitive, and rich in motor-skill learning. Badminton requires players to hit the shuttlecock across the net using a racket, either in singles or doubles, while applying various strokes with different speeds, directions, trajectories, and tactical intentions. Basic badminton techniques generally include grip, stance, footwork, and strokes, all of which must be mastered as an integrated movement system rather than as isolated technical elements (Bimantara et al., 2022; Devrilmez, 2016; Han et al., 2022). Among these techniques, the lob stroke has strategic importance because it sends the shuttlecock high and deep toward the opponent's backcourt, creating time for recovery, pushing the opponent away from the net, and opening opportunities for the next attacking pattern. Recent studies also emphasize that clear or lob performance is influenced by technical consistency, arm strength, wrist flexibility, and explosive power (Pohan et al., 2024; Lein et al., 2024; Alvarizi et al., 2026).

The development of badminton skills in school-based physical education has increasingly been linked to evidence-based learning models, motor competence, and sport-specific physical conditioning. Modified badminton-based physical education has been reported to improve students' motor skills, indicating that badminton can be used not only as a sport unit but also as a medium for broader motor development (Ishak et al., 2025; Saleh et al., 2025). In addition, student-centered and game-based approaches have shown positive effects on basic badminton skills because they increase engagement, repetition, and contextual decision-making during learning (Amri et al., 2025; González-Peño et al., 2024; Ibrahim, 2025).

From a biomechanical perspective, overhead badminton strokes depend on sequential coordination of the lower limbs, trunk, shoulder, elbow, forearm, wrist, and racket. Studies on overhead clear and smash techniques show that skilled players generate more effective segmental acceleration and better upper-limb coordination than novice players (Huang et al., 2025; Zhao et al., 2019; Rusdiana et al., 2021). The shoulder, elbow, and wrist contribute substantially to racket speed and shuttlecock trajectory, meaning that technical learning must be supported by adequate muscular strength and neuromuscular control (Ahmed & Ghai, 2020; Artazila et al., 2024; Dong et al., 2024). Therefore, improving the lob stroke is not only a matter of repeating the hitting motion, but also of strengthening the physical components that allow students to execute the stroke with height, distance, control, and accuracy.

Resistance training has become an important part of youth and adolescent sport development when it is supervised, progressive, technically safe, and adjusted to students' characteristics. Contemporary evidence shows that resistance training can improve muscular strength, power, motor performance, and injury-prevention capacity in children and adolescents (Lloyd et al., 2016; Behm et al., 2017; Chaabene et al., 2020; Lesinski et al., 2020; León-Reyes et al., 2025; Moreno-Torres et al., 2025). Dumbbell-based exercises are practical for school settings because they are relatively simple, low-cost, adjustable, and suitable for developing upper-limb strength. Specifically, overhead dumbbell training activates the shoulder complex, triceps, scapular stabilizers, and upper back muscles, which are closely related to overhead striking movements in badminton (Błażkiewicz et al., 2022; Coratella et al., 2022).

Although several studies have examined badminton skill learning, lob drills, multishuttle training, arm-muscle training, and resistance-band interventions, research that specifically investigates the effect of overhead dumbbell training on improving lob stroke performance among vocational school students remains limited. Previous studies have mostly focused on general badminton learning models, smash performance, forehand clear, or athlete populations rather than physical education students in vocational schools (Tiong et al., 2019; Wang et al., 2025; Hu et al., 2025; Ishak et al., 2025). Other studies have confirmed the relationship between arm strength, wrist flexibility, and lob ability, but correlational findings do not directly explain whether a structured overhead dumbbell program can cause measurable improvement in students' lob stroke performance.

This gap is important because students of SMK Negeri 6 Makassar need a training approach that is not only technically relevant but also feasible within school-based physical education. The lob stroke requires students to combine overhead movement mechanics with sufficient arm and shoulder strength. Without

specific conditioning, students may hit the shuttlecock too flat, too short, or without stable control. Therefore, overhead dumbbell training is conceptually relevant because it strengthens the movement pattern that supports overhead stroke execution.

This study aims to determine the effect of overhead dumbbell training on improving lob stroke performance in badminton among students of SMK Negeri 6 Makassar. The novelty of this research lies in its attempt to integrate a simple resistance-training method into badminton learning within a vocational school context. Unlike studies that focus only on technical drills, this research positions overhead dumbbell training as a supporting intervention that connects physical conditioning with technical execution. Thus, the study contributes to the development of evidence-based physical education practice, especially in designing badminton learning that is measurable, practical, and responsive to students' motor-skill needs.

Based on the conceptual and empirical literature, badminton lob performance is shaped by technical mastery, upper-limb strength, wrist control, shoulder stability, and repeated task-specific practice. Overhead dumbbell training is assumed to be a relevant intervention because it develops the muscular components involved in overhead hitting actions. Therefore, this study is expected to provide empirical evidence that strengthens the role of structured resistance training in improving badminton lob strokes among vocational school students, while also offering practical implications for physical education teachers and coaches in developing more effective badminton learning programs

METHODS

This study employed a quantitative experimental method using a control group pretest–posttest design to examine the effect of overhead dumbbell training on the improvement of badminton lob strokes among students of SMK Negeri 6 Makassar. An experimental approach was selected because the study aimed to test the causal effect of a specific training intervention on a measurable motor-skill outcome. In sport and physical education research, pretest–posttest experimental designs are widely used to determine whether a structured intervention produces meaningful performance changes after treatment, especially when comparing an experimental group with a control group (Creswell & Creswell, 2018; Fraenkel et al., 2019; Ishak et al., 2025). Recent badminton studies also recommend controlled intervention designs because technical performance is influenced by training exposure, movement repetition, physical conditioning, and task-specific feedback.

The population of this study consisted of 20 students of SMK Negeri 6 Makassar, and all members of the population were used as the research sample because the population size was limited and manageable. The sample was divided into two groups: the experimental group, which received overhead dumbbell training, and the control group, which followed regular badminton learning activities without the overhead dumbbell intervention. Group allocation was conducted to ensure that both groups had comparable initial ability before treatment. This design allowed the researcher to compare the difference between pretest and posttest scores in each group and to evaluate whether the improvement in the experimental group was greater than that of the control group.

The independent variable in this study was overhead dumbbell training, while the dependent variable was badminton lob stroke ability. The intervention was designed to strengthen the shoulder, arm, wrist, and upper-body muscles involved in overhead badminton movements. This approach is consistent with recent evidence showing that properly supervised resistance training can improve strength, power, motor performance, and sport-specific movement quality in adolescents (Behm et al., 2017; Lesinski et al., 2020; Chaabene et al., 2020; León-Reyes et al., 2025). Biomechanical studies further indicate that overhead badminton strokes require coordinated movement of the shoulder, elbow, wrist, trunk, and lower limbs, making upper-limb strengthening relevant for improving stroke execution and shuttlecock trajectory (Zhao et al., 2019; Cui et al., 2022; Huang et al., 2025; Dong et al., 2024).

Data were collected using a badminton lob stroke test administered before and after the intervention. The pretest measured students' initial lob ability, while the posttest measured performance after the treatment period. The test focused on the ability to direct the shuttlecock high and deep toward the opponent's backcourt area, reflecting the functional purpose of the lob stroke in badminton. The collected data were analyzed descriptively and inferentially. Descriptive statistics were used to determine the mean, standard deviation, minimum, maximum, and score improvement. Before hypothesis testing, the data were examined for normality

and homogeneity. If the assumptions were met, a paired-sample t-test was used to examine improvement within each group, while an independent-sample t-test was used to compare the improvement between groups. The hypothesis was accepted if the significance value was lower than 0.05, indicating that overhead dumbbell training had a significant effect on improving badminton lob stroke ability.

RESULTS AND DISCUSSION

Result

This section presents the results of data analysis concerning the effect of overhead dumbbell training on improving badminton lob strokes among students of SMK Negeri 6 Makassar. The analysis was conducted through descriptive statistics, normality testing, and hypothesis testing using an independent sample t-test. The research involved 20 students divided into two groups: 10 students in the overhead dumbbell training group and 10 students in the control group.

Descriptive Statistical Analysis

The descriptive analysis was conducted to describe the students' badminton lob stroke performance before and after the treatment. The results are presented in Table 1.

Table 1.
Descriptive Statistics of Badminton Lob Stroke Performance

Descriptive Statistics	Overhead Dumbbell Training Pretest	Overhead Dumbbell Training Posttest	Control Group Pretest	Control Group Posttest
N	10	10	10	10
Mean	15.4000	21.6000	15.4000	18.5000
Standard Deviation	3.20416	2.98887	3.09839	3.37474
Variance	10.267	8.933	9.600	11.389
Range	10.00	8.00	9.00	9.00
Minimum	11.00	17.00	11.00	14.00
Maximum	21.00	25.00	20.00	23.00
Sum	154.00	216.00	154.00	185.00

Source: Data processing, 2025.

Based on Table 1, the pretest score of the overhead dumbbell training group showed a total score of 154.00, with a mean score of 15.4000 and a standard deviation of 3.20416. The lowest score was 11.00, while the highest score was 21.00, resulting in a range of 10.00. After receiving the overhead dumbbell training intervention, the posttest score increased to a total of 216.00, with a mean score of 21.6000 and a standard deviation of 2.98887. The minimum score increased to 17.00, and the maximum score reached 25.00, with a range of 8.00.

In the control group, the pretest score also showed a total score of 154.00, with a mean score of 15.4000 and a standard deviation of 3.09839. The minimum score was 11.00, and the maximum score was 20.00, producing a range of 9.00. In the posttest, the control group obtained a total score of 185.00, with a mean score of 18.5000 and a standard deviation of 3.37474. The minimum score increased to 14.00, while the maximum score reached 23.00.

These results indicate that both groups experienced improvement from pretest to posttest. However, the increase in the overhead dumbbell training group was greater than that of the control group. The mean score of the experimental group increased by 6.2000 points, from 15.4000 to 21.6000. Meanwhile, the control group increased by 3.1000 points, from 15.4000 to 18.5000. This shows that overhead dumbbell training provided a stronger improvement in badminton lob stroke performance than regular learning activities without the specific training intervention.

Table 2.
Mean Score Improvement of Badminton Lob Stroke Performance

Group	Pretest Mean	Posttest Mean	Mean Improvement
Overhead Dumbbell Training	15.40	21.60	6.20
Control Group	15.40	18.50	3.10

The comparison shows that the overhead dumbbell training group achieved a higher posttest mean and a greater improvement score. Conceptually, this improvement may be related to the role of overhead dumbbell training in strengthening the shoulder, arm, wrist, and upper-body muscles involved in executing the badminton lob stroke. Since the lob stroke requires the shuttlecock to be hit high and deep into the opponent's backcourt area, students need sufficient upper-limb strength, movement control, and stroke stability.

Normality Test

Before hypothesis testing, a normality test was conducted to determine whether the data were normally distributed. The normality test used the Kolmogorov-Smirnov and Shapiro-Wilk tests with a significance level of 0.05. The results are presented in Table 2.

Table 3.
Results of Normality Test

Variable	Kolmogorov-Smirnov		Shapiro-Wilk		α	Description
	Statistic	Sig.	Statistic	Sig.		
Overhead Dumbbell Training	0.169	0.200	0.964	0.829	0.05	Normal
Control Group	0.181	0.200	0.952	0.692	0.05	Normal

Source: Data processing, 2025.

Based on Table 2, the normality test for the overhead dumbbell training group showed a Kolmogorov-Smirnov significance value of 0.200 and a Shapiro-Wilk significance value of 0.829. Both values were greater than 0.05, indicating that the data were normally distributed. Similarly, the control group obtained a Kolmogorov-Smirnov significance value of 0.200 and a Shapiro-Wilk significance value of 0.692. Since both significance values were also greater than 0.05, the control group data were categorized as normally distributed.

Thus, the data from both groups met the normality assumption. Therefore, the hypothesis testing was continued using a parametric test, namely the independent sample t-test, to compare the posttest scores between the overhead dumbbell training group and the control group.

Hypothesis Testing

The independent sample t-test was used to determine whether there was a significant difference in posttest badminton lob stroke performance between the overhead dumbbell training group and the control group. The results are presented in Table 3.

Table 4.
Independent Sample t-Test of Posttest Badminton Lob Stroke Performance

Variable	Group	Mean	Mean Difference	t-count	df	Sig. (2-tailed)	t-table
Badminton Lob Stroke Posttest	Overhead Dumbbell Training	21.6000	3.1000	2.175	18	0.043	2.093
	Control Group	18.5000					

Source: Data processing, 2025.

Based on Table 3, the independent sample t-test showed that the posttest mean score of the overhead dumbbell training group was 21.6000, while the posttest mean score of the control group was 18.5000. The mean difference between the two groups was 3.1000 points. The statistical test produced a t-count value of 2.175, while the t-table value at df = 18 was 2.093. In addition, the significance value was 0.043, which was lower than 0.05.

These findings indicate that there was a significant difference between the overhead dumbbell training group and the control group in badminton lob stroke performance. Since the t-count value was higher than the t-table value and the significance value was lower than 0.05, the null hypothesis was rejected. Therefore, it can be concluded that overhead dumbbell training had a significant effect on improving badminton lob strokes among students of SMK Negeri 6 Makassar.

The results also show that the students who received overhead dumbbell training experienced better performance improvement than those who did not receive the intervention. The experimental group improved by 6.2000 points, while the control group improved by only 3.1000 points. This difference suggests that

overhead dumbbell training is more effective in enhancing the physical components needed for lob stroke execution, especially arm strength, shoulder stability, wrist control, and overhead hitting consistency.

Overall, the descriptive and inferential analyses demonstrated that overhead dumbbell training contributed positively to the improvement of badminton lob stroke performance. The experimental group showed a higher increase in mean score compared with the control group. The normality test confirmed that the data were normally distributed, allowing the use of parametric statistical testing. The independent sample t-test further confirmed that the difference between the two groups was statistically significant. Therefore, the research hypothesis was accepted: overhead dumbbell training significantly improves badminton lob stroke performance among students of SMK Negeri 6 Makassar.

Discussion

The results of this study indicate that overhead dumbbell training had a significant effect on improving badminton lob stroke performance among students of SMK Negeri 6 Makassar. Descriptively, the experimental group showed a clear improvement from the pretest mean score of 15.4000 to the posttest mean score of 21.6000, with an increase of 6.2000 points. In comparison, the control group improved from 15.4000 to 18.5000, with an increase of 3.1000 points. The posttest comparison between the two groups also showed a mean difference of 3.1000 points in favor of the overhead dumbbell training group. Inferentially, the independent sample t-test produced a t-count value of 2.175, which was higher than the t-table value of 2.093, with a significance value of 0.043 < 0.05. These findings confirm that the improvement achieved by the experimental group was not merely caused by ordinary learning repetition, but by the specific contribution of overhead dumbbell training.

The stronger improvement in the experimental group can be explained through the principle of training specificity. The badminton lob is an overhead stroke that requires students to generate force through the coordinated action of the shoulder, elbow, forearm, wrist, trunk, and lower limbs. Overhead dumbbell training directly stimulates the upper-limb muscle groups involved in this movement pattern, particularly the deltoid, triceps brachii, rotator cuff, scapular stabilizers, forearm muscles, and wrist-supporting muscles. Therefore, the training intervention was mechanically relevant to the skill being improved. This is consistent with biomechanical studies showing that overhead badminton strokes depend on effective segmental coordination and force transfer from the body to the racket (Zhao et al., 2019; Rusdiana et al., 2021; Cui et al., 2022; Huang et al., 2025). In badminton, the quality of an overhead stroke is strongly related to the ability to control racket acceleration, contact timing, and shuttlecock trajectory. A lob stroke that is hit too weakly will fail to reach the opponent's backcourt, while a lob that lacks control may become an easy attacking opportunity for the opponent. Biomechanical research on overhead strokes also confirms the role of the shoulder, elbow, wrist, and racket velocity in producing effective shuttlecock flight.

These findings are also supported by recent literature on youth resistance training. Properly supervised resistance training has been shown to improve muscular strength, power, motor performance, and sport-specific movement outcomes among children and adolescents (Lloyd et al., 2016; Granacher et al., 2016; Behm et al., 2017; Myers et al., 2017; Collins et al., 2018; Peitz et al., 2018; Chaabene et al., 2020; Lesinski et al., 2020; León-Reyes et al., 2025; Moreno-Torres et al., 2025; Valle-Muñoz et al., 2025). The present study strengthens this evidence in the context of school badminton learning. The use of dumbbells is practical because it allows progressive loading, can be adjusted to students' ability levels, and does not require complex equipment. When applied with appropriate technique, supervision, and dosage, dumbbell training can become a safe and meaningful method for developing the physical foundation of sport skills. Recent reviews and position statements emphasize that youth resistance training is effective when it is developmentally appropriate, technically controlled, and integrated into broader physical education or sport training programs.

The improvement in lob stroke performance can also be associated with increased arm muscle strength and wrist control. Previous badminton research has shown that wrist flexibility, arm muscle strength, and arm explosive power are significantly related to lob shot ability (Ishak et al., 2024; Pohan et al., 2024; Lein et al., 2024). This means that a successful lob stroke is not only determined by technical knowledge, but also by the physical capacity needed to execute the movement effectively. The present data support this argument because students who received overhead dumbbell training achieved a higher posttest mean than those in the control group. This suggests that strengthening the upper limbs helped students hit the shuttlecock higher,

deeper, and more consistently. In practical terms, the exercise may have improved the students' ability to maintain racket stability during the contact phase and produce sufficient force to direct the shuttlecock toward the back area of the court. A 2024 study in JOCCA similarly reported significant relationships between wrist flexibility, arm muscle strength, arm explosive power, and lob shot ability in badminton.

From a pedagogical perspective, the findings are important for physical education teachers because they show that badminton skill learning should not rely only on repeated technical drills. Students often experience difficulty performing the lob because the movement requires strength, timing, coordination, and confidence. If the physical foundation is weak, students may understand the technique but still fail to produce an effective stroke. Therefore, the integration of overhead dumbbell training into badminton learning can help bridge the gap between technical instruction and physical readiness. This aligns with contemporary physical education research emphasizing that modified, structured, and evidence-based learning models can improve students' motor skills and sport-specific competence (Bimantara et al., 2022; Ishak et al., 2025; Saleh et al., 2025; Wardhana et al., 2026; Amri et al., 2025; González-Peño et al., 2024; Ibrahim, 2025). Badminton-based physical education studies have also shown that structured learning interventions can improve student motor skills more effectively than conventional learning alone.

Although the control group also experienced improvement, the magnitude was smaller. This improvement is understandable because the control group still participated in regular badminton learning, which allowed students to practice and become more familiar with the lob movement. However, the experimental group's higher improvement indicates that regular practice becomes more effective when supported by specific strengthening exercises. This finding supports the principle that technical skill development and physical conditioning should be treated as complementary components in sport education. Similar conclusions have been reported in studies showing that resistance training improves not only general strength but also movement quality, coordination, and sport-specific performance when the training task is relevant to the target skill (Suchomel et al., 2016; Moran et al., 2017; Lesinski et al., 2020; Chaabene et al., 2020; Dong et al., 2024).

Overall, this study confirms that overhead dumbbell training is an effective intervention for improving badminton lob stroke performance among students of SMK Negeri 6 Makassar. The significant difference between the experimental and control groups shows that the training provided a real contribution to students' performance development. Theoretically, the findings support the relationship between upper-limb strength, overhead movement mechanics, and lob stroke quality. Practically, the study offers an applicable training model for physical education teachers and badminton coaches at the school level. Overhead dumbbell training can be used as a simple, economical, and measurable method to strengthen students' arm, shoulder, and wrist capacity, thereby improving their ability to perform lob strokes more effectively in badminton learning.

CONCLUSION

Based on the results of the study, it can be concluded that overhead dumbbell training has a significant effect on improving badminton lob stroke performance among students of SMK Negeri 6 Makassar. The descriptive analysis showed that the experimental group, which received overhead dumbbell training, experienced a greater improvement than the control group. The mean score of the experimental group increased from 15.4000 in the pretest to 21.6000 in the posttest, with an improvement of 6.2000 points. Meanwhile, the control group increased from 15.4000 to 18.5000, with an improvement of 3.1000 points. This comparison indicates that students who followed the overhead dumbbell training program demonstrated better lob stroke development than students who only participated in regular badminton learning activities.

The hypothesis testing further strengthened this finding. The independent sample t-test showed that the t-count value was 2.175, which was higher than the t-table value of 2.093, with a significance value of 0.043 < 0.05. Therefore, the null hypothesis was rejected, and the research hypothesis was accepted. This means that there was a significant difference between the overhead dumbbell training group and the control group in badminton lob stroke performance.

Practically, overhead dumbbell training can be considered an effective, simple, and applicable training method for school-based badminton learning. The exercise supports the development of arm strength, shoulder stability, wrist control, and overhead movement coordination, all of which are important in producing

a high, deep, and accurate lob stroke. Thus, physical education teachers and badminton coaches may use overhead dumbbell training as a supporting program to improve students' technical performance in badminton.

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