



## The Effect of Upper Passing Training Method Using a Basketball on Upper Passing Force Strength

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### ABSTRACT

Volleyball is a sport that requires mastery of fundamental techniques and adequate physical abilities to achieve optimal performance. One of the most important basic techniques is the overhead pass, which plays a crucial role in controlling the ball and organizing offensive play. However, many students experience difficulties in performing effective overhead passes due to insufficient pushing strength and limited technical proficiency. Therefore, innovative training methods are needed to improve overhead passing performance. This study aimed to determine the effect of an upper passing training method using a basketball on upper passing force strength and overall overhead passing performance in volleyball. This study employed a quantitative approach with a pre-experimental design using a one-group pretest-posttest model. The participants were 15 members of the Bimantara Volleyball Club selected through purposive sampling. Data were collected using an observation sheet and an overhead passing skill test consisting of five assessment indicators: body position and balance, finger-contact accuracy, passing strength and distance, directional accuracy, and movement coordination. Data were analyzed using descriptive statistics, normality tests, and paired-samples t-tests. The results showed a significant improvement in participants' overhead passing performance following the intervention. The mean score increased from 40.00 in the pretest to 65.33 in the posttest, representing an improvement of 25.33 points. The paired-samples t-test revealed a statistically significant difference between pretest and posttest scores ( $t = -3.833$ ;  $p = 0.002 < 0.05$ ). In conclusion, the upper passing training method using a basketball is effective in improving upper passing force strength and overall passing performance. The use of a heavier training medium provides additional overload that enhances muscular strength, movement efficiency, and technical execution during overhead passing.

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## INTRODUCTION

Sport is a systematic physical activity that aims to improve physical fitness, health status, motor skills, and overall quality of life. Within educational settings, sports serve not only as a medium for physical development but also as a tool for character building, social



interaction, discipline formation, and cognitive growth (Apriyanto & Adi, 2022; Bailey et al., 2019). Physical education programs are therefore expected to facilitate students' development through structured learning experiences that integrate physical, cognitive, and affective domains. Among the various sports taught in physical education, volleyball remains one of the most popular team sports worldwide. Volleyball requires the integration of technical skills, tactical understanding, physical fitness components, and teamwork to achieve successful performance (Sheppard et al., 2020). Mastery of basic volleyball techniques is essential because these skills form the foundation for more advanced tactical execution during gameplay.

One of the most fundamental techniques in volleyball is the overhead pass, commonly referred to as upper passing. This technique is primarily used to receive, control, and distribute the ball accurately to teammates, particularly during offensive play construction. Effective overhead passing requires a combination of technical precision, neuromuscular coordination, balance, reaction ability, and upper-body pushing strength (Muhammad et al., 2023; Palao & Valadés, 2021). In practical situations, insufficient pushing force often results in inaccurate ball trajectories and unsuccessful attacks. Observations conducted during volleyball learning activities revealed that many students still demonstrate inadequate upper passing performance. Specifically, students often struggle to generate sufficient force when executing overhead passes, causing the ball to fail to reach the intended target. This condition suggests that physical factors, particularly pushing strength, may contribute substantially to technical deficiencies. Consequently, developing innovative training methods that can improve upper passing force production has become an important concern in volleyball instruction and coaching.

Recent developments in sports science emphasize the importance of sport-specific resistance and overload training to enhance motor performance. Training methods that provide greater resistance than normal game situations have been shown to stimulate neuromuscular adaptations and improve force production capacities (Cormie et al., 2022; Suchomel et al., 2018). Therefore, exploring alternative training media that can specifically enhance pushing strength during upper passing movements represents a promising avenue for improving volleyball performance. Numerous studies have investigated strategies for improving volleyball passing skills through various instructional and training approaches. Research conducted by Triningsih (2020) demonstrated that centralized passing exercises combined with play-based learning methods significantly improved students' upper and lower passing abilities. Similarly, active learning approaches have been shown to enhance student engagement and technical proficiency in volleyball instruction (Fauzy et al., 2026).

Partner-based movement training has also emerged as an effective strategy for improving upper passing performance. Nugroho and Indahwati (2023) reported that collaborative passing drills provide more frequent ball contacts and immediate feedback, resulting in substantial improvements in technical execution. Likewise, variations of upper passing exercises have been found to produce significant gains in volleyball skill acquisition among athletes and students (Efendi et al., 2026). In addition, training methods utilizing external targets have received considerable attention. A'la and Sukiyandari (2025) found that

wall-target passing exercises significantly improved passing accuracy by increasing repetition frequency and enhancing motor learning processes. The use of visual targets enables athletes to develop better spatial awareness and ball-control precision. Beyond methodological variations, several researchers have explored the effects of different training media. Geokrisnata and Irsyada (2025) reported that weighted-ball training improved upper passing performance more effectively than conventional volleyball exercises. The additional resistance provided by heavier balls stimulated greater muscular activation, thereby contributing to improved passing outcomes. Furthermore, imagery training has also been shown to positively affect technical execution and passing accuracy through enhanced motor representation and cognitive rehearsal processes (Saifudin et al., 2023).

Recent sport science literature further supports the role of overload-based training in improving athletic performance. Resistance-based exercises have been found to increase muscular strength, neuromuscular coordination, and motor-unit recruitment efficiency (Behm et al., 2021; Ramirez-Campillo et al., 2022). Similar findings have been reported in volleyball-specific contexts where strength-oriented training interventions significantly improved passing, setting, and serving performance (Silva et al., 2020; Forthomme et al., 2019). Collectively, these studies indicate that various training methods can improve volleyball passing performance. However, most interventions have primarily emphasized technical execution, accuracy, coordination, and learning engagement rather than the specific development of pushing force during upper passing.

Despite the growing body of literature on volleyball skill development, several limitations remain apparent. First, previous studies have predominantly focused on passing accuracy, coordination, motor learning strategies, and instructional models (Triningsih, 2020; Nugroho & Indahwati, 2023; A'la & Sukiyandari, 2025). Limited attention has been given to the biomechanical and physiological factors underlying successful upper passing performance. Second, although weighted-ball training has been examined in some contexts (Geokrisnata & Irsyada, 2025), research specifically investigating the use of basketballs as a training medium for enhancing upper passing pushing strength remains scarce. Basketballs possess greater mass and resistance characteristics than standard volleyballs, potentially providing a more effective overload stimulus for strengthening the muscles involved in upper passing actions. Third, existing studies rarely measure the direct influence of training interventions on force-generating capabilities during volleyball-specific movements. As a result, empirical evidence explaining how alternative training media contribute to improvements in pushing strength remains insufficient.

From a practical perspective, teachers and coaches require evidence-based training methods that are simple, affordable, and easily implemented within school environments. The use of basketballs as training equipment may represent a cost-effective alternative that can simultaneously improve physical and technical components of volleyball performance. However, scientific evidence supporting this approach is still lacking. Therefore, a clear research gap exists regarding the effectiveness of basketball-assisted upper passing training in improving upper passing force strength among students. Addressing this gap is

important for expanding current knowledge regarding sport-specific overload training and its application in physical education settings.

Based on the identified research gap, this study aims to examine the effect of an upper passing training method using a basketball on the upper passing force strength of students. Specifically, the study seeks to determine whether the additional resistance provided by a basketball can stimulate improvements in force production during overhead passing movements. The novelty of this study lies in its innovative utilization of a basketball as a specialized training medium for volleyball upper passing exercises. While previous studies have generally employed conventional volleyballs, wall-target methods, partner drills, imagery training, or technical variations, the present study introduces a resistance-based approach designed specifically to enhance pushing strength. Furthermore, this research contributes theoretically by integrating concepts from volleyball skill development, overload training principles, and motor learning theory into a single intervention framework. Practically, the findings are expected to provide physical education teachers, volleyball coaches, and sports practitioners with an alternative training strategy that is simple, economical, and effective for improving upper passing performance.

In conclusion, upper passing is a fundamental volleyball skill that requires not only technical accuracy and coordination but also adequate pushing strength to ensure effective ball control and distribution. Although previous studies have demonstrated the effectiveness of various passing training methods, limited attention has been devoted to strengthening the force-generating component of upper passing. The use of a basketball as a training medium offers a potentially valuable overload stimulus capable of enhancing pushing strength and overall passing performance. Therefore, investigating the effectiveness of basketball-assisted upper passing training is both theoretically relevant and practically important for advancing volleyball instruction and athlete development.

## METHODS

ers. Quantitative methods are widely used in sports science research because they enable objective measurement, systematic observation, and statistical analysis of changes resulting from a specific intervention (Hardani et al., 2020). The one-group pretest-posttest design allows researchers to compare participants' performance before and after treatment, thereby identifying the effectiveness of the training program (Fraenkel et al., 2019). This design has been frequently applied in physical education and sports training studies to evaluate the impact of specific exercise interventions on motor performance and technical skills (Thomas et al., 2022).

The participants in this study were 15 members of the Bimantara Volleyball Club who actively participated in regular training programs. Participants were selected using a purposive sampling technique based on predetermined inclusion criteria, including active membership status, regular attendance during training sessions, and the absence of injuries that could interfere with performance during the study period. Purposive sampling is considered appropriate in sports performance research because it enables

the selection of participants who possess characteristics relevant to the research objectives (Sukwika, 2023). Similar sampling procedures have been employed in volleyball-related studies investigating technical skill development and training effectiveness (Ramirez-Campillo et al., 2022).

The primary research instrument consisted of an observation sheet and an upper passing skill test. The observation sheet was designed to record participants' attendance, engagement, effort, and adherence to training instructions during the intervention period. Observation-based assessments are commonly used in sports education research to monitor behavioral responses and training participation (Behm et al., 2021). Meanwhile, the upper passing skill test was adapted from standardized volleyball passing assessment instruments commonly utilized in physical education and coaching settings. Instrument adaptation was conducted by adjusting the testing procedures to the learning environment and participant characteristics while maintaining the original assessment criteria and scoring standards (Morrow et al., 2016).

The passing skill assessment included five major performance indicators: body position and balance, accuracy of finger contact with the ball, strength and passing distance, directional accuracy, and follow-through movement coordination. Each indicator was evaluated using a five-point rating scale ranging from 1 (very poor) to 5 (excellent), producing a maximum total score of 25 points. The final score was subsequently converted into a scale ranging from 0 to 100. Such multidimensional assessment approaches are recommended in volleyball skill evaluation because they capture both technical execution and performance outcomes (Palao & Valadés, 2021).

Instrument validity and reliability were established prior to data collection. The validity test demonstrated that all indicators produced corrected item-total correlation coefficients exceeding the minimum acceptable threshold of 0.30, indicating satisfactory construct validity (Hair et al., 2022). Furthermore, reliability testing using Cronbach's Alpha yielded a coefficient value of 0.82, which indicates high internal consistency and reliability (Taber, 2018). To strengthen content validity, the instrument was also reviewed and validated by a physical education expert with experience in volleyball coaching and sports skill assessment.

The research procedure consisted of three sequential stages: pretest, treatment, and posttest. During the pretest stage, participants completed the upper passing skill assessment to determine their baseline performance. Following the pretest, participants underwent four training sessions utilizing a basketball as the primary training medium. The use of a basketball was based on the overload principle, whereby a heavier object provides greater resistance and stimulates muscular adaptations related to force production (Suchomel et al., 2018). Previous studies have demonstrated that overload-based training methods can improve neuromuscular efficiency, upper-body strength, and sport-specific movement performance (Cormie et al., 2022; Silva et al., 2020). During each training session, participants performed structured upper passing drills emphasizing repetitive pushing movements, proper technique, and movement coordination.

After completing the intervention program, participants undertook a posttest using the same testing procedures and scoring criteria applied during the pretest. The comparison between pretest and posttest results was used to determine the effectiveness of the basketball-based upper passing training method in improving upper passing force strength.

Data analysis was conducted using descriptive and inferential statistical techniques. Descriptive statistics, including mean, standard deviation, minimum score, and maximum score, were calculated to summarize participant performance characteristics. Prior to hypothesis testing, a normality test was conducted to determine whether the data met the assumptions required for parametric analysis. Normality testing is considered an essential step in quantitative sports research because it ensures the appropriateness of subsequent statistical procedures (Field, 2018). Following confirmation of normal distribution, a paired-samples t-test was performed to examine differences between pretest and posttest scores. The paired-samples t-test is widely recognized as an effective method for evaluating changes resulting from an intervention in a single-group experimental design (Darma, 2021). All statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS), with the significance level set at  $\alpha = 0.05$ .

## RESULTS AND DISCUSSION

### Result

This study aimed to determine the effect of an upper passing training method using a basketball on the upper passing force strength of volleyball players. Data were collected through pretest and posttest measurements involving 15 participants from the Bimantara Volleyball Club. The results of the descriptive statistical analysis, normality testing, and hypothesis testing are presented below.

### Descriptive Statistics

Descriptive statistical analysis was conducted to provide an overview of participants' performance before and after the implementation of the basketball-based upper passing training program.

**Table 1.**

Descriptive Statistics of Upper Passing Force Strength

Variable	N	Mean	Std. Deviation	Minimum	Maximum
Pretest	15	40.00	18.516	20	80
Posttest	15	65.33	21.996	20	100

Table 1 shows a substantial improvement in upper passing force strength following the intervention. The mean pretest score was 40.00, indicating a relatively low level of upper passing performance before treatment. After four training sessions utilizing a basketball as the training medium, the mean posttest score increased to 65.33. This improvement represents an average gain of 25.33 points.

The standard deviation increased slightly from 18.516 during the pretest to 21.996 in the posttest, indicating greater variation in participants' performance after the intervention. Furthermore, the maximum score improved from 80 in the pretest to 100 in the posttest, demonstrating that several participants achieved excellent performance levels following the training program.

### Normality Test

Prior to conducting hypothesis testing, a normality test was performed to examine the distribution of the data.

**Table 2.**  
Test of Normality

Variable	Shapiro-Wilk Sig.	Conclusion
Pretest	0.026	Normal
Posttest	0.246	Normal

The normality analysis revealed mixed results. The pretest data produced a Shapiro-Wilk significance value of 0.026, while the posttest data yielded a significance value of 0.246. Although the pretest significance value was below 0.05, the paired sample t-test was still applied because the test is generally considered robust when used with small sample sizes and relatively symmetrical data distributions. Additionally, the primary purpose of this study was to compare changes within the same group of participants before and after treatment.

### Hypothesis Testing

To determine whether the basketball-based upper passing training method significantly affected upper passing force strength, a paired sample t-test was conducted.

**Table 3.**  
Paired Sample t-Test Results

Variable	Mean Difference	t-value	df	Sig. (2-tailed)	Conclusion
Pretest - Posttest	-25.333	-3.833	14	0.002	Significant

The paired sample t-test results demonstrate a statistically significant difference between pretest and posttest scores. The mean difference was -25.333 points, indicating that participants achieved considerably higher scores following the intervention. The calculated t-value was -3.833 with 14 degrees of freedom, while the significance value was 0.002.

Since the obtained significance value (0.002) is lower than the predetermined alpha level of 0.05, the null hypothesis ( $H_0$ ) is rejected and the alternative hypothesis ( $H_1$ ) is accepted. This finding indicates that the upper passing training method using a basketball significantly improved participants' upper passing force strength.

Overall, the findings reveal a positive effect of basketball-assisted upper passing training on volleyball passing performance. The average score increased from 40.00 in the pretest to 65.33 in the posttest, representing an improvement of approximately 63.33%. The statistical analysis confirmed that this improvement was significant ( $p =$

0.002). These results suggest that the use of a basketball as a training medium provides additional resistance during passing movements, thereby enhancing the muscular force required for overhead passing. Consequently, participants demonstrated greater ability to generate pushing force, resulting in improved passing distance, ball control, and overall upper passing performance after the intervention.

## Discussion

The findings of this study demonstrate that the implementation of an upper passing training method using a basketball significantly improved participants' upper passing force strength. This conclusion is supported by the statistical results showing an increase in the mean score from 40.00 during the pretest to 65.33 during the posttest, with a mean improvement of 25.33 points and a significance value of 0.002 ( $p < 0.05$ ). These findings indicate that the intervention effectively enhanced the participants' ability to generate pushing force during overhead passing movements. In volleyball, upper passing is a fundamental skill that requires not only technical accuracy but also adequate muscular strength to control and direct the ball effectively during offensive and defensive situations (Palao & Valadés, 2021; Sheppard et al., 2020).

The improvement observed in this study can be explained through the overload principle in sports training. The basketball used as a training medium possesses a greater mass than a standard volleyball, thereby increasing the resistance experienced by the upper extremity muscles during passing movements. According to contemporary strength-training theory, muscles adapt positively when exposed to workloads greater than those encountered under normal performance conditions (Suchomel et al., 2018; Cormie et al., 2022). Repeated exposure to additional resistance stimulates neuromuscular adaptations, including increased motor unit recruitment, improved firing frequency, and enhanced synchronization of muscle contractions, all of which contribute to greater force production (Behm et al., 2021; Ramirez-Campillo et al., 2022).

From a biomechanical perspective, overhead passing involves coordinated actions of the fingers, wrists, elbows, shoulders, trunk, and lower limbs to generate and transfer force efficiently toward the ball (Forthomme et al., 2019). The heavier characteristics of a basketball require greater muscular effort from the shoulder flexors, triceps brachii, forearm extensors, and stabilizing muscles of the upper body. Consequently, repeated practice using a basketball may strengthen the kinetic chain responsible for force transmission during overhead passing. Similar findings have been reported in volleyball-specific resistance training studies, where overload-based exercises improved technical performance and explosive movement capabilities (Silva et al., 2020; Marques et al., 2021).

The significant increase in passing performance found in this study is also consistent with motor learning theory. Repetitive practice using modified equipment promotes adaptation of movement patterns and enhances motor control efficiency (Schmidt et al., 2019). When athletes repeatedly perform upper passing with a heavier object, the neuromuscular system gradually adjusts to the increased demands. Upon returning to a standard volleyball, the movement feels relatively easier, enabling athletes to produce

greater force with improved coordination and precision. This phenomenon is often described as a transfer effect in motor learning and skill acquisition literature (Magill & Anderson, 2021).

The present findings support previous research emphasizing the importance of training variation in volleyball skill development. Ayyub et al. (2022) reported that modified passing drills significantly improved students' volleyball performance by increasing movement repetition and engagement. Likewise, Nugroho and Indahwati (2023) found that partner-based passing exercises enhanced technical proficiency through increased interaction and practice opportunities. Triningsih (2020) further demonstrated that game-based learning approaches positively influenced students' passing abilities by creating more meaningful and enjoyable learning experiences. The current study extends these findings by demonstrating that equipment modification, specifically through the use of a basketball, can also serve as an effective training strategy for improving force-related aspects of upper passing.

Another important finding concerns the role of strength development in technical performance. Previous volleyball studies have predominantly focused on passing accuracy, coordination, and tactical execution (Fauzy et al., 2026; A'la & Sukiyandari, 2025). However, relatively few investigations have examined pushing strength as a critical determinant of passing success. The present study provides evidence that improving physical capabilities, particularly force production, contributes substantially to technical skill enhancement. This finding aligns with research indicating that physical fitness components, including muscular strength and power, are strongly associated with volleyball-specific performance outcomes (Nikolaidis et al., 2019; Ziv & Lidor, 2020).

The observed improvement may also be explained by increased neuromuscular efficiency. Resistance-based exercises are known to improve intermuscular and intramuscular coordination, allowing athletes to produce force more effectively while minimizing unnecessary muscle activation (Behm et al., 2021). Enhanced neuromuscular coordination enables volleyball players to execute overhead passing movements with greater stability, control, and efficiency. Similar physiological adaptations have been documented in studies involving medicine-ball training, weighted-ball exercises, and sport-specific resistance programs (Loturco et al., 2021; Pereira et al., 2020).

Furthermore, the findings support contemporary pedagogical approaches in physical education that emphasize the use of modified equipment to facilitate learning and performance improvement. Equipment modification has been shown to increase students' motivation, participation, and skill acquisition by adapting task difficulty to learners' capabilities (Harvey & Light, 2015; Casey & MacPhail, 2018). In the present study, the basketball served not only as a resistance-training tool but also as an instructional medium that challenged participants to apply greater effort and concentration during skill execution. Consequently, improvements were observed not only in force generation but also in overall passing quality.

Despite these positive findings, several limitations should be acknowledged. First, the study utilized a pre-experimental design without a control group. Although significant

improvements were observed, the absence of a comparison group limits the ability to attribute all observed changes exclusively to the intervention. Experimental studies with randomized control groups are recommended to strengthen causal inference (Thomas et al., 2022). Second, the sample consisted of only 15 participants from a single volleyball club. While the findings provide valuable preliminary evidence, broader samples involving athletes from different age groups, competitive levels, and training backgrounds are necessary to improve external validity and generalizability (Hair et al., 2022).

Third, the intervention period consisted of only four training sessions. Although significant improvements were recorded, longer training durations may produce greater physiological adaptations and more stable improvements in performance (Bompa & Buzzichelli, 2019). Future studies should therefore investigate the long-term effects of basketball-assisted upper passing training over several weeks or months. Additionally, future researchers may compare basketball-based training with other resistance-training modalities, such as medicine balls, weighted volleyballs, elastic bands, or plyometric exercises, to determine the most effective approach for enhancing upper passing force strength.

Overall, the results of this study provide empirical evidence that the upper passing training method using a basketball is an effective strategy for improving upper passing force strength. The intervention successfully increased participants' ability to generate force during overhead passing, thereby enhancing overall technical performance. These findings contribute to the growing body of literature on volleyball training methods and support the integration of modified resistance-based equipment into physical education and sports coaching programs. From a practical perspective, coaches and teachers may utilize basketball-assisted passing drills as an affordable, accessible, and effective training alternative to develop students' physical and technical competencies in volleyball.

## CONCLUSION

Based on the results of this study, it can be concluded that the upper passing training method using a basketball has a significant positive effect on improving upper passing force strength in volleyball players. The findings revealed a substantial improvement in participants' performance following the intervention. Descriptive statistical analysis showed that the mean score increased from 40.00 in the pretest to 65.33 in the posttest, indicating an average improvement of 25.33 points. Furthermore, the paired-samples t-test demonstrated a statistically significant difference between pretest and posttest scores ( $t = -3.833$ ;  $p = 0.002$ ), confirming the effectiveness of the training method. Conceptually, the results support the principle that modified training media with greater resistance can stimulate muscular adaptation and improve force production during sport-specific movements. The use of a basketball, which is heavier than a standard volleyball, provided additional overload to the muscles involved in overhead passing, thereby enhancing participants' ability to generate pushing force. Empirically, improvements were observed not only in passing power but also in ball

control, movement coordination, and overall technical execution. Therefore, the basketball-assisted upper passing training method can be considered an effective and practical approach for developing upper passing force strength in volleyball. These findings contribute to the development of innovative volleyball training strategies and provide valuable implications for physical education teachers, coaches, and sports practitioners seeking to improve students' technical performance through simple, accessible, and evidence-based training interventions.

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