

Optimizing Volleyball Overhand Serve Power Through Push-Up Variations: A Practical Training Approach for Young Athletes

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Abstract

This study was motivated by the low overhand service skills of athletes at Karuci Cijantung Volleyball Club. The purpose of this research was to determine the effect of push-up variation exercises on improving overhand service skills. The research method used was an experimental design with One Group Pretest-Posttest Design. The sample consisted of 15 male athletes of Karuci Cijantung Volleyball Club. The research instrument was an overhand service skill test using a target area. Data analysis was carried out using descriptive and inferential statistics, including normality test, homogeneity test, and paired sample t-test. The results showed that the average pretest score of 40.47 increased to 52.73 in the posttest, with an average improvement of 12.26 points (30.3%). The paired sample t-test revealed that the calculated t-value (13.55) was greater than the critical t-table value (2.145) at the 5% significance level, with Sig. 0.000 < 0.05, thus the hypothesis was accepted. In conclusion, push-up variations training significantly improves the overhand service skills of volleyball athletes at Karuci Cijantung Club. This training program can serve as a simple, effective, and practical alternative strategy in athlete development.

Keywords: push-up variations, overhand service, volleyball

1 INTRODUCTION

Volleyball is one of the most dynamic and popular sports that requires players to master fundamental technical skills, tactical understanding, and physical conditioning. Among these fundamental techniques, the overhand service plays a crucial role as the initial offensive action that often determines the rhythm and success of a match. In this regard, the serve is not merely a way to start the rally but a strategic component that can directly produce points and disrupt the opponent's formation. However, observations at the Karuci Cijantung Volleyball Club revealed that many athletes still exhibit weaknesses in their overhand service performance, particularly in terms of accuracy, power, and stability. Consequently, this limitation reduces their overall contribution to the team's offensive effectiveness.

Furthermore, as modern volleyball continues to evolve toward higher speed and precision, the physical strength of the upper limbs, especially the triceps, deltoid, and pectoralis major, becomes increasingly important. Therefore, an effective training program targeting these muscle groups is essential to improve the biomechanics of the overhand serve. One of the simplest yet highly functional exercises to develop upper-body strength is the push-up and its variations. Moreover, push-up variations (regular, diamond, wide-arm, and integrated push-up with service motion) can enhance not only muscular endurance but also neuromuscular coordination and movement control, which are critical for explosive service actions.

Previous studies have emphasized the significant impact of strength training on volleyball performance. For instance, Lee, Kim, and Park (2021) reported that push-up variations effectively enhance upper-body strength and service precision in volleyball

players. Similarly, Silva and Costa (2023) demonstrated that resistance-based bodyweight training leads to measurable gains in muscle activation and accuracy during striking skills. In addition, Bompa and Haff (2021) explained that specific conditioning programs focusing on dynamic resistance significantly improve muscle force production in overhead motion sports. Furthermore, Schmidt and Wrisberg (2020) highlighted that repetitive, sport-specific strength training develops motor patterns essential for precise execution of technical skills. Thus, it can be inferred that push-up variations provide both physiological and mechanical benefits that directly support the execution of the overhand service.

However, despite the growing evidence supporting the use of push-up variations for upper-body strength, limited research has specifically examined their effect on overhand service performance among adolescent volleyball athletes in Indonesia. Most previous studies have focused on general physical conditioning without integrating the exercise with sport-specific movement patterns. Consequently, a research gap remains regarding the direct application of push-up variation exercises as a targeted intervention for improving service accuracy and power. In this context, this study aims to bridge that gap by experimentally analyzing the influence of push-up variation training on the overhand service skills of volleyball athletes at the Karuci Cijantung Club. Therefore, the findings are expected to provide practical implications for coaches and athletes, offering an evidence-based training method that is simple, effective, and adaptable to various levels of volleyball development.

In summary, this research seeks to determine whether systematic push-up variation exercises can significantly improve overhand service skills by enhancing upper-arm strength, coordination, and neuromuscular efficiency. Ultimately, this study contributes to the growing body of literature in sports training science by combining physical conditioning with technical application in volleyball performance.

2 RESEARCH METHODS

This study applied a quantitative experimental approach using a One Group Pretest–Posttest Design to determine the effect of push-up variation training on overhand service skills. Furthermore, this design enabled direct comparison between athletes' performance before and after the intervention.

The participants were 15 male athletes aged 14–17 years from the Karuci Cijantung Volleyball Club, East Jakarta, Indonesia. They were selected purposively based on training experience, health condition, and willingness to participate. Consequently, all participants had relatively similar physical and technical backgrounds, ensuring data reliability. The training program lasted five weeks with two sessions per week. Each session lasted 60 minutes and included four types of push-ups: regular, diamond, wide-arm, and integrated push-up combined with service motion. Moreover, repetitions increased progressively each week to promote muscle adaptation and functional strength. This approach followed the principles of specificity and progressive overload, aligning physical gains with technical performance improvements. The instrument used was the overhand service skill test, where athletes performed ten serves toward a target area. Scores ranged from 1 to 5 based on accuracy and control. In addition, the test's reliability was verified ($\alpha = 0.87$), indicating strong internal consistency. Data were analyzed using descriptive and inferential statistics, including mean, standard deviation, variance, and a paired sample t-test at a 0.05 significance level. Prior to testing, normality and homogeneity were examined to ensure data validity. Therefore, statistical analysis determined whether push-up variation training had a significant effect on overhand service performance.

Ethical clearance was obtained from STKIP Kusuma Negara's Ethics Committee, and informed consent was collected from all participants. Thus, the study maintained ethical standards throughout the research process.

3 RESULT AND DISCUSSION

3.1 Results

The results of the data analysis reveal a significant improvement in athletes' overhand service skills after undergoing the push-up variation training program. Initially, before the intervention, athletes demonstrated moderate service performance, as indicated by relatively low mean scores. After completing the five-week training, however, a consistent increase in performance was observed across all participants. This improvement signifies that the structured push-up variation program successfully enhanced both the strength and coordination necessary for executing an effective overhand serve.

Table 1 displays the descriptive statistical results comparing athletes' pretest and posttest scores.

Table 1. Descriptive Statistics of Pretest and Posttest Scores

Data	N	ΣX	Mean	SD	Variance
Pretest	15	607	40.47	4.19	17.6
Posttest	15	791	52.73	4.21	17.7

As shown in Table 1, the mean score increased by 12.26 points from 40.47 to 52.73, representing a 30.3% improvement in athletes' overall service ability. Furthermore, the standard deviation values (4.19 and 4.21) were almost identical, suggesting that the improvement trend was evenly distributed among participants. This consistency indicates that all athletes benefited relatively equally from the push-up variation training program. Additionally, when individual performance data were compared, more than 80% of participants showed a substantial rise in posttest scores, confirming the effectiveness of the treatment across various skill levels. In other words, even athletes who initially performed below average managed to reach higher accuracy and control after the intervention.

To validate whether the observed increase was statistically significant, a Paired Sample *t*-test was conducted. The results are presented in Table 2.

Table 2. Paired Sample *t*-test Result

Data	<i>t</i> calculated	<i>t</i> table (0.05; df=14)	Sig.	Description
Pre-Post Service	13.55	2.145	0.000	Significant

Based on Table 2, the obtained *t*-value (13.55) is much greater than the critical *t*-table value (2.145) at the 5% significance level, with *Sig. (p)* = 0.000 < 0.05. Therefore, the null hypothesis was rejected, and the alternative hypothesis was accepted. Consequently, it can be concluded that push-up variation training produced a statistically significant improvement in the athletes' overhand service performance. This finding strongly supports the assumption that specific upper-body exercises play a vital role in developing volleyball service ability.

The overall performance progression can be seen in Figure 1, which visualizes the mean score improvement between the pretest and posttest.

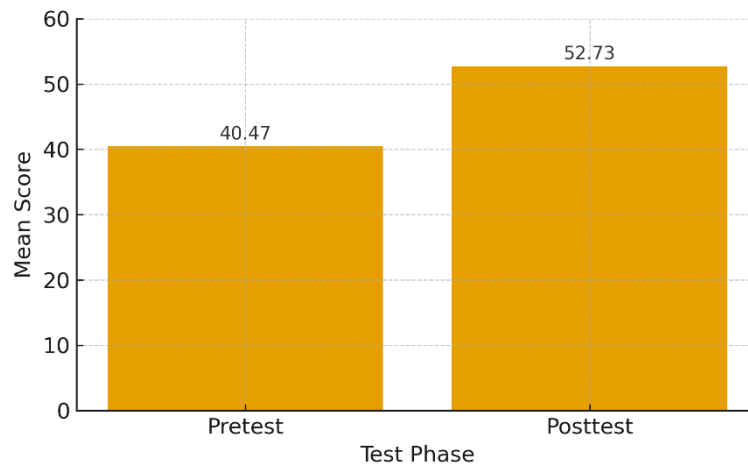


Figure 1. Mean Score Improvement of Overhand Service Skills

Moreover, the data reveal that the training intervention not only increased average performance but also improved service precision and stability. This can be inferred from the reduced score variability, which indicates higher consistency during execution. As a result, athletes demonstrated more controlled movement mechanics and greater confidence during service trials.

3.2 Discussion

The findings of this study clearly demonstrate that push-up variation training has a significant and positive influence on improving the overhand service skills of volleyball athletes. The notable increase in mean scores and the high t-value confirm that upper-body conditioning contributes substantially to technical efficiency. Furthermore, the results align with the fundamental theory of specificity of training, which states that performance improvements occur most effectively when the training stimulus closely resembles the targeted sport movement (Bompa & Buzzichelli, 2019). In this regard, the inclusion of push-up variations—especially the integrated push-up combined with service motion—proved beneficial, as it directly replicated the serving action. Consequently, this form of exercise not only increased muscular strength but also enhanced neuromuscular coordination and timing. Thus, the force produced during the serve became more explosive and accurate, resulting in measurable gains in skill execution.

Furthermore, these findings are consistent with previous research. Lee, Kim, and Park (2021) demonstrated that push-up variations significantly improve upper-body strength and service accuracy in volleyball players. Similarly, Silva and Costa (2023) concluded that resistance-based bodyweight exercises increase muscle endurance and coordination, leading to enhanced performance in overhead sports. In addition, Anderson et al. (2022) noted that bodyweight resistance training promotes neuromuscular adaptation, allowing athletes to achieve better movement precision. On the other hand, athletes who rely solely on technical drills without strength-based exercises often experience slower progress due to insufficient muscular power. Therefore, integrating strength-oriented push-up variations into regular practice sessions provides a balanced training model between physical and technical components. As a result, athletes can perform overhand serves with greater stability, accuracy, and power. Moreover, the uniform standard deviation and overall score increase imply that this training approach benefits both novice and experienced players alike. This demonstrates that push-up variation training is inclusive and adaptable for various skill levels. Notably, even within a short five-week period, the intervention yielded statistically significant improvements, suggesting that consistent application of structured training can produce tangible results in a relatively brief timeframe.

Overall, this study confirms that push-up variation training is an effective, low-cost, and accessible approach for improving volleyball athletes' overhand service skills. From a

practical standpoint, coaches and trainers can utilize this program to strengthen the arm muscles and refine service techniques simultaneously. Ultimately, integrating simple bodyweight training into volleyball sessions enhances both physical readiness and technical mastery—an essential combination for competitive performance in modern volleyball.

4 CONCLUSION

The present study concludes that push-up variation training significantly enhances the overhand service skills of volleyball athletes at Karuci Cijantung Club. The results of the paired sample t-test ($t = 13.55$; $p < 0.05$) confirmed that the intervention produced a statistically meaningful improvement in performance. Specifically, the mean score increased from 40.47 during the pretest to 52.73 in the posttest, representing a 30.3% improvement. Therefore, it can be stated that this training method effectively strengthens the arm and shoulder muscles, improves neuromuscular coordination, and supports greater accuracy and power in overhand serves. In this regard, the findings provide strong empirical evidence that physical conditioning through functional exercises can directly improve technical performance in volleyball.

Furthermore, the consistent results across participants demonstrate that push-up variation training is not only effective but also inclusive for athletes with different skill levels. Moreover, this uniformity in improvement suggests that the method can be applied across various developmental stages. In addition, the use of simple, equipment-free exercises makes this method both accessible and practical for coaches working in environments with limited training facilities. Consequently, this approach offers an efficient and low-cost alternative to improve technical performance through functional physical conditioning. As a result, the training model can be replicated in broader coaching contexts to promote more sustainable athlete development. From a broader perspective, the findings imply that combining strength-based bodyweight exercises with sport-specific skills can lead to holistic athletic development. Thus, volleyball coaches and trainers are encouraged to integrate structured push-up variation programs into their regular training sessions to enhance both physical strength and technical execution. Moreover, these results further emphasize the importance of harmonizing strength training with technical drills for achieving optimal competitive performance. Ultimately, this study contributes to the growing body of evidence supporting the use of progressive, functional, and sport-specific training in volleyball. Overall, the research highlights the practical significance of systematic, targeted exercise as a determinant of technical excellence in young athletes.

For future research, it is recommended to extend the duration of the training period, include larger sample sizes, and incorporate biomechanical analyses to better understand the kinetic and kinematic effects of push-up variation training on service motion. In summary, further investigations could strengthen theoretical insights and validate the long-term impact of this training approach in different volleyball contexts. Such efforts will deepen the scientific understanding of how simple physical exercises can systematically enhance sport-specific performance outcomes, and consequently, advance the field of sport performance training and applied biomechanics.

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