



EVIDENCE-BASED ANALYSIS OF BASIC VOLLEYBALL TRAINING METHODS: FOCUS ON OVERHAND SERVES AND UNDERHAND PASSES

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Abstract

This study analyzes the effectiveness of various volleyball basic technique training methods, focusing on overhead serves and underhand passes, through an evidence-based approach. This study was conducted to address the need for more adaptive technical training to meet the demands of modern play, given that conventional training approaches, which tend to be repetitive, still dominate and often fail to improve skill transfer to game situations. The analysis was conducted on a number of studies that highlighted variations in training methods, such as blocked practice, random practice, mixed practice, paired drills, small-sided games, and the use of mechanical and visual feedback. The main findings show that blocked practice is effective in the early stages of movement pattern formation, while random and game-based practice is superior in skill transfer and long-term retention. Partner drills are more effective at improving groundstrokes than individual practice, while mechanical feedback has been shown to be more accurate in improving the kinematic consistency of overhead serves than verbal instruction. This study confirms that the most effective training approach is the integration of stabilization of basic movement patterns, variation in training conditions, game context, and data-based technical feedback. The results of this study can be used as a reference for coaches, sports educators, and practitioners to design training programs that are scientific, applicable, and relevant to the characteristics of modern volleyball

Keywords: Volleyball, Overhead serve, Underhand pass, Evidence-based, training methods

INTRODUCTION

Volleyball is a dynamic team sport that demands a combination of physical fitness, technical skill, and effective coordination among players. Success in volleyball is not determined solely by



physical strength, but also by the ability to execute fundamental techniques accurately and consistently during game situations. Therefore, the mastery of basic skills plays a crucial role in supporting team performance and competitive outcomes. Basic volleyball techniques serve as the foundation for more complex tactical and strategic play. Players who possess strong fundamental skills are better able to adapt to game dynamics, maintain ball control, and support effective transitions between defense and attack. Consequently, training programs that emphasize the development of basic techniques are essential for improving overall player performance at various levels of competition

Volleyball requires optimal technical mastery and body coordination, particularly in passing and setting skills (Sari et al., 2025). Among basic techniques, the overhand serve and underhand pass are key elements that influence team success. The overhand serve initiates the attack and provides an opportunity to score points through speed and ball direction that are difficult for opponents to anticipate (Wiyaka et al., 2018). Meanwhile, the underhand pass functions as the initial step in organizing an attack by accurately directing the ball to a teammate (Rustiyarto et al., 2013). These techniques are essential for maintaining stability during transitions between defense and attack. Therefore, consistent mastery of basic techniques is fundamental to improving volleyball players' performance, as supported by findings showing that most athletes demonstrate good to very good proficiency in basic skills (Ali et al., 2024).

Several studies have consistently confirmed that basic volleyball techniques, particularly overhead serves and underhand passes, remain a serious challenge in sports education and youth development programs. Evidence from several research studies supports this claim. Iyet Yulianti & Oki Candra, 2025 found that overall volleyball technical skills were only 66.5, which is categorized as poor. (Fatah Firmansyah et al., 2022) also reported that serving and passing techniques were only at a "moderate" level, with most students demonstrating average or below-average skill levels.

Common mistakes such as unstable posture, toss errors, uncontrolled ball direction, and late ball contact are still frequently found, especially among novice players and physical education students (Sari et al., 2025; Sumarna Dede et al., 2020). Conventional sports training methods that rely on repetitive mechanical exercises significantly hinder athletes' ability to transfer skills to real-game contexts. The "game-like situation" approach creates an innovative and dynamic training environment where athletes can develop more adaptive skills (Febriani et al., 2020 and Kumar et al., 2022)

As explained by Ahmad Suherly Suherly Dina Saputra et al., 2019 emphasizes that motor skills are crucial for volleyball performance, showing a direct correlation between motor skills and



basic volleyball techniques. (Fatah Firmansyah et al., n.d.) further supports this by showing that different teaching styles have a significant impact on learning outcomes, with reciprocal teaching and command methods affecting student performance differently.

As sports coaching science has evolved, the evidence-based training paradigm has gained recognition as research shows that evidence-based coach education programs have a significant positive impact on coach effectiveness and athlete performance (Li et al., 2025). The evidence-based approach guides coaches to select training methods based on empirical evidence, not solely on experience. For example, a meta-analysis by Czyż et al., 2024 found that random practice (high variation) resulted in better skill transfer than repetitive block practice. In addition, this effect also contributed to long-term retention of motor skills. In the context of small-sided games, research by Clemente et al., 2021 shows that SSG interventions significantly improve the technical execution of young players. Furthermore, Anwar et al., 2024 found that eight weeks of rondo-model SSG training improved basic passing accuracy. On the feedback side, a study of mechanical overhead serves in volleyball by Hassan et al., 2024 proved that mechanical feedback is more effective in improving movement consistency and serve accuracy than regular verbal feedback.

This collection of evidence shows that basic volleyball technique learning needs to shift from a traditional approach to an evidence-based approach that emphasizes exercise variation, real-time feedback, and game context. This approach not only helps players improve their mechanical techniques but also trains cognitive aspects such as decision-making, visual perception, and adaptation to dynamic situations on the court (Zhu et al., 2024). Therefore, this study is important as a systematic review and evidence-based analysis of various volleyball basic technique training methods, with a focus on overhand serving and underhand passing techniques. Through this analysis, it is hoped that a deeper understanding of the most effective training method trends will be obtained, while also providing practical recommendations for coaches, educators, and sports practitioners in designing scientific, efficient, and relevant training programs that meet the demands of modern play.

METHODOLOGY

This study uses an evidence-based literature review method with a comparative analysis approach to studies that examine basic volleyball techniques, particularly overhand serves and underhand passes. Data collection was conducted through searching scientific articles in digital databases, including PubMed, Google Scholar, ScienceDirect, ResearchGate, and DOAJ. The search process was carried out using the keywords: “volleyball fundamental skills,” “overhand serve training,” “forearm passing volleyball,” “random practice motor learning,” and “small-sided



games volleyball” in both English and Indonesian.

The selected publication range was from 2017 to 2025 to ensure that the study represented the latest developments in motor learning science and evidence-based training methods. Older articles were only used if they had fundamental theoretical relevance but were not used as primary sources.

Literature selection was based on the following criteria: (1) research focused on improving basic volleyball techniques, (2) provided experimental results or measurable evaluation data, and (3) was relevant to the topics of training method variation, feedback, or motor learning. Articles that did not include specific technical variables, were not relevant to training methods, or focused only on non-technical factors such as team psychology, nutrition, or general biomechanics were excluded from the analysis.

The data obtained was then classified based on the type of training method, sample group, technical focus, and performance improvement results. Furthermore, each finding was compared to identify patterns of training effectiveness, emphasizing the differences in the learning phases between technique stabilization through block training and adaptation improvement through random and game-based training. The final results were synthesized to produce a training recommendation model that is applicable for coaches and sports practitioners.

RESULTS

The development of basic volleyball techniques has become an important focus in sports pedagogy and coaching research, particularly in identifying effective training methods that are appropriate for different age groups and skill levels. Mastery of fundamental skills such as serving and passing is essential, as these techniques form the foundation for tactical execution and overall game performance. Consequently, numerous empirical studies have examined various training approaches, including drills, small-sided games, varied practice, and feedback-based methods, to determine their effectiveness in improving technical proficiency. A synthesis of these studies provides valuable evidence-based insights for coaches and educators in designing more effective volleyball training programs.

Tabel 1. Result

No	Researcher (Year)	Sample	Technical Focus	Exercise Methods	Key Results
1.	Roxanne R. dela Cruz (2024)	52 students Consisting of kindergarten and first grade elementary	Underhand Pass in Mini Volleyball	Group 1: Small-Sided Games Group 2: Drill Practice	Improving forearm passing skills, from “Fair” to “Good” ⁷ . Both groups showed comparable



		school students.			effectiveness, with no statistically significant differences between them. (R. R. dela Cruz, 2024)
2.	Cruz, M.P., Lage, G.M., et al. (2018)	20 children (10 per group). Ages 10-12 years old.	Volleyball Service	Group 1: Random Practice. Group 2: Constant Practice.	Both groups studied the Generalized Motor Program (GMP). Random Practice resulted in higher parameterization learning (motor skill parameters). (M. P. Cruz et al., 2018)
3.	Manaf M. Hassan, Hameed H. Khalaf, et al. (2024)	45 male students (beginners) in the Experiment Group (n=20) and Control Group (n=25).	Volleyball Service	Visual and mechanical feedback. Occasional verbal and visual feedback.	Mechanical Feedback produced significantly higher improvements in kinematic coherence and service arm accuracy compared to the control group. Mechanical feedback was more efficient in enhancing learning. (Hassan et al., 2024)
4.	Dikky Fernando Girsang, Dedi Nofrizal (2024)	20 male junior high school students (10 per group).	Down Passing Ability	Group 1: Paired Underhand Passing Drill. Group 2: Individual Drill.	The Paired Down Passing method is significantly more effective than the Individual Drill method. Paired down passing drills have a greater impact on improving students' down passing skills. (Girsang Fernando Dikky & Nofrizal Dedi, 2024)
5.	Luping Qu, et al., 2025.	Sixty physical education students participated in the experiment for eight weeks. They were homogeneous in terms of characteristics such as age, gender, and	Frontal underhand serve, frontal overhand serve, and floating frontal overhand serve.	Block training groups focus on a single technique to establish stable movement patterns. Mixed training groups use a variety of techniques so that participants can adapt to a range of conditions.	Low, high, and moderate interference training groups had different effects on motor skill learning in volleyball, each showing optimal performance in skill acquisition, transfer, and long-term retention. (Qu et al., 2025)



		exercise experience.		Random training groups change the order of techniques to improve adaptation.	
6.	Enrique Castro dkk, 2022.	Elementary school students, elite athletes, college students, youth players, and athletes of various levels.	Focused technical drills such as passing, serving, and spiking	Small games in mini volleyball, with 1 vs. 1 and 4 vs. 4 players, conducted individually or in small groups, using media such as videos and demonstrations to clarify techniques and strategies.	Mini volleyball training and small games are effective in improving players' technical and tactical skills, including technique, passing and setting accuracy. Small games are more effective than traditional methods for technical accuracy and tactical awareness. (de Oliveira Castro et al., 2022)
7.	Cicero Luciano Alves Costa dkk, (2024)	33 students, consisting of 18 experienced participants and 15 novice participants.	Development and validation of a test for serving accuracy in volleyball that can distinguish players' technical performance based on their level of experience.	Basic overhead serve technique drills are done individually to improve ball control, accuracy, and confidence. Repeat the drills with distance adjustments for beginners, even without feedback during the test.	The volleyball serve accuracy test demonstrated good validity and reliability, with performance ability based on experience level. High reliability was recorded with an ICC of 0.81 for beginners and an ICC of 0.84 for experienced players, who performed better. The test was effective in measuring serve accuracy. (Costa et al., 2024)

Based on the results of seven studies, there is a general pattern showing the direction of development of basic volleyball technique training methods that are increasingly evidence-based. The following are the main findings from various studies:

1. Varied training (random and mixed practice) is more effective for developing upper serve technique adaptation. Qu et al., 2025 proved that high-interference training improves skill transfer and retention compared to monotonous block training.
2. Repetitive drill training still plays an important role for beginners, especially in mastering underhand passing techniques. Girsang Fernando Dicky & Nofrizal Dedi, 2024 found that



paired drills provide more significant results than individual training because they help establish stable basic movement patterns.

3. Small-sided games (SSG) and mini-volleyball have been proven to improve ball control, coordination, and decision-making faster than pure drill methods. R. dela Cruz, 2024; de Oliveira Castro et al., 2022 showed that small-game-based training accelerates the development of both technical and tactical aspects in young players.
4. Technical feedback (verbal, visual, and mechanical) accelerates corrections in body posture, toss, and ball contact during overhead serves. Hassan et al., 2024 showed that mechanical feedback resulted in higher accuracy and consistency of movement than verbal feedback alone.
5. Progressive step-by-step training, starting from no ball, shadow movement, target practice, to serve games, provides the most stable technical improvement. This pattern is outlined in the study by Costa et al., 2024 which emphasizes the importance of validating accuracy measurement tools to monitor serve performance progress.
6. The integration of technical training and physical conditioning (explosive power and shoulder muscle strength) supports overall technical performance improvement. Several studies emphasize that good physical ability strengthens the execution of techniques such as overhead serves and underhand passes (Hassan et al., 2024; Qu et al., 2025)
7. Objective test-based evaluations, such as measuring serve accuracy reliability Costa et al., 2024 help coaches assess the effectiveness of training using a scientific and measurable approach.

In general, the trend in results shows that basic volleyball technique training becomes more effective when it is varied, contextual, and supported by immediate feedback. The combination of drills, small games, and visual or mechanical feedback results in significant improvements in overhand serves and underhand passes, while accelerating players' motor adaptation to real game situations.

DISCUSSION

The effectiveness of basic volleyball technique training has increasingly become a central topic in coaching science, particularly in response to the evolving demands of modern competitive play. Traditional training models that rely heavily on repetitive drills are now being critically evaluated, as athletes are required not only to execute techniques correctly but also to adapt those techniques to dynamic and unpredictable game situations. As a result, recent empirical studies have emphasized training approaches that integrate technical execution, contextual decision-making, and motor learning principles to enhance both skill acquisition and performance consistency.

The results of various studies show that the development of basic volleyball training methods



has moved from a conventional repetitive approach to a training model based on variation, game context, and technical feedback. In underhand passing techniques, a game-based contextual approach has proven effective without compromising the formation of basic techniques. Research data from Roxanne R. dela Cruz (2024) shows a significant improvement from the “Fair” to “Good” category in both small-sided games and drill practice groups, with no significant differences between groups, indicating that game-based training is still capable of building mechanical movement patterns. These findings are in line with the research by Girsang & Nofrizal (2024), which shows that paired drills produce more significant results than individual training because the rhythm of the pass, the angle of bounce, and the timing between players train consistency and ball control in a real context. Thus, the development of underhand passing cannot be done through isolative training alone, but requires interactions that mimic the dynamics of a match.

In the overhand serve technique, the effectiveness of training methods is more influenced by the level of task interference during the motor learning process. Cruz et al. (2018) found that random practice resulted in better motor parameterization than constant practice, as task variation forced athletes to readjust their stroke coordination in different situations. This is reinforced by Qu et al. (2025), who showed a clear pattern: block training is effective for establishing stable movement patterns in the early stages, but random training is superior in skill transfer and long-term retention. In other words, repetition alone is not enough; players must be placed in varied situations so that the technique remains consistent under pressure during matches.

The quality of technical correction has been proven to be a key factor in improving serve accuracy. Manaf Hassan et al. (2024) showed that mechanical feedback resulted in significant improvements in kinematic coherence and serve accuracy compared to occasional verbal and visual feedback. This means that motion-based corrections are far more productive than abstract verbal instructions. Coaches need to provide feedback that directly relates to the player's actual movement patterns, not just technical commands such as “swing higher” without a biomechanical context.

Validating performance measurement tools is also an important part of an evidence-based approach. Costa et al. (2024) developed a service accuracy test that is able to differentiate performance based on player experience with high reliability. This instrument reinforces that technical evaluation is no longer merely the subjectivity of the coach, but requires standardized tools to ensure that training methods produce real improvements. This supports the modern coaching paradigm that prioritizes objective measurement and quantitative data as the basis for evaluating the effectiveness of training programs.

Improvements in underhand passing are more optimal when training involves stimuli for



interaction between players. Small-sided games not only shape basic techniques but also hone decision-making in the context of the game (Roxanne R. dela Cruz, 2024). Paired drills strengthen the stability of the passing rhythm, making them better than individual drills (Girsang & Nofrizal, 2024). Passing is not just a ball contact technique, but a coordinative skill that requires the context of the game. Overhead serves require movement adaptation, not just mechanical technique. Random practice results in more flexible parameter learning (Cruz et al., 2018), while random training excels in long-term transfer and retention (Qu et al., 2025). This explains why players who are “perfect in training” often lose consistency in matches because their training is too monotonous.

Verbal instructions often fail because they are too generic. Mechanical feedback is far more effective at improving arm movement coherence during serves (Manaf Hassan et al., 2024). Implication: coaches should reduce abstract instructions and start using motion analysis, visual demonstrations, and technical correction tools. The serve accuracy test developed by Costa et al. (2024) provides a reliable assessment standard for consistently monitoring progress. Objective evaluation is a key requirement for evidence-based coaching.

Overall, the findings indicate that effective basic technique training is not singular but a combination of strategies: stabilizing movement patterns through blocked drills, improving adaptation through random practice, strengthening tactics through small-sided games, and optimizing movement through mechanical feedback. This integrated model is more compatible with the demands of modern play because it combines mechanical, cognitive, and adaptive aspects simultaneously. Players are not only able to execute techniques correctly, but also able to read the situation and execute techniques in a timely manner in dynamic game conditions.

From a practical point of view, these results have clear implications for coaches: training should not stop at mechanical repetition. An effective program is a gradual program that starts with basic movement stabilization, then moves on to varied and game-based exercises, and is enriched with technology-based technical feedback. This approach ensures that players are not merely “able to hit the ball correctly,” but can do so within the rhythm of the game, under opponent pressure, and in complex tactical situations. Therefore, the chosen training method must be tailored to the phase of skill development, the players' level of experience, and the team's competitive goals.

In conclusion, the collective evidence underscores the importance of adopting a holistic and evidence-based approach to basic volleyball technique training. Training programs that combine structured drills, contextual game-based activities, varied practice, and precise technical feedback are more effective in developing stable yet adaptable skills. Such an approach not only improves technical accuracy but also enhances players' ability to perform under match pressure. Therefore, coaches and practitioners are encouraged to move beyond single-method training models and



implement integrated training strategies that align with athletes' developmental stages and the tactical demands of competitive volleyball.

CONCLUSION

Effective volleyball basic technique training methods involve integrating strategies according to skill development stages. Effective blocking drills in the early stages help establish stable basic movement patterns, while random drills are important for transferring techniques to real-game situations. Partner drills and small-sided games improve ball control and tactical skills in underhand passing. In addition, mechanical feedback is more effective than verbal feedback in improving the accuracy of overhand serves. A relevant training approach combines technical stabilization, variation in conditions, game context, and precise feedback, thereby helping to design more adaptive and evidence-based training programs.

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