



The Effect Of Walking Lunge With Unilateral Shoulder Press Exercise On Semi Smash Accuracy

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ABSTRACT

The semi-smash is a fast-paced attack technique in volleyball that demands the integration of explosive leg power, core stability, and shoulder control to produce an accurate and effective shot. However, extracurricular training at the school level often does not integrate functional strength training models specific to the biomechanical requirements of the smash. Plyometric training, specifically variations of the walking lunge with unilateral shoulder press, is a method capable of developing muscular power by simultaneously activating the lower and upper extremity kinetic chains, potentially improving smash accuracy. This study aimed to analyze the effect of this training on semi-smash accuracy in male extracurricular volleyball students at MTs Al-Khairat Tondo. The study used a quasi-experimental design with a non-randomized pretest-posttest control group. The sample consisted of 20 students selected using total sampling and divided into experimental and control groups (n=10 each). The intervention was implemented for 6 weeks, administered three times per week. Smash accuracy was measured before and after the intervention using a target smash test. The results showed a significant increase in both groups ($p < 0.05$), but the highest increase occurred in the experimental group from 10.10 ± 1.79 to 14.10 ± 1.91 ($p < 0.001$), compared to the control group from 10.20 ± 1.81 to 11.90 ± 1.91 ($p = 0.009$). There was a significant difference between groups after the intervention ($p = 0.019$) with a significant difference in improvement ($p = 0.002$). It was concluded that walking lunge with unilateral shoulder press training had a significant effect on increasing the accuracy of students' semi smashes.

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A. Conception and design of the study;
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INTRODUCTION

Volleyball is a sport with a high level of participation in Indonesia, from elementary school to university levels through extracurricular activities and coaching clubs. Developing modern volleyball performance requires a scientific approach based on evidence-based training in selecting training methods, developing physical fitness, and optimizing playing techniques. In the context of competitive performance, volleyball success is determined not only by mastery of basic techniques, but also by the



integration of physical condition, tactics, strategy, and the athlete's psychological readiness (Asnaldi, 2020; Duhe & Haryanto, 2021). One of the most dominant techniques for scoring points is the smash, particularly the semi-smash, which demands transition speed, coordination of the initial step, explosive power during the takeoff, accuracy of the shot, and stability upon landing. The semi-smash falls into the quick attack category, requiring precise timing between the setter and spiker, as well as simultaneous lower and upper extremity explosiveness (Wahyu Cirana et al., 2021). However, the reality on the ground shows that extracurricular training at the madrasah (Islamic) and junior high school (SMA) levels is still dominated by conventional approaches. Students often play immediately after warming up without structured interventions on physical components such as strength, speed, and explosive power. Yet, various studies have shown that leg strength, shoulder power, and core stability significantly contribute to jump quality and smash accuracy (Hamdani & Utomo, 2021; Afdi et al., 2019). The limited variety of dynamic strength-based training and unilateral coordination is a crucial issue. As a result, the accuracy of semi-smashes among extracurricular students is often suboptimal, both in terms of ball direction and shot consistency. This issue highlights the urgent need for research, particularly in testing the effectiveness of more specific and functional training models on improving semi-smash accuracy.

Literature over the past decade has shown that plyometric-based training approaches and combined strength-power training are effective in improving vertical jump performance and striking ability in volleyball (Markovic & Mikulic, 2019; Slimani et al., 2016). Plyometric training works through the stretch-shortening cycle (SSC) mechanism, which increases neuromuscular efficiency and short-term force production capacity. Recent research in the context of youth volleyball has shown that leg power training directly contributes to increased jump height and shot velocity (Ramirez-Campillo et al., 2020). Furthermore, unilateral training has been shown to improve dynamic balance and inter-limb coordination, which are crucial for jumping and striking movements (Suchomel et al., 2018). The walking lunge is a functional exercise that stimulates strength in the quadriceps, hamstrings, gluteus maximus, and core stabilization. When combined with the unilateral shoulder press, this exercise involves simultaneous activation of the shoulder, deltoid, and triceps brachii, improving lower and upper extremity coordination. This combination reflects the open-closed chain kinetic movement pattern (kinetic chain integration) relevant to the biomechanics of the volleyball smash (Andrejić, 2012). Several studies in other sports, such as basketball, have shown that variations of the walking lunge with a unilateral shoulder press can improve vertical jump performance, sprinting, and motor control (Andrejić, 2012). Other research in young athletes indicates that combined lower-upper body strength training improves performance transfer to game-specific movements (Suchomel et al., 2018; Cormie et al., 2011). However, in the context of school volleyball, the majority of research still focuses on classic plyometric exercises such as depth jumps, squat jumps, or box jumps (Sulistyo, 2016; Hamdani & Utomo, 2021). Studies specifically integrating the walking lunge with a unilateral shoulder press on the accuracy of the semi-smash are still very

limited. Therefore, this approach has innovative potential in the development of functional training methods based on game technique requirements.

Although numerous studies have demonstrated the effectiveness of plyometric training in increasing explosive power, several significant research gaps remain. First, most studies only measure improvements in physical variables such as vertical jump or power output without directly linking them to game-specific technical indicators such as semi-smash accuracy. However, physical improvements do not necessarily translate directly to improved technical accuracy (Ramirez-Campillo et al., 2020). Second, research exploring simultaneous lower- and upper-body combination training in a single dynamic movement pattern is still limited to sports other than volleyball. The biomechanical context of the semi-smash requires synchronized integration of the kinetic chain from the legs, core, and shoulders, so training that solely emphasizes the legs is less than optimal in terms of performance transfer (Suchomel et al., 2018). Third, empirical studies on Islamic junior high school students or those in early adolescence are relatively limited. This phase is a sensitive period for neuromuscular development, crucial for establishing the foundation of technique and physical conditioning (Lloyd & Oliver, 2016). Fourth, there has been no contextual research within the extracurricular environment of religious-based schools like MTs Al-Khairat Tondo that quantitatively and experimentally tests the effectiveness of walking lunges with unilateral shoulder presses on semi-smash accuracy. Therefore, there is an urgent need to fill this literature gap through structured research that empirically tests the causal relationship between walking lunges with unilateral shoulder presses and improved semi-smash accuracy in extracurricular volleyball students.

Based on the identified research problems and gaps, this study aims to analyze the effect of walking lunges with unilateral shoulder press training on the accuracy of semi-smashes in male volleyball extracurricular students at MTs Al-Khairat Tondo. Conceptually, this study integrates strength-power training principles with a biomechanical approach to smashing through functional movement patterns involving unilateral coordination and core stabilization. This training is designed to improve leg explosiveness, shoulder strength, and neuromuscular synchronization, which play a role in producing accurate and powerful shots. Empirically, this study offers novelty in three main aspects: (1) Training Model Novelty; Testing variations of walking lunges with unilateral shoulder presses in the context of school volleyball, which has not been widely studied in the national and international literature, (2) Dependent Variable Novelty; Focusing on semi-smash accuracy as an indicator of technical performance, rather than simply a general physical variable such as vertical jump, (3) Contextual Novelty; Implemented on MTs students, a population of early adolescents, thus contributing to the development of school-based training models. The implications of this research are expected to enrich the scientific body of sports coaching, particularly in the development of training methods based on lower-upper body kinetic chain integration. Furthermore, the results have the potential to provide practical recommendations for school coaches in designing more systematic, scientific training programs oriented

toward improving specific technical performance. With a structured approach based on current literature, this research is expected to make a significant academic contribution to the development of volleyball coaching science and meet the publication standards of the reputable SINTA journal.

METHODS

This study used a quasi-experimental design with a non-randomized group pretest-posttest design, which is recommended in school-based sports intervention research when full randomization is difficult (Thomas, Nelson, & Silverman, 2015; Hopkins, 2019). This approach allows for testing the causal effect of training on changes in technical performance through comparisons of pre- and post-treatment scores, as well as between groups (Grgic et al., 2020; Suchomel et al., 2018). The study was conducted from December 2024 to January 2025 on the volleyball court at MTs Al-Khairat Tondo for six weeks, three times per week (Tuesday, Thursday, and Saturday), for a total of 18 training sessions. The duration and frequency refer to the recommended training adaptation window for increasing strength and power in adolescents, which is 6–8 weeks, with a frequency of 2–3 times per week, to ensure optimal neuromuscular adaptation without the risk of overtraining (Lloyd & Oliver, 2016; Ramirez-Campillo et al., 2020).

The study population consisted of all 20 male volleyball extracurricular students at MTs Al-Khairat Tondo. The sampling technique used total sampling due to the limited population size and all subjects meeting the inclusion criteria. Exclusion criteria included illness, musculoskeletal injuries, or absence from training sessions for more than 20%. Subjects were then divided into two groups (experimental and control) of 10 individuals each using the ordinal pairing technique (ABBA formula) based on their initial smash accuracy score. This technique was used to maintain equivalence of initial abilities and minimize selection bias (Sullivan & Feinn, 2012). The experimental group received an intervention consisting of walking lunges with unilateral shoulder presses as the core part of the training program. The exercises were performed at a progressive intensity (60–75% of 1RM estimated external load) and 3–4 sets of 10–12 repetitions per side. This movement combination involved activation of the quadriceps, hamstrings, gluteus maximus, deltoid, and triceps brachii muscles, as well as core stabilization through an integrated kinetic chain pattern, which is relevant to the biomechanics of the volleyball smash (Cormie et al., 2011; Suchomel et al., 2018). The integration of lower and upper extremities in a single dynamic sequence has been shown to improve intermuscular coordination and transfer of performance to sport-specific movements (Behm & Sale, 2018; Grgic et al., 2020). The control group underwent routine extracurricular training without any additional specific interventions. All sessions were supervised by researchers and coaches to ensure protocol adherence and adherence to the principles of progressiveness and safety (Faigenbaum et al., 2019).

The research data were primary data obtained through direct testing. The instrument used was a semi-smash accuracy test using a target zone test, in accordance

with the volleyball technique measurement guidelines (Ministry of National Education; Budiwanto, 2004). The test was administered twice: at baseline (pretest) and at the end of the intervention (posttest). The validity and reliability of target-based technique measurements have been widely used in game skills research to measure shot accuracy and consistency (Sheppard et al., 2018; Slimani et al., 2016).

Data analysis was performed using Microsoft Excel 2019 and SPSS 23.0. Normality was tested using the Shapiro–Wilk test, as recommended for small samples (Razali & Wah, 2011). If the data were normally distributed, a paired sample t-test was used for intra-group analysis and an independent sample t-test for between-group analysis. If not normal, the nonparametric Wilcoxon Signed-Rank and Mann–Whitney U tests were used. The significance level was set at $p < 0.05$ with effect size reporting to assess the practical significance of the intervention results (Sullivan & Feinn, 2012; Hopkins, 2019).

RESULTS AND DISCUSSION

Result

The results of the study present changes in semi-smash accuracy values at two measurement points: before (baseline/pretest) and after the intervention (endline/posttest). The Shapiro–Wilk normality test showed that all data were normally distributed ($p > 0.05$), allowing for parametric analysis using paired sample t-tests and independent sample t-tests. This approach aligns with recommendations for statistical analysis in sports intervention studies with small samples (Hopkins, 2019; Grgic et al., 2020).

Intra-Group Changes

Table 1 shows that before the intervention, the average semi-smash accuracy of the control and experimental groups was relatively equivalent, at 10.20 ± 1.81 and 10.10 ± 1.79 , respectively. After a 6-week training period, the experimental group experienced a significant increase to 14.10 ± 1.91 ($p < 0.001$), while the control group increased to 11.90 ± 1.91 ($p = 0.009$).

Percentage-wise, the experimental group increased by $\pm 39.6\%$, while the control group increased by $\pm 16.7\%$. The magnitude of the increase in the experimental group indicates a substantial training effect, both statistically and practically. This finding is consistent with the literature that integrating strength-power training can improve neuromuscular coordination and technical accuracy in competitive sports (Suchomel et al., 2018; Ramirez-Campillo et al., 2020).

The walking lunge with unilateral shoulder press involves an integrated kinetic chain pattern, thus optimizing the transfer of strength adaptations to specific skills such as the smash (Cormie et al., 2011; Behm & Sale, 2018). Neuromuscular adaptation over 6 weeks allows for improved core stability, postural control, and lower-upper extremity coordination, contributing to shot precision (Faigenbaum et al., 2019; Lloyd & Oliver, 2016).

Table 1.
 Semi-Smash Accuracy Before and After Intervention

Group	Period	Minimum	Maximum	Mean ± SD	p-value
Control	Pre-Test	8	13	10,20 ± 1,81	0.009*
	Post-Test	9	15	11,90 ± 1,91	
Experiment	Pre-Test	7	13	10,10 ± 1,79	<0.001*
	Post-Test	11	17	14,10 ± 1,91	

Inter-Group Comparison

An independent sample t-test analysis showed no significant difference between the two groups at pretest (p=0.903). This indicates statistically equivalent baseline conditions and strengthens the internal validity of the research design.

After the intervention, there was a significant difference between the experimental and control groups (p=0.019). The difference in improvement (Δ) in the experimental group was 4.00 ± 1.05 , while in the control group it was only 1.70 ± 1.64 , a significant difference (p=0.002).

These results demonstrate that the addition of walking lunges with unilateral shoulder presses provided a greater effect than conventional training. Recent literature indicates that unilateral training improves dynamic balance, motor control, and rotational stabilization, which are important in the takeoff and smash phases (Grgic et al., 2020; Slimani et al., 2016). Additionally, simultaneous strengthening of the lower and upper extremities improves the efficiency of energy transfer from the legs to the arms upon ball contact (Sheppard et al., 2018; Markovic & Mikulic, 2019).

Table 2.
 Differences in Semi-Smash Accuracy Between Groups

Period	Control (Mean ± SD)	Experiment (Mean ± SD)	p-value
Before Intervention	10,20 ± 1,81	10,10 ± 1,79	0.903
After Intervention	11,90 ± 1,91	14,10 ± 1,91	0.019*
Delta (Δ)	1,70 ± 1,64	4,00 ± 1,05	0.002*

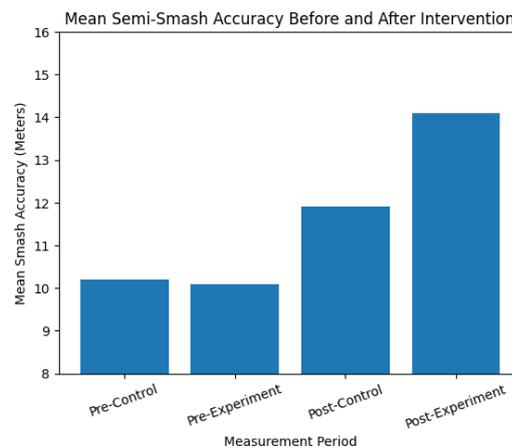


Figure 1.
 Average Smash Accuracy Improvement Chart

Significant improvements in both groups indicate that regular training continues to provide technical adaptations (Lloyd & Oliver, 2016). However, the significantly greater

improvements in the experimental group confirm the effectiveness of the unilateral functional strength-based training model.

Physiologically, these adaptations can be explained by increased motor unit activation, efficient rate of force development, and intermuscular coordination, which contribute to movement accuracy (Cormie et al., 2011; Suchomel et al., 2018). Biomechanically, improved pelvic and shoulder stability allows for control of the arm angle at ball contact, resulting in more precise smash direction (Sheppard et al., 2018).

Therefore, conceptually and empirically, the results of this study support that walking lunge training with unilateral shoulder press significantly improves semi-smash accuracy in male extracurricular volleyball students at MTs Al-Khairat Tondo.

Discussion

The walking lunge with unilateral shoulder press training intervention in this study was implemented in a structured manner over six weeks, three times per week. This pattern was designed to provide a consistent training stimulus to trigger optimal neuromuscular adaptation in adolescents. Recent literature indicates that a 6–8-week training period, performed 2–3 times per week, is an effective range for improving strength, explosive power, and motor coordination in school-age athletes (Lloyd & Oliver, 2016; Ramirez-Campillo et al., 2020). Therefore, the intervention design implemented in this study met the principles of overload, progression, and continuity recommended for long-term athlete development.

Physiologically, the increase in semi-smash accuracy in the experimental group can be explained by neuromuscular adaptation mechanisms. Repeated strength training increases motor unit activation, muscle fiber synchronization, and rate of force development (RFD) capacity (Cormie et al., 2011; Suchomel et al., 2018). These adaptations allow for faster and more stable force production during the takeoff and smash phases. In addition to muscle hypertrophy, there is also an increase in the efficiency of intermuscular coordination, particularly in the quadriceps, hamstrings, gluteus maximus, deltoid, and triceps brachii muscles, which play a dominant role in jumping and hitting movements (Grgic et al., 2020).

These findings align with previous research showing that strength-based and plyometric training can significantly improve volleyball smash performance (Slimani et al., 2016; Markovic & Mikulic, 2019). However, the main difference in this study lies in the integration of unilateral lower and upper extremity movements within a single functional training sequence. The walking lunge stimulates leg strength and stability, as well as pelvic control, while the unilateral shoulder press improves shoulder stability and coordination of the dominant arm. This integration represents the concept of kinetic chain integration, which is the transfer of energy from the legs through the core to the arms upon ball contact (Sheppard et al., 2018).

In the biomechanics of the semi-smash, the approach and takeoff phases require explosive leg power, while the impact phase requires shoulder stability and directional control. Weakness in either component of the kinetic chain will decrease impact

accuracy. Unilateral training has been shown to be effective in improving dynamic balance and rotational stability, which play a crucial role in maintaining control during the aerial phase (Behm & Sale, 2018; Faigenbaum et al., 2019). Therefore, the increase in smash accuracy in the experimental group was not only due to increased muscle strength but also to improvements in motor control and postural stability.

The results showed that both groups experienced significant improvement, but the improvement in the experimental group was significantly greater than in the control group. This indicates that regular extracurricular training does provide adaptations to basic technique, but without functional strength interventions, the improvement is relatively limited. The literature confirms that developing technique without adequate physical capacity will limit performance quality (Hopkins, 2019; Ramirez-Campillo et al., 2020).

Conceptually, the improvement in the accuracy of the semi-smash can be linked to the theory of specificity of training. The walking lunge with unilateral shoulder press shares a similar movement pattern to the smash, involving hip extension, core stabilization, and explosive arm thrust. The principle of specificity states that training adaptation will be optimal if the movement pattern resembles the target skill (Suchomel et al., 2018). Therefore, the transfer of training to improve smash accuracy in this study has a strong theoretical basis.

In addition to neuromuscular aspects, the adaptation that occurs is also related to improved proprioception and balance control. Research shows that unilateral training increases stabilizer muscle activity and improves sensorimotor responses (Grgic et al., 2020). In the context of the semi-smash, improved proprioception helps athletes control arm angle and ball direction more precisely. This explains why the difference in improvement (Δ) in the experimental group was significantly higher than in the control group.

The three-times-per-week training frequency implemented in this study also supports optimal adaptation. Recent literature suggests that consistent training frequencies, lasting less than 60 minutes and involving large muscle groups, can improve strength, endurance, and coordination without increasing the risk of injury in adolescents (Faigenbaum et al., 2019; Lloyd & Oliver, 2016). Therefore, the significant improvement in the experimental group can be attributed to the implementation of training frequencies consistent with scientific recommendations.

The findings of this study are also relevant to studies emphasizing the importance of integrating strength-power training in the development of young volleyball athletes (Markovic & Mikulic, 2019; Slimani et al., 2016). Dynamic strength-based training programs not only increase jump height but also contribute to improved technical control and movement efficiency. In a school context, this approach has practical implications because it can be implemented without the need for complex facilities while still providing significant adaptive stimuli.

Statistically significant differences between groups after the intervention demonstrate the effectiveness of the applied training model. The higher improvement values in the experimental group indicate a strong intervention effect, both statistically

and practically significant. Hopkins (2019) emphasized that in sports research, practical significance is as important as statistical significance, as it directly relates to improvements in actual performance on the field.

Overall, this discussion confirms that the walking lunge with unilateral shoulder press effectively improves the accuracy of the semi-smash through neuromuscular adaptation mechanisms, increased kinetic chain stability, and improved motor control. Integrating functional strength training into extracurricular programs significantly impacts students' technical performance. These findings support the development of a training model based on lower and upper extremity integration as an innovative strategy for youth volleyball development.

The practical implication of this research is the need for school coaches to integrate specific functional strength training into their routine programs. This approach is more effective than conventional training that focuses solely on gameplay without structured physical intervention. Thus, conceptually and empirically, this research makes a significant contribution to the development of science-based volleyball training methods at the secondary education level.

CONCLUSION

Based on the statistical analysis, it can be concluded that the walking lunge with unilateral shoulder press significantly improved the accuracy of semi-smashes in male volleyball extracurricular students at MTs Al-Khairat Tondo. The experimental group's average smash accuracy increased from 10.10 ± 1.79 in the pretest to 14.10 ± 1.91 in the posttest ($p < 0.001$), with a difference in improvement (Δ) of 4.00 ± 1.05 . Meanwhile, the control group only experienced an increase from 10.20 ± 1.81 to 11.90 ± 1.91 ($p = 0.009$) with a Δ of 1.70 ± 1.64 . The difference in improvement between groups was significant ($p = 0.002$), indicating that the training intervention had a greater effect than conventional training. Conceptually, this improvement is influenced by neuromuscular adaptation, increased core stability, and integration of the lower and upper extremity kinetic chains, which support the precision of smash stroke direction. Empirically, this training model can be an effective alternative for developing smash power and accuracy in young athletes. The limitations of this study lie in the limited sample size and homogeneity of subject characteristics, so the generalizability of the results to similar populations is limited.

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We hope that the results of this study will make a tangible contribution to the development of school-age volleyball coaching and serve as a scientific reference for improving the quality of training in educational settings.

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