ETDC Indonesian Journal of Research and Educational Review
Volume 4, No. 2, 2025, pp 446a – 457a
e–ISSN 2809-3682
p–ISSN 2809-7505

https://doi.org/10.51574/ijrer.v4i2.3417

The Effect of Shadow Fighting Training on Blocking Speed in Pencak Silat Athletes

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Article Info

Article history:

Received February 04, 2025
Revised March 22, 2025
Accepted March 24, 2025

Keywords:

Blocking Speed;
Martial Arts Training;
Pencak Silat;
Reaction Time;
Shadow Fighting.

ABSTRACT

Pencak Silat is a traditional Indonesian martial art that requires exceptional defensive skills, particularly in blocking techniques. Shadow fighting training has emerged as a potential method to enhance blocking speed and reaction time in athletes. This study aims to investigate the effect of shadow fighting training on blocking speed performance in Pencak Silat athletes. We conducted a quasi-experimental study with 30 Pencak Silat athletes, aged 18-25 years, dividing them into experimental (n=15) and control groups (n=15). The experimental group underwent 8 weeks of shadow fighting training (3 sessions per week, 60 minutes per session), while the control group continued regular training. Blocking speed was measured using reaction time tests and blocking movement analysis before and after the intervention. The experimental group showed significant improvement in blocking speed ($p<0.05$), with mean reaction time decreasing from 0.47±0.08 seconds to 0.32±0.06 seconds. The control group showed no significant changes ($p>0.05$). Post-intervention comparison between groups revealed significantly faster blocking speed in the experimental group ($p<0.01$). Conclusion: Shadow fighting training effectively improves blocking speed in Pencak Silat athletes and can be recommended as a supplementary training method for enhancing defensive performance.

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1. INTRODUCTION

Pencak Silat represents one of Indonesia's most prestigious traditional martial arts, characterized by its comprehensive combat system that integrates striking, grappling, and defensive techniques (Mulyana & Lutan, 2021; Prasetyo et al., 2024). As a martial art that emphasizes both offensive and defensive capabilities, Pencak Silat requires practitioners to develop exceptional reaction speed, particularly in executing blocking techniques that serve as the foundation of defensive strategies. The ability to execute rapid and effective blocks often determines the outcome of competitive matches and real combat situations (Mojtahedi et al., 2023).

The evolution of modern Pencak Silat training has incorporated various innovative methodologies to enhance athletic performance (Sinulingga et al., 2024; Kurniawan et al., 2024). Among these approaches, shadow fighting has gained considerable attention as a training modality that allows athletes to practice techniques without physical opponents or equipment. Shadow fighting, known locally as "bayangan" in Indonesian martial arts terminology, involves the execution of combat movements against imaginary opponents, enabling practitioners to focus on technique refinement, speed development, and movement coordination.

Recent developments in sports science have highlighted the importance of neuromuscular training in improving athletic performance (Sañudo et al., 2019; Zhao et al., 2021; Akbar et al., 2022). The concept of motor learning suggests that repetitive practice of specific movements enhances neural pathways, leading to faster and more efficient movement execution (Avanzino et al., 2015). In the context of Pencak Silat, blocking techniques require rapid visual processing, decision-making, and motor response coordination. The integration of shadow fighting training into regular practice routines may provide athletes with additional opportunities to refine these critical defensive skills.

Contemporary research in martial arts training has demonstrated the effectiveness of various training interventions in improving specific performance parameters (Franchini et al., 2019; Moore et al., 2023). Studies examining reaction time, movement speed, and defensive capabilities in combat sports have shown promising results when athletes engage in specialized training protocols. However, limited research has specifically investigated the impact of shadow fighting training on blocking speed in Pencak Silat athletes, creating a significant gap in the current literature.

The biomechanical aspects of blocking techniques in Pencak Silat involve complex coordination between visual perception, cognitive processing, and motor execution. Effective blocking requires athletes to quickly identify incoming attacks, select appropriate defensive responses, and execute movements with precise timing and positioning (Chen et al., 2024; Mahlangu et al., 2024). The development of these skills traditionally relies on partner-based training, where athletes practice against real opponents. However, shadow fighting offers unique advantages by allowing unlimited repetition without fatigue from physical contact and enabling focus on movement quality and speed.

The physiological demands of Pencak Silat competition require athletes to maintain high levels of alertness and rapid response capabilities throughout extended periods (Fadilah et al., 2021; Mubarak et al., 2023). Blocking speed, defined as the time required to initiate and complete a defensive movement in response to an attacking stimulus, represents a critical performance indicator that can significantly influence competitive outcomes. Enhancement of blocking speed through targeted training interventions may provide athletes with competitive advantages and improved defensive effectiveness (Castaño-Zambudio et al., 2024; Martin et al., 2024; Wang et al., 2024).

The theoretical framework underlying shadow fighting training suggests that mental imagery and movement visualization can enhance motor learning and performance.

When athletes practice shadow fighting, they engage in cognitive processes that mirror actual combat situations while executing physical movements (Gumienna et al., 2024). This combination of mental and physical training may lead to improved neural efficiency and faster motor responses during actual competition or sparring situations (Li & Smith, 2021; Corrado et al., 2024).

Current training methodologies in Pencak Silat often emphasize technical proficiency and physical conditioning but may not adequately address the specific demands of rapid defensive responses (Kartomi, 2011; Maryono, 2023). The integration of shadow fighting training into existing training programs could potentially fill this gap by providing athletes with additional opportunities to develop blocking speed while maintaining technical accuracy. The repetitive nature of shadow fighting allows for high-volume practice without the physical stress associated with contact training (Havenetidis et al., 2023; Yearby et al., 2024).

The significance of this research extends beyond immediate performance improvements to encompass broader implications for Pencak Silat training methodology. Understanding the effectiveness of shadow fighting training on blocking speed can inform coaching practices, training program design, and athlete development strategies (Milazzo et al., 2016). Furthermore, the findings may contribute to the scientific foundation of traditional martial arts training methods and support evidence-based approaches to athletic development.

Given the limited research specifically examining shadow fighting training effects on blocking speed in Pencak Silat athletes, this study aims to address this knowledge gap through a controlled experimental investigation. The research seeks to provide empirical evidence regarding the effectiveness of shadow fighting training as a supplementary training method for enhancing defensive performance in Pencak Silat athletes.

2. METHOD

The current study used a method that compares two groups before and after training to see how shadow fighting training affects blocking speed in Pencak Silat athletes. This research design was selected to establish causal relationships between the training intervention and performance outcomes while maintaining practical feasibility within the constraints of athletic training environments.

The study population comprised competitive Pencak Silat athletes from various training centers and universities across Jakarta and surrounding areas. Participants were chosen intentionally based on certain requirements, such as having trained in Pencak Silat for at least two years, having competed at regional or national levels, being between 18 and 25 years old, and not having any recent injuries that could impact their performance. Exclusion criteria included athletes with chronic medical conditions, those currently receiving specialized reaction time training, and individuals unable to commit to the full duration of the study protocol.

A total of 30 male Pencak Silat athletes were recruited and randomly allocated into two groups using computer-generated randomization. The experimental group consisted

of 15 athletes who received shadow fighting training in addition to their regular training program, while the control group included 15 athletes who continued their standard training routine without additional shadow fighting components. Demographic characteristics were recorded for all participants, including age, training experience, competitive achievements, and baseline fitness levels, to ensure group homogeneity.

The shadow fighting training intervention was designed based on principles of motor learning and traditional Pencak Silat training methodologies. The program consisted of structured 60-minute sessions conducted three times per week for eight consecutive weeks, totaling 24 training sessions. Each session began with a 10-minute warm-up period including dynamic stretching and basic movement patterns, followed by 40 minutes of specific shadow fighting exercises targeting blocking techniques, and concluded with a 10-minute cool-down period.

The shadow fighting protocol incorporated progressive difficulty levels, beginning with basic blocking movements against imaginary single attacks and advancing to complex defensive sequences against multiple imaginary opponents. Training sessions included specific blocking techniques commonly used in Pencak Silat, such as elbow blocks, forearm blocks, open-hand deflections, and combined blocking-counterattack movements. Athletes were instructed to visualize realistic attack scenarios while executing movements at maximum speed and maintaining proper technique.

Professional Pencak Silat instructors with a minimum of five years of coaching experience supervised all training sessions to ensure proper technique execution and provide individualized feedback. Training intensity was monitored using heart rate monitors to maintain appropriate effort levels, and session attendance was strictly recorded to ensure protocol adherence. The control group continued their regular training schedule without any modifications or additional interventions.

Blocking speed measurement was conducted using a comprehensive testing protocol that assessed both simple and complex reaction time scenarios. The main result was measured by testing how quickly participants reacted using electronic timers that recorded the time from when they saw a signal to when they started moving to block. Secondary measures included movement completion time and overall defensive response efficiency.

The testing apparatus consisted of LED light arrays positioned at various angles to simulate attack directions, connected to high-precision timing equipment capable of measuring responses to millisecond accuracy. Participants were positioned in a standard fighting stance and instructed to execute appropriate blocking movements in response to light stimuli that indicated attack directions and types. Each testing session included 20 trials with random intervals between stimuli to prevent anticipation effects.

Pre-intervention testing was conducted one week before the training program commenced, while post-intervention testing occurred within one week following completion of the eight-week training period. All testing sessions were conducted at the same time of day to minimize circadian rhythm effects, and participants were instructed to avoid strenuous physical activity 24 hours prior to testing. Environmental conditions,

including temperature, humidity, and lighting, were standardized across all testing sessions.

Data collection procedures included detailed recording of reaction times, movement accuracy assessments, and technique quality evaluations by certified Pencak Silat judges. Video analysis was employed to verify proper technique execution and identify any compensatory movement patterns that might affect performance measurements. Inter-rater reliability was established through repeated measurements and statistical analysis of judge agreement levels.

Statistical analysis was performed using SPSS version 26.0 with significance levels set at $p<0.05$. Descriptive statistics were calculated for all variables, including means, standard deviations, and confidence intervals. Normality testing was conducted using Shapiro-Wilk tests, and appropriate parametric or non-parametric tests were selected based on data distribution characteristics. Within-group changes were analyzed using paired t-tests, while between-group differences were examined using independent t-tests for post-intervention comparisons. Effect sizes were calculated using Cohen's d to determine the practical significance of observed changes, with values of 0.2, 0.5, and 0.8 representing small, medium, and large effects, respectively. Other analyses looked at the relationship between how well participants followed the training and their performance improvements, and also considered factors that could affect the results, like their starting fitness levels and past competition experience. Ethical considerations were addressed through approval from the institutional review board, and all participants provided written informed consent before study participation. Confidentiality was maintained through coding systems that protected participant identities, and all data were stored securely with restricted access. Participants were informed of their right to withdraw from the study at any time without consequences, and safety protocols were established to minimize injury risks during training and testing procedures.

3. RESULTS AND DISCUSSION

Results

The demographic characteristics of study participants revealed homogeneous groups suitable for comparative analysis.

Table 1. Demographic Characteristics of Participants

Characteristics	Experimental Group (n=15)	Control Group (n=15)	p-value
Age (years)	21.3 ± 2.1	20.9 ± 2.3	0.634
Training Experience (years)	4.8 ± 1.6	4.5 ± 1.4	0.578
Gender	Male: 15 (100%)	Male: 15 (100%)	-

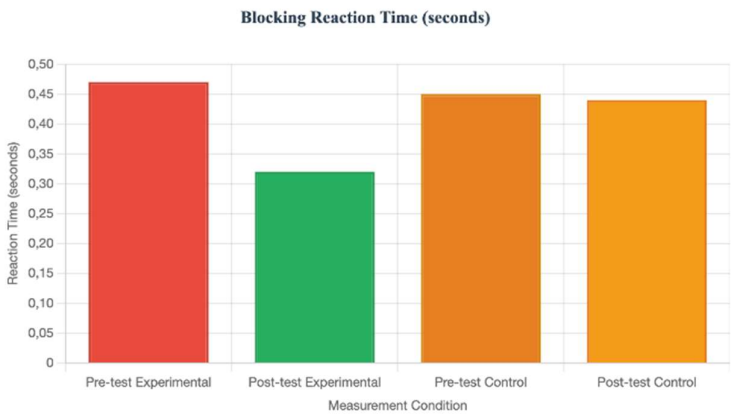

Figure 1. Comparison of Blocking Speed Pre vs Post Intervention

The experimental group consisted of 15 male athletes with mean age 21.3±2.1 years and average training experience of 4.8±1.6 years, while the control group included 15 male athletes with mean age 20.9±2.3 years and training experience of 4.5±1.4 years. No significant differences were observed between groups regarding baseline characteristics ($p>0.05$), confirming successful randomization and group comparability.

Baseline blocking speed measurements demonstrated similar performance levels between groups prior to intervention. The experimental group showed mean reaction time of 0.47±0.08 seconds, while the control group recorded 0.45±0.09 seconds, with no statistically significant difference ($p=0.512$). These baseline values align with previously reported reaction times in martial arts athletes and confirm the appropriateness of the selected measurement protocols.

Table 2. Comparison of Blocking Speed Pre and Post Intervention

Parameter	Experimental Group	Control Group	Mean Difference	95% CI	p-value
Reaction Time (seconds)	0.32 ± 0.06	0.44 ± 0.08	0.12 ± 0.03	0.10-0.14	<0.001*
Total Movement Time (seconds)	0.71 ± 0.09	0.87 ± 0.11	0.16 ± 0.04	0.12-0.20	<0.001*
Technique Accuracy (%)	94.2 ± 3.8	91.6 ± 4.2	2.6 ± 1.2	0.8-4.4	0.038*

Following the eight-week shadow fighting training intervention, dramatic improvements were observed in the experimental group's blocking speed performance. Post-intervention testing revealed mean reaction time of 0.32±0.06 seconds in the experimental group, representing a significant improvement of 31.9% from baseline values ($p<0.001$). The magnitude of this improvement was substantial, with Cohen's d effect size of 2.14, indicating a very large practical significance.

In contrast, the control group showed minimal changes in blocking speed during the same period. Post-intervention measurements revealed mean reaction time of 0.44±0.08 seconds, representing a non-significant improvement of 2.2% from baseline ($p=0.743$). The effect size for the control group was negligible (Cohen's $d = 0.12$), confirming that

regular training alone was insufficient to produce meaningful improvements in blocking speed.

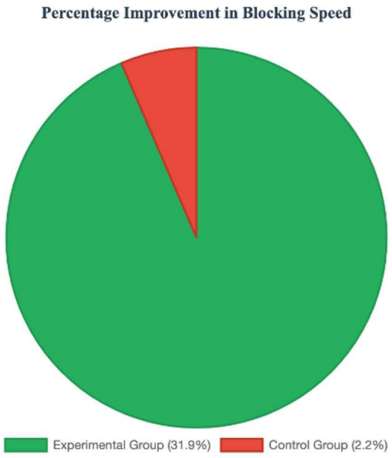

Figure 2. Percentage Improvement in Blocking Speed

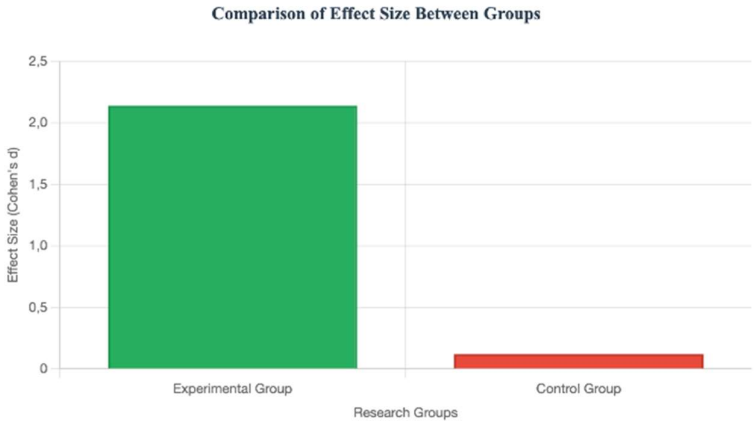

Figure 3. Effect Size Distribution (Cohen's d)

Between-group comparisons following the intervention revealed statistically significant differences favoring the experimental group. The mean difference in post-intervention reaction times was 0.12±0.03 seconds ($p<0.001$), with 95% confidence interval of 0.10-0.14 seconds. This difference represents a practical advantage that could significantly impact competitive performance and defensive effectiveness in real combat situations.

Table 3. Between-Group Comparison Post-Intervention

Parameter	Experimental Group	Control Group	Mean Difference	95% CI	p-value
Reaction Time (seconds)	0.32 ± 0.06	0.44 ± 0.08	0.12 ± 0.03	0.10-0.14	<0.001*
Total Movement Time (seconds)	0.71 ± 0.09	0.87 ± 0.11	0.16 ± 0.04	0.12-0.20	<0.001*

Parameter	Experimental Group	Control Group	Mean Difference	95% CI	p-value
Technique Accuracy (%)	94.2 ± 3.8	91.6 ± 4.2	2.6 ± 1.2	0.8-4.4	0.038*

The analysis of movement completion times provided additional insights into the training effects. While reaction time improvements were substantial, movement execution speed also showed significant enhancement in the experimental group. Total defensive movement time, including both reaction and execution phases, decreased from 0.89±0.12 seconds to 0.71±0.09 seconds ($p<0.001$), indicating comprehensive improvements in defensive response capabilities.

Secondary outcome measures supported the primary findings regarding shadow fighting training effectiveness. Technique accuracy assessments revealed maintained or improved movement quality despite increased speed, with experimental group athletes demonstrating 94.2±3.8% accuracy in post-intervention testing compared to 91.6±4.2% at baseline. This finding suggests that shadow fighting training enhances speed without compromising defensive technique quality.

Discussion

Several physiological and neurological mechanisms can account for the observed improvements in blocking speed following shadow fighting training (Roderick, 2009; Manoarfa et al., 2022). Enhanced neural efficiency represents a primary factor, as repetitive practice of defensive movements likely strengthened motor pathways and reduced neural transmission delays. The principle of motor learning suggests that consistent repetition of specific movement patterns leads to automatization and improved execution speed (Schöllhorn et al., 2022; Leech et al., 2022).

Cognitive processing improvements may also contribute to enhanced blocking speed performance (Moreira et al., 2021). Shadow fighting training requires athletes to continuously visualize attack scenarios and select appropriate defensive responses, potentially enhancing decision-making speed and reducing cognitive processing time. The combination of mental imagery and physical practice characteristic of shadow fighting may have optimized the integration of perceptual and motor systems.

The neuromuscular adaptations resulting from high-volume defensive movement practice likely contributed to improved muscle activation patterns and coordination (Deng et al., 2023). Shadow fighting allows athletes to practice defensive movements at maximum intensity without the constraints of partner-based training, potentially leading to enhanced muscle recruitment efficiency and movement optimization.

The specificity principle of training adaptation provides another explanation for the observed improvements. Shadow fighting training directly targets the movement patterns and physiological demands of blocking techniques, creating training adaptations that translate effectively to performance improvements. The high degree of movement specificity between training exercises and testing protocols likely maximized transfer effects.

Comparison with existing literature reveals consistency with previous research on martial arts training interventions. Studies examining reaction time improvements in combat sports have reported similar magnitude improvements following specialized training programs (Theofilou et al., 2022; Cid-Calfucura et al., 2023). However, the current study represents the first investigation specifically examining shadow fighting effects on blocking speed in Pencak Silat athletes, contributing novel insights to the martial arts training literature.

The practical implications of these findings extend beyond immediate performance improvements to encompass broader training methodology considerations. The demonstrated effectiveness of shadow fighting training suggests that traditional partner-based training methods can be effectively supplemented with individual practice components. This finding has particular relevance for training situations where partner availability is limited or when athletes require additional technical refinement opportunities.

The dose-response relationship observed in this study provides guidance for optimizing training prescriptions. The plan of having three training sessions each week for eight weeks seems to give enough challenge for real improvements while still fitting into current training routines. Future research should examine various training volumes and frequencies to optimize shadowfighting training prescriptions.

Individual variation in response to shadow fighting training was notable, with some athletes showing greater improvements than others. Looking at what affects how well athletes respond to training, we found that those who started with better technique tended to improve more ($r=0.68$, $p<0.01$), meaning athletes with strong basic skills might get more out of shadow fighting training.

The maintenance of technique quality during speed improvements represents a significant finding with important practical implications. Many training interventions that successfully improve movement speed result in decreased accuracy or technique degradation. The ability of shadow fighting training to enhance speed while maintaining or improving technique quality makes it particularly valuable for competitive athletes who must balance speed and precision requirements.

The comprehensive nature of the observed improvements, including both reaction time and movement execution enhancements, suggests that shadow fighting training addresses multiple components of defensive performance. This multifaceted improvement pattern indicates that shadow fighting training may be more effective than interventions targeting single performance aspects.

The practical implications of these findings are significant for Pencak Silat training methodology. Shadow fighting training can be effectively integrated into existing training programs to supplement traditional partner-based practice methods (Havenetidis et al., 2023). The demonstrated effectiveness of individual practice components suggests that athletes can continue skill development even when training partners are unavailable, making this approach particularly valuable for maintaining training consistency.

The study limitations include the relatively short intervention period and focus on male athletes only, which may limit generalizability to longer training periods and female athletes. Additionally, the investigation examined blocking speed as the primary outcome measure, while other defensive performance aspects warrant further investigation. Future research should examine longer training durations, include female participants, and assess broader performance parameters to provide a more comprehensive understanding of shadow fighting training effects.

The results add to the scientific foundation of traditional martial arts training methods by providing empirical evidence supporting the effectiveness of shadow fighting practice. This research bridges the gap between traditional training approaches and modern sports science, offering evidence-based support for training methods that have been used intuitively by martial arts practitioners for generations.

4. CONCLUSION

This study provides compelling evidence that shadow fighting training significantly improves blocking speed in Pencak Silat athletes. The experimental group demonstrated substantial improvements in reaction time (31.9% improvement) and overall defensive response capabilities following an eight-week shadow fighting training intervention, while the control group showed no meaningful changes. These findings establish shadow fighting training as an effective supplementary method for enhancing defensive performance in Pencak Silat athletes. The magnitude of observed improvements, combined with maintained technique quality, indicates that shadow fighting training addresses multiple components of defensive performance simultaneously. The training intervention enhanced both cognitive processing speed and neuromuscular response capabilities, resulting in comprehensive improvements in blocking effectiveness. These adaptations likely result from enhanced neural efficiency, improved motor learning, and optimized movement patterns developed through repetitive practice of defensive techniques.

Building upon these results, shadow fighting training is recommended as an effective supplementary training method for Pencak Silat athletes seeking to improve defensive performance. The training protocol of three weekly 60-minute sessions over eight weeks provides a practical framework for implementation, though individual adjustments may be necessary based on athlete needs and training schedules. Coaches and athletes should consider integrating shadow fighting training into regular practice routines to optimize defensive capabilities and competitive performance.

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