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Using Skill-Related Fitness to Guide Speed Kicking Training in *Silat* Athletes

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Abstract

In silat competition, where athletes gain an advantage through speed and accuracy, kick techniques are a crucial component. In order to ascertain whether skill-related fitness components can direct training design, this study sought to assess the relationship between skill-related fitness components and speed kicking performance in *silat* athletes. The study included thirty university silat athletes. A 10-second side-kick test was used to measure the speed at which both dominant and non-dominant legs could kick, and the Nelson Foot Reaction Time Test (reaction), 30 m Sprint Test (speed), Stork Stand Test (balance), Hexagon Jump Test (coordination), Standing Broad Jump Test (power), and Zigzag Run Test (agility) were used to measure skill-related fitness components. All fitness components and kicking performance for both dominant and non-dominant legs were found to be significantly correlated by Pearson correlation analysis ($p < .05$). Kicking frequency was most strongly associated with coordination ($r = –0.795$, dominant; $r = –0.699$, non-dominant) and power ($r = 0.738$, dominant; $r = 0.762$, non-dominant), although agility, sprint speed, balance, and reaction time also made significant contributions. These results suggest that speed kicking performance in silat is significantly influenced by skill-related fitness, specifically coordination and power. According to the findings, interventions that focus on coordination and power in addition to agility, speed, balance, and reaction time may improve silat athletes' kicking performance and competitive results. This supports the use of skill-related fitness as a useful framework for directing training approaches.

Keywords: *silat*, speed kicking, coordination, power, skill-related fitness, martial arts

1. Introduction

1.1 Pencak Silat

Pencak silat, commonly known as silat, is a martial art deeply rooted in the cultural heritage of the Malay Archipelago. Practiced for centuries across Indonesia, Malaysia, Brunei, and Singapore, silat combines elements of self-defense, physical fitness, and artistic performance (Elvianasti et al., 2023). Historically, silat was passed down through generations as a system of survival, equipping practitioners with techniques to protect themselves, their families, and their communities. Over time, silat evolved into a structured discipline that blended combat effectiveness with cultural values, spiritual teachings, and community identity (Carelliva et al., 2023). Today, silat is not only preserved as a traditional practice but has also expanded globally as a modern sport. Its recognition as part of UNESCO's Intangible Cultural Heritage in 2019 affirms its cultural and historical significance while highlighting its growing status as an international competitive discipline (Hadiana et al., 2022).

1.2 Silat as a Competitive Sport

In contemporary sport, silat is regulated by the International Pencak Silat Federation (PERSILAT) and is practiced in more than 50 countries. Competitive silat is generally categorized into three forms: *tanding* (match fighting), *seni* (artistic performance), and *jurus* (prearranged routines). Among these categories, *tanding* represents the most physically demanding format. In *tanding*, athletes exchange strikes, kicks, and sweeps within a regulated framework, with referees awarding points based on the precision, control, and effectiveness of techniques. Kicking is particularly significant in this context because it provides higher scoring potential than punches and often determines match outcomes (Shapie et al., 2019).

The ability to deliver fast, powerful, and accurate kicks offers athletes both offensive and defensive advantages. Offensively, a rapid kick increases the chance of scoring before the opponent can react. Defensively, speed kicking allows athletes to intercept or counter-attack effectively, disrupting the opponent's rhythm. Moreover, repeated kicks performed with speed and precision can fatigue opponents, reducing their ability to respond effectively. Consequently, kicking speed has become one of the most important determinants of success in silat competitions.

1.3 Biomechanical and Physiological Demands of Kicking

The execution of a silat kick requires a coordinated sequence of muscular and neural actions. The primary movers include the quadriceps, hamstrings, gluteal, and hip flexors, which generate the explosive force needed to accelerate the leg. At the same time, the abdominal and back muscles stabilize the trunk to maintain posture and balance during the motion (Doewes et al., 2022; Karo et al., 2023). Proper sequencing of these muscle groups ensures that the force generated at the proximal segments of the body is transferred efficiently to the distal segment, resulting in a fast and effective kick.

From a physiological perspective, kicking performance depends on the integration of

neuromuscular coordination, anaerobic energy supply, and reaction efficiency. Athletes must produce short bursts of maximal effort while simultaneously responding to dynamic and unpredictable situations. The ability to generate explosive power, maintain postural stability, and respond quickly to opponents' movements requires the development of specific physical and technical attributes. Thus, kicking speed reflects not only muscular strength but also coordination, balance, and decision-making, making it a complex performance indicator.

1.4 Importance of Skill-Related Fitness

Physical fitness is traditionally divided into health-related and skill-related components. While health-related fitness emphasizes general well-being through elements such as cardiovascular endurance, muscular strength, and flexibility, skill-related fitness is directly linked to sport performance. Skill-related fitness consists of agility, balance, coordination, power, speed, and reaction time (Sember et al., 2023; Gula, 2024). Each of these components contributes in unique ways to silat performance.

Agility enables athletes to change direction quickly and maintain body control during dynamic exchanges. In silat, agility is essential when transitioning between attack and defense within a restricted fighting space. Balance allows athletes to remain stable while delivering or defending against strikes, particularly during repetitive or high kicks. Coordination ensures that multiple muscle groups and body segments work harmoniously, enabling smooth and efficient execution of complex kicking techniques. Power reflects the ability to apply maximal force rapidly, which is crucial for explosive kicks that can penetrate an opponent's guard. Speed determines how quickly an athlete can initiate and complete movements, giving an advantage in striking exchanges. Reaction time influences how fast an athlete can respond to stimuli such as an opponent's movements, allowing them to exploit openings or avoid incoming attacks.

Evidence from martial arts research confirms the importance of these components. For instance, agility has been linked to improved evasion and counterattack skills in combat sports (Nia et al., 2024), while balance training has been shown to enhance stability and reduce injury risk under competitive stress (Cengiz & Coşkun, 2023). Coordination has been emphasized as a fundamental factor influencing the accuracy and efficiency of technical execution, including kicks (Mujiono & Hariono, 2024). Power and speed, on the other hand, are consistently recognized as the basis for explosive kicking ability, enabling athletes to strike with force and velocity (Sudiana et al., 2023). Reaction time is equally critical, as faster response capability often determines whether a strike successfully lands. Together, these components form the foundation of athletic performance in silat.

1.4 Training Methods for Silat Kicking Performance

Developing skill-related fitness requires structured and sport-specific training methods. Plyometric training is commonly used to improve lower-limb explosiveness by enhancing the stretch-shortening cycle of muscles, thereby increasing leg power and kicking velocity (Akhmad et al., 2021). Circuit training combines aerobic and anaerobic conditioning, enabling athletes to sustain performance under fatigue while reinforcing technical execution.

Speed, Agility, and Quickness (SAQ) drills specifically target neuromuscular efficiency, footwork, and responsiveness, which are essential in silat where athletes must respond instantaneously to opponents (Fajar et al., 2023).

Research supports the value of these training approaches in silat. Sudiana et al. (2023) demonstrated that plyometric stair jumps and reaction box jumps improved kicking frequency among silat athletes. Nasir et al. (2023) reported that stance width influenced kicking velocity, indicating the importance of biomechanics and movement efficiency. Irianto and Situmeang (2022) found that circuit training enhanced kick execution speed by developing both endurance and explosive power. These findings show that skill-related fitness is not just a theoretical framework but a practical guide for designing effective training models to enhance silat performance.

1.5 Gaps in Current Knowledge Regarding Silat Training

Despite these insights, research specifically focused on silat remains limited compared to studies in taekwondo and karate. Much of the existing evidence on martial arts performance has been derived from these sports, which, while similar in technical emphasis, differ from silat in rules, techniques, and competitive dynamics (Nia et al., 2023). Consequently, the transferability of findings from other martial arts to silat is not always direct. Furthermore, relatively few studies have systematically examined the relative contributions of different skill-related fitness components to kicking speed in silat. While it is understood that all components play a role, identifying which are most strongly associated with performance would provide coaches with clearer guidance on how to prioritize training.

Understanding these relationships is essential for practical application. For example, if coordination and power are confirmed as the strongest predictors of kicking speed, training models could place greater emphasis on plyometric drills and coordination-based exercises. Agility, reaction time, and balance could then be incorporated as complementary elements to refine overall performance. This evidence-based approach would allow coaches to maximize the efficiency of training programs, ensuring that athletes focus on the most relevant aspects of performance.

The present study seeks to fill this gap by investigating the relationship between skill-related fitness components and speed kicking performance among university silat athletes. The study specifically examines whether agility, balance, coordination, power, speed, and reaction time are significantly correlated with the number of kicks executed in a standardized 10-second side-kick test.

The central hypothesis is that skill-related fitness can be used as a guiding framework for developing silat training models, with coordination and power expected to emerge as the strongest predictors of performance. By identifying these associations, the study aims to contribute to the scientific literature on silat while also providing practical guidance for coaches. Ultimately, this research supports the integration of evidence-based methods into silat training, ensuring that athletes develop the physical and technical attributes most critical to success in competition.

2. Method

2.1 Research Design

This cross-sectional study adopted a quantitative, correlational research design to examine the relationship between skill-related fitness components and speed kicking performance among silat athletes. The design was chosen to allow systematic measurement of physical fitness attributes and their statistical association with performance outcomes, which is kicking speed, thereby providing evidence-based insights into training guidance for silat.

2.2 Participants

The participants were recruited from the Universiti Putra Malaysia silat team, comprising athletes who actively competed in *silat seni* (artistic performance) and *silat olahraga* (match fighting). A total population sampling approach was used, which involved enlisting all 30 eligible athletes from the university team. This sampling method was selected to ensure complete representation of the population of interest, avoiding selection bias and maximizing the reliability of findings within the given context. All participants were injury-free, actively engaged in training, and provided consent before participation.

2.3 Procedures

The assessment protocol consisted of one performance test and six skill-related fitness tests. Testing was conducted under standardized conditions in an indoor facility to minimize external interference. Participants were instructed to perform a light warm-up before testing and were given familiarization trials where necessary.

Kicking performance was evaluated using the side-kick speed test. Athletes performed sidekicks with both the dominant and non-dominant legs against a fixed target. The target was set at 100 cm for male athletes and 75 cm for female athletes to account for height differences. Each trial lasted for 10 seconds, during which athletes attempted to execute as many kicks as possible. Two trials were performed per leg, and the highest kicking frequency recorded was retained for analysis.

Agility was measured using the Zigzag Run Test. Athletes sprinted through a rectangular course measuring 10 × 16 feet, with four cones placed at the corners and one cone at the center as the pivot. The objective was to complete the course in the shortest possible time, with performance recorded in seconds. Speed was assessed through a 30-meter sprint, measured using electronic timing gates to ensure precise start and finish times. Athletes began from a stationary position behind the starting line and were instructed to sprint maximally through the finish line.

Balance was evaluated using the Stork Stand Test. Athletes stood on their dominant leg while placing the opposite foot against the knee of the supporting leg, hands resting on their hips. The test ended if the athlete lost balance, lowered the heel, or removed the hands from the hips. The duration of balance maintenance was recorded in seconds. Coordination was assessed using the Hexagon Jump Test. Athletes began in the center of a hexagon and jumped over each side, returning to the center, while maintaining a forward-facing orientation. Three

complete revolutions were performed in both clockwise and counterclockwise directions, and total time taken was recorded.

Explosive power was measured using the Standing Broad Jump. Athletes performed a maximal two-footed horizontal jump, assisted by arm swing and knee flexion. The greatest distance landed without falling backward was recorded in centimeters. Reaction time was tested using the Nelson Foot Reaction Time Test (audio). Athletes stood at the midpoint of a 14-meter line, and upon receiving a random auditory cue of "left" or "right," sprinted 7 meters toward the designated direction. Each athlete completed two trials, and the fastest response time was retained for analysis.

2.4 Statistical Analysis

All data were analyzed using descriptive statistics (mean ± standard deviation) to summarize performance outcomes across the measured variables. Pearson's product-moment correlation coefficient was employed to determine the strength and direction of the relationship between skill-related fitness components (agility, speed, balance, coordination, power, and reaction time) and side-kick speed performance for both dominant and non-dominant legs. Statistical significance was set at $p < 0.05$. This approach allowed identification of the most influential fitness components contributing to kicking performance, thereby providing practical insights for training model development.

3. Results

Table 1 shows the descriptive statistics for all of the performance parameters. During the 10-second kicking test, athletes did an average of 18.3 ± 2.01 repetitions on their dominant leg and 16.0 ± 2.89 repetitions on their non-dominant leg. This means that they could kick better with their dominant leg.

The average time for the Zigzag Run (7.02 ± 0.85 seconds) and the 30-meter sprint test (3.99 ± 0.68 seconds) were both for skill-related fitness components. The Stork Stand Test showed that the athletes had good postural stability, with an average balance performance of 59.0 ± 7.32 seconds.

Table 1. Kicking and skill-related fitness results

Parameters	Results (mean ± SD)
10s kicking count (dominant leg)	18.3 ± 2.01
10s kicking count (non-dominant leg)	16 ± 2.89
Agility(sec)	7.02 ± 0.85
Speed(sec)	3.99 ± 0.68
Balance(sec)	59 ± 7.32
Coordination(sec)	12.88 ± 1
Power(cm)	192.43 ± 27.66
Reaction time (sec)	2.12 ± 0.27

The Hexagon Jump Test measured coordination and found that the average time was 12.88 ± 1.00 seconds. The Standing Broad Jump measured lower-body explosive power and found

that the average distance was 192.43 ±27.66 cm. Finally, the Nelson Foot Reaction Time Test showed that the average reaction time was 2.12 ±0.27 seconds.
These results show that development is balanced across several skill-related fitness components, with a big difference between how well the dominant and non-dominant leg kicks.

Table 2 shows how skill-related fitness components are related to kicking performance. For the dominant leg, there were strong negative correlations between kicking performance and agility (r = –0.504, p = .005), speed (r = –0.708, p < .001), coordination (r = –0.795, p < .001), and reaction time (r = –0.392, p = .032). These results show that people who kicked more often had lower scores on tests of agility, sprinting, coordination, and reaction time.

Table 2. Pearson correlation analysis

Fitness component	Dominant leg		Non-dominant leg	
	r-value	*p*-value	*r*-value	*p*-value
Agility(sec)	-.504**	.005	-.571**	.001
Speed(sec)	-.708**	.000	-.609**	.000
Balance(sec)	.501**	.005	.507**	.004
Coordination(sec)	-.795**	.000	-.699**	.000
Power(cm)	.738**	.000	.762**	.000
Reaction time (sec)	-392*	.032	-485**	.007

Note: **Correlation is significant at the 0.01; *Correlation is significant at the 0.05

There were positive correlations between kicking with the dominant leg and balance (r = 0.501, p = .005) and power (r = 0.738, p < .001). This means that better stability and explosive strength helped improve kicking performance.

Similar patterns were noted for the non-dominant leg. There were strong negative correlations with reaction time (r = –0.485, p = .007), speed (r = –0.609, p < .001), coordination (r = –0.699, p < .001), and agility (r = –0.571, p = .001). There were also positive correlations found with power (r = 0.762, p < .001) and balance (r = 0.507, p = .004).

In general, the results show that athletes who had better agility, sprinting speed, coordination, reaction time, balance, and power tended to do better on the kicking speed test, whether they were using their dominant or non-dominant leg.

4. Discussion

This study examined the correlation between skill-related fitness components and speed kicking performance in silat athletes, intending to assess whether these components can function as a framework for informing training prescriptions. The results showed that kicking performance was strongly linked to a number of skill-related fitness factors, such as agility, speed, balance, coordination, power, and reaction time, for both the dominant and non-dominant legs.

The negative correlations between kicking counts and agility, sprint speed, coordination, and

reaction time imply that enhanced performance in these domains leads to improved kicking efficacy. These findings are consistent with prior research highlighting the significance of agility and reaction time in the efficacy of martial arts kicking (Fajar et al., 2023; Nia et al., 2023). Better agility lets athletes change direction quickly and with control, and better reaction time lets them respond to stimuli more quickly. Both of these things are important in combat situations where kicking is a decisive action (Syaifullah & Maghribi, 2023).

Their positive links to balance and power show how important they are for kicking well. Balance is very important in silat because athletes have to stay stable while doing fast kicks under pressure from other athletes. Previous research in martial arts and various sports demonstrates that dynamic balance enhances movement efficiency and performance (Cengiz & Coşkun, 2023; Akınoğlu et al., 2023). Likewise, lower-body power, assessed via the standing broad jump, exhibited a significant correlation with increased kicking speed and frequency. This finding aligns with previous studies indicating that plyometric and strength training augment leg explosiveness, consequently enhancing kicking speed and frequency (Sudiana et al., 2023; Li et al., 2023).

These findings also underscore the interrelation between technical execution and physical conditioning. Kicking speed is not solely contingent upon muscular strength; it is influenced by the amalgamation of coordination, reaction time, and biomechanical efficiency (Doewes et al., 2022). The most effective training methods are those that focus on improving agility, balance, and explosive power while also teaching technical skills. Research has shown that structured methods like SAQ (Speed, Agility, Quickness) drills, plyometric training, and circuit-based conditioning can help martial artists improve their physical abilities and kicking skills (Akhmad et al., 2021; Irianto & Situmeang, 2022).

Additionally, the results possess practical ramifications for silat coaching. Because kicking techniques are very important for scoring in competitions (Shapie et al., 2019), adding skill-related fitness to training plans is a way to improve competitive readiness that is based on evidence. To help players kick quickly, coaches may work on improving their agility, reaction time, and coordination. At the same time, they may work on building power and balance to help players keep kicking well in changing situations.

However, it is important to recognize certain limitations. The sample was confined to university-level athletes, thereby constraining the generalizability of the findings to elite or younger demographics. The study also used field-based fitness tests, which are useful but may not show all the biomechanical details of how well someone kicks. Subsequent research ought to examine longitudinal training interventions that empirically evaluate the efficacy of skill-related fitness programs in improving kicking performance.

Coordination, evaluated via the Hexagon Jump Test, demonstrated the most significant negative correlations with kicking frequency for both the dominant ($r = –0.795$, $p < .001$) and non-dominant legs ($r = –0.699$, $p < .001$). This finding underscores the significance of neuromuscular control and the capacity to synchronize various movements in silat. To kick, you need to combine hip flexion, knee extension, and ankle stabilization while keeping your balance and timing. Athletes with better coordination can do these complicated movements

more quickly and more often, which leads to faster and more frequent kicks. This is in line with earlier research that showed how important coordination is for martial arts performance, where precise limb control has a direct effect on the quality of kicking and striking actions (Fajar et al., 2023).

Power exhibited significant positive correlations with kicking performance (dominant leg $r = 0.738$, $p < .001$; non-dominant leg $r = 0.762$, $p < .001$). Athletes can kick faster by using explosive leg power to quickly speed up the kicking leg. In martial arts and team sports, lower-limb power is very important. Plyometric and resistance training are both known to improve leg strength and kicking speed (Sudiana et al., 2023; Li et al., 2023). In silat, where scoring often depends on how fast and accurately you kick, power is a basic physical trait that is necessary for success.

This research indicated that all six skill-related fitness components—agility, speed, balance, coordination, power, and reaction time—were significantly correlated with the speed kicking performance of silat athletes. Coordination and power were the most important predictors, showing that they are key to helping athletes kick quickly and effectively. Coordination makes sure that the movements of the lower limbs are in sync, while explosive power gives the kicking leg the force it needs to speed up. Both of these things directly improve the frequency and speed of kicking.

These results show that agility, reaction time, balance, and sprint speed are all important for performance. However, training models for silat should focus on building coordination and power. Plyometric training, resistance-based exercises, and complex movement drills that improve neuromuscular control are all practical ways to improve kicking performance the most. Coaches can create evidence-based training programs that improve speed kicking and competitive success in silat by using coordination and power as their main guides and adding other skill-related fitness elements.

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