Vol. 9, No.1, 2026, pp. 166-173
DOI: https://doi.org/10.32698/02241

Contents lists available at Journal Global Econedu

**Journal of Educational and Learning Studies**
ISSN: 2655-2760 (Print) ISSN: 2655-2779 (Electronic)

Journal homepage: http://jurnal.globaleconedu.org/index.php/jels

# Determinants of crescent kick performance in pencak silat athletes: path analysis

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**Article Info**

***Article history:***

Received Apr 18th, 2026
Revised May 29th, 2026
Accepted Jun 30th, 2026

***Keywords:***

Speed,
Flexibility,
Training motivation,
Crescent kick ability

**ABSTRACT**

This study aimed to examine the direct and indirect effects of speed, flexibility, and training motivation on crescent kick ability among Pencak Silat athletes at Walet Puti Martial Arts School, Jambi City. A quantitative associative design with path analysis was employed. The sample consisted of 40 athletes selected through purposive sampling from a population of 80 athletes. Speed was measured using a 30-meter sprint test, flexibility through the sit-and-reach test, motivation using a validated questionnaire, and crescent kick ability through a standardized crescent kick test. Data were analyzed using path analysis at a significance level of 0.05. Speed demonstrated the strongest direct effect on crescent kick ability (β = -0.934; 87.20%), followed by flexibility (β = 0.292; 0.85%) and motivation (β = 0.091; 0.82%). Motivation mediated the effects of speed (0.25%) and flexibility (0.15%) on kicking performance. Simultaneously, speed, flexibility, and motivation explained 96.82% of the variance in crescent kick ability ($R^2$ = 0.984). Speed was the dominant determinant of crescent kick performance, while flexibility and motivation provided complementary contributions. Integrating physical and psychological training is essential for optimizing Pencak Silat performance.



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## Introduction

Pencak Silat is one of the most prominent martial arts in Southeast Asia and has increasingly gained international recognition through regional and global competitions (Mansyukri et al., 2025; Putrie & Sumartiningsih, 2025). Success in Pencak Silat competitions is largely determined by athletes' ability to execute offensive and defensive techniques effectively while maintaining tactical control throughout the match. Among various attacking techniques, the crescent kick is considered one of the highest-scoring techniques because it enables athletes to reach the target area quickly and efficiently. Consequently, improving crescent kick performance has become a critical concern in athlete development programs because technical proficiency in this skill directly influences competitive achievement (Wijaya et al., 2021; Zulfikar, 2020).

The execution of a crescent kick requires the integration of several physical capacities, particularly speed and flexibility. From a biomechanical perspective, speed contributes to rapid lower-limb acceleration, efficient force transmission, and shorter reaction time, whereas flexibility allows athletes to achieve optimal joint positioning and a wider range of motion during kicking execution. Athletes possessing superior speed and flexibility generally demonstrate greater kicking velocity and movement efficiency in combat sports (Manihuruk &

Siahaan, 2025; Yanti et al., 2025). Nevertheless, the extent to which these physical attributes independently and collectively influence crescent kick performance in Pencak Silat remains insufficiently understood.

Among physical fitness components, speed has been consistently identified as an important predictor of performance in striking and kicking sports. Studies in combat sports indicate that athletes with higher movement speed tend to exhibit superior technical effectiveness and competitive performance because they can generate explosive actions and reduce opponents' response time (Ariyadi et al., 2025; Juwanda, 2020). Similarly, adequate flexibility facilitates optimal kicking mechanics by reducing movement restrictions and improving limb positioning during skill execution (Kahfi et al., 2025; Karim, 2025). However, previous studies have predominantly investigated speed and flexibility as isolated predictors and have rarely examined their relative contributions within an integrated explanatory model.

In addition to physical attributes, contemporary sport science increasingly recognizes the importance of psychological determinants in athletic performance. Training motivation plays a central role in directing athletes' effort, persistence, and engagement in training activities. According to Self-Determination Theory, motivated athletes are more likely to demonstrate greater adherence to practice, stronger commitment to performance goals, and higher levels of concentration during skill acquisition processes (Dimyati et al., 2020; Txi et al., 2023). Furthermore, physically competent athletes frequently develop greater confidence and willingness to participate actively in training, suggesting that motivation may function as a mechanism through which physical capabilities influence sport-specific performance outcomes (Lubis et al., 2021; Lubis, Thongdaeng, et al., 2022; Syaifullah & Doewes, 2020).

Despite the growing body of literature on Pencak Silat performance, several substantive limitations remain evident. First, existing studies have predominantly focused on isolated physical variables and have not adequately integrated physical and psychological determinants within a single analytical framework (Bafirman et al., 2023; Lubis, Haqiyah, et al., 2022; Mulyana & Lutan, 2021). Second, empirical evidence concerning the indirect mechanisms through which speed and flexibility may influence technical performance via motivational processes remains scarce. Third, research employing path analysis to investigate the direct and mediated relationships among these variables is still uncommon in the context of Pencak Silat, thereby limiting a comprehensive understanding of the determinants of crescent kick performance.

Therefore, this study aims to analyze the direct and indirect effects of speed, flexibility, and training motivation on crescent kick ability among athletes of Walet Puti Pencak Silat School, Jambi City. The novelty of this study lies in the development of an integrated causal model that simultaneously incorporates physical and psychological perspectives by positioning motivation as an intervening variable between physical attributes and technical performance. By applying path analysis, this study provides a more comprehensive explanation of the mechanisms underlying crescent kick performance and offers empirical evidence that can support the design of evidence-based training programs integrating physical conditioning and psychological enhancement to optimize Pencak Silat achievement.

## Method

This study employed a quantitative associative research design using path analysis to examine the direct and indirect effects of speed, flexibility, and training motivation on crescent kick ability among Pencak Silat athletes. Path analysis was selected because it allows the simultaneous investigation of causal relationships among multiple variables, including mediating effects. In the proposed structural model, speed ($X_1$) and flexibility ($X_2$) served as exogenous variables, training motivation ($X_3$) functioned as an intervening variable, and crescent kick ability (Y) was treated as the endogenous variable. The study was conducted at Walet Puti Pencak Silat School in Jambi City during May 2026.

The population consisted of 80 Pencak Silat athletes registered at Walet Puti Pencak Silat School. A purposive sampling technique was employed to select 40 athletes who met the inclusion criteria and actively participated in training programs. Data were collected using standardized measurement instruments. Speed was assessed through a 30-meter sprint test, flexibility was measured using the sit-and-reach test, training motivation was evaluated using a 32-item Likert-scale questionnaire encompassing intrinsic and extrinsic motivational dimensions, and crescent kick ability was measured using a standardized crescent kick performance test. All instruments were administered following established testing procedures to ensure measurement consistency and accuracy.

Data analysis was conducted using IBM SPSS Statistics version 27. Descriptive statistics, including mean, standard deviation, minimum, and maximum values, were calculated to summarize the characteristics of each variable. Prior to hypothesis testing, assumption tests were performed, including normality and linearity

analyses, to verify the suitability of the data for path analysis. Subsequently, path analysis was applied to estimate the direct effects of speed, flexibility, and motivation on crescent kick ability, as well as the indirect effects of speed and flexibility mediated through motivation. Statistical significance was determined at the 0.05 level, and the magnitude of direct, indirect, and total effects was calculated using standardized path coefficients and coefficients of determination ($R^2$).

## Results and Discussions

### Descriptive Statistics of Research Variables

Table 1 presents the descriptive statistics of the study variables, including speed, flexibility, motivation, and crescent kick performance among Pencak Silat athletes of Walet Puti Martial Arts School, Jambi City.

**Table 1.** Descriptive Statistics of Research Variables (n = 40)

| Variable | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|
| Speed (30-m Sprint, s) | 6.06 | 9.36 | 7.68 | 1.05 |
| Flexibility (Sit and Reach, cm) | 9.00 | 25.00 | 16.55 | 4.35 |
| Motivation (Score) | 46 | 122 | 85.40 | 22.00 |
| Crescent Kick Ability (Score) | 10 | 27 | 20.53 | 4.87 |

The descriptive analysis indicates considerable variation among the athletes across all measured variables. The average sprint time was 7.68 seconds, suggesting moderate speed performance. Flexibility scores averaged 16.55 cm, while the mean motivation score reached 85.40, indicating a moderate level of training motivation. Crescent kick performance showed a mean score of 20.53 points, reflecting variability in technical execution among athletes. These findings suggest that physical and psychological characteristics differed substantially among participants and may contribute to variations in crescent kick performance.

### Normality and Linearity Tests

Prior to path analysis, the assumptions of normality and linearity were examined.

**Table 2.** Assumption Testing Results for Path Analysis

| Relationship Tested | Normality (Sig.) | Decision | Linearity (Sig.) | Decision |
|---|---|---|---|---|
| Crescent Kick Ability on Speed | 0.330 | Normal | 0.413 | Linear |
| Crescent Kick Ability on Flexibility | 0.597 | Normal | 0.192 | Linear |
| Crescent Kick Ability on Motivation | 0.181 | Normal | 0.166 | Linear |
| Motivation on Speed | 0.128 | Normal | 0.133 | Linear |
| Motivation on Flexibility | 0.238 | Normal | 0.370 | Linear |

Prior to conducting the path analysis, the assumptions of normality and linearity were examined to ensure the suitability of the data for structural modeling. As presented in Table 2, all significance values for the normality tests exceeded the threshold of 0.05, indicating that the data were normally distributed. Similarly, all linearity significance values were greater than 0.05, demonstrating that the relationships among the variables were linear. These findings confirm that the data satisfied the fundamental assumptions required for path analysis and were appropriate for subsequent hypothesis testing.

### Path Analysis Results

The hypothesized relationships among speed, flexibility, motivation, and crescent kick ability were tested using path analysis.

**Table 3.** Path Coefficients among Research Variables

| Structural Model | Path | Beta Coefficient | Sig. |
|---|---|---|---|
| Model 1 | Speed to Motivation | 0.555 | 0.000 |
| Model 1 | Flexibility to Motivation | 0.436 | 0.070 |
| Model 2 | Speed to Crescent Kick Ability | -0.934 | 0.033 |
| Model 2 | Flexibility to Crescent Kick Ability | 0.292 | 0.073 |
| Model 2 | Motivation to Crescent Kick Ability | 0.091 | 0.001 |

The path analysis results indicate that speed significantly influenced motivation ($\beta = 0.555$, $p < 0.05$). Furthermore, speed ($\beta = -0.934$, $p = 0.033$) and motivation ($\beta = 0.091$, $p = 0.001$) significantly affected crescent

kick ability. Flexibility showed a positive path coefficient toward crescent kick ability (β = 0.292), although its significance level was weaker than the established criterion. Overall, the structural model confirmed that both physical and psychological factors contributed to athletes' kicking performance.

**Table 4.** Summary of Direct, Indirect, and Simultaneous Effects on Crescent Kick Ability

| Effect Type | Relationship | Coefficient (β) | Effect (%) | Sig. |
|---|---|---|---|---|
| Direct Effect | Speed to Crescent Kick Ability | -0.934 | 87.20 | 0.033 |
| Direct Effect | Flexibility to Crescent Kick Ability | 0.292 | 0.85 | 0.073 |
| Direct Effect | Motivation to Crescent Kick Ability | 0.091 | 0.82 | 0.001 |
| Indirect Effect | Speed to Motivation to Crescent Kick Ability | 0.050 | 0.25 | – |
| Indirect Effect | Flexibility to Motivation to Crescent Kick Ability | 0.039 | 0.15 | – |
| Simultaneous Effect | Speed, Flexibility, and Motivation to Crescent Kick Ability | $R^2 = 0.984$ | 96.82 | 0.000 |

The path analysis demonstrated that speed exerted the strongest direct effect on crescent kick ability (β = -0.934, p = 0.033), accounting for 87.20% of the explained variance. Flexibility (β = 0.292, p = 0.073) and motivation (β = 0.091, p = 0.001) also showed positive effects, although their contributions were considerably smaller. Motivation further acted as an intervening variable, producing indirect effects of 0.050 (0.25%) for the relationship between speed and crescent kick ability and 0.039 (0.15%) for the relationship between flexibility and crescent kick ability. Simultaneously, the three predictors explained 96.82% of the variance in crescent kick performance ($R^2 = 0.984$, $p < 0.001$), indicating that the proposed model provided a very strong explanation of technical performance among the athletes.

As shown in Figure 1, speed exhibited the largest standardized coefficient (β = -0.934), indicating that it was the most influential determinant of crescent kick performance, whereas flexibility and motivation demonstrated relatively smaller effects.

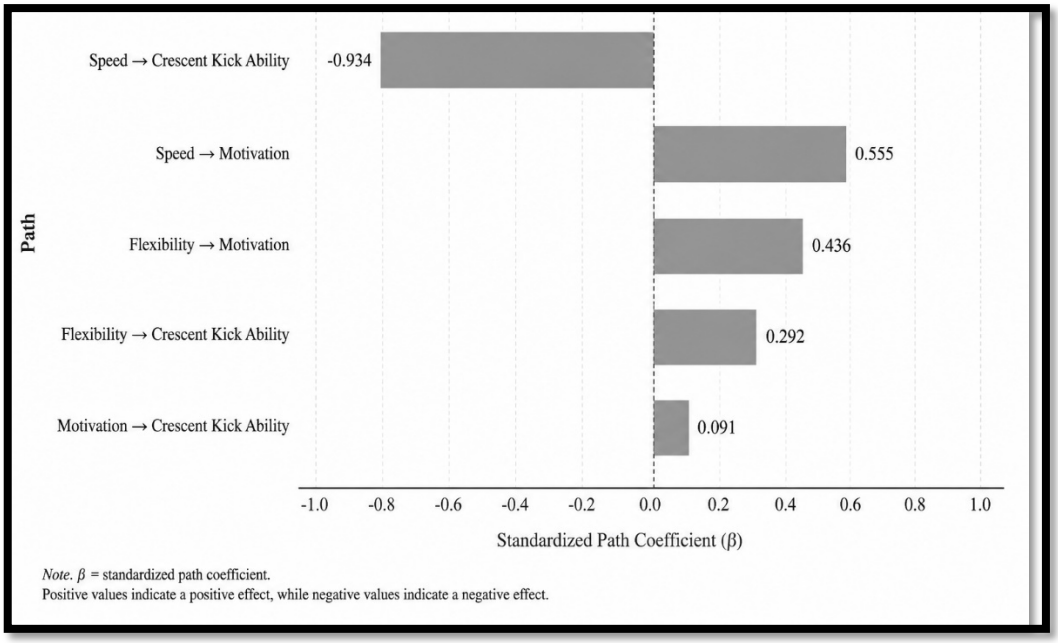


**Figure 1.** Standardized Path Coefficients (Horizontal Bar Chart)

The findings of this study demonstrate that speed is the most influential factor affecting crescent kick ability among Pencak Silat athletes at Walet Puti Martial Arts School, Jambi City. The path analysis revealed a direct effect coefficient of β = -0.934, contributing 87.20% to crescent kick performance. Although the coefficient was negative due to the scoring direction of the 30-meter sprint test (where lower time indicates higher speed), the

practical interpretation suggests that athletes with superior sprint performance tended to exhibit better crescent kick ability. This result highlights the importance of movement velocity in executing effective crescent kicks, as the technique requires rapid lower-limb acceleration, explosive execution, and efficient neuromuscular coordination. Faster athletes are generally capable of generating greater kicking momentum and reaching the target more efficiently, thereby enhancing technical performance during competition (Irawan et al., 2021; Risma et al., 2025).

The descriptive statistics further support the significance of speed in Pencak Silat performance. Male athletes recorded a mean sprint time of 6.74 seconds, with 55% classified in the very good category and 45% in the good category. In contrast, female athletes demonstrated a mean sprint time of 8.62 seconds, with 70% categorized as moderate and 30% as poor. These differences were reflected in crescent kick performance, where male athletes achieved a mean score of 23.90 compared with 17.15 among female athletes. Such findings suggest that variations in speed capacity may partially explain differences in technical kicking performance. From a physiological perspective, speed is strongly associated with fast-twitch muscle fiber recruitment, neuromuscular efficiency, and rapid force production, all of which are essential components of effective kicking actions in martial arts (Muktiani et al., 2022; Widiastuti et al., 2022).

Flexibility was also found to contribute positively to crescent kick ability, although its direct effect was considerably smaller ($\beta = 0.292$; contribution = 0.85%). The descriptive data indicated that flexibility levels were relatively favorable among participants, with 45% of male athletes and 50% of female athletes classified in the very good category. These findings suggest that adequate flexibility supports the execution of crescent kicks by increasing joint range of motion and facilitating optimal kicking mechanics. Greater flexibility allows athletes to achieve higher kicking trajectories while maintaining postural control and reducing mechanical restrictions during movement. Nevertheless, the relatively small contribution indicates that flexibility alone is insufficient to substantially improve kicking performance without the support of other physical capacities, particularly speed and explosive movement ability (Dongoran et al., 2020; Nelson et al., 2022; Rohayati et al., 2022).

Training motivation emerged as a significant psychological predictor of crescent kick ability, with a direct effect coefficient of $\beta = 0.091$ and a contribution of 0.82%. Although the magnitude of the effect was modest, motivation plays a critical role in influencing athletes' willingness to engage consistently in training activities, maintain effort during practice, and persist in skill development. The motivational profile of the athletes showed that 40% were categorized as having moderate motivation, 27.5% high motivation, and only 2.5% very high motivation. These results indicate that motivational development remains an area with considerable potential for improvement. Athletes who possess stronger motivation are more likely to demonstrate higher training adherence, greater concentration during practice, and stronger commitment to performance goals, all of which contribute indirectly to technical skill acquisition (Ambarwati et al., 2024; Damrah et al., 2023; Syarif et al., 2020).

The mediating role of motivation provides additional insight into the mechanisms underlying crescent kick performance. The indirect effect of speed on crescent kick ability through motivation was 0.050 (0.25%), while the indirect effect of flexibility through motivation was 0.039 (0.15%). Although these indirect contributions were relatively small, they indicate that physical attributes may influence performance not only through biomechanical pathways but also through psychological processes. Athletes who perceive themselves as physically capable often develop greater confidence, self-efficacy, and enthusiasm toward training, which subsequently strengthens their motivation to practice and improve performance. This finding supports contemporary sport performance models that emphasize the interaction between physical and psychological determinants of athletic achievement (Regency & Sinurat, 2020; Subekti, Hidayatullah, Syaifullah, Setiyadi, & Warthadi, 2025).

Another important finding is the exceptionally high explanatory power of the proposed model. The simultaneous analysis yielded an $R^2$ value of 0.984, indicating that speed, flexibility, and motivation collectively explained 96.82% of the variance in crescent kick ability. This result suggests that the selected predictors represent the dominant factors associated with kicking performance among the studied athletes. Only 3.18% of the variance remained unexplained by the model, implying that other factors such as muscular power, balance, coordination, technical mastery, tactical understanding, anthropometric characteristics, and competitive experience may account for the remaining variation (Burhanuddin et al., 2023; Sampurna et al., 2021; Sejati et al., 2022; Teo et al., 2022). The substantial coefficient of determination demonstrates the suitability of the proposed structural model in explaining crescent kick performance within this athletic population.

From a practical perspective, the findings provide important implications for coaches and practitioners involved in Pencak Silat athlete development. Training programs should prioritize the enhancement of speed-related capacities because speed demonstrated the strongest contribution to crescent kick performance.

Flexibility training should be maintained as a complementary component to optimize movement range and technical efficiency, while motivational strategies should be systematically integrated into coaching practice to sustain athlete engagement and commitment. The combination of physical conditioning and psychological development appears essential for maximizing technical performance (Anifah et al., 2021; Mardius et al., 2026; Subekti, Hidayatullah, Syaifullah, Setiyadi, & Fatoni, 2025; Sudirman et al., 2022). Therefore, future athlete development programs should adopt a multidimensional training approach that simultaneously addresses physical, technical, and motivational aspects to improve crescent kick effectiveness and competitive success.

## Conclusions

This study concludes that speed, flexibility, and training motivation significantly contribute to the crescent kick ability of Pencak Silat athletes at Walet Puti Martial Arts School, Jambi City. Among these variables, speed emerged as the most dominant factor, demonstrating the largest direct contribution to crescent kick performance. Flexibility and motivation also positively influenced kicking ability, although their contributions were relatively smaller. Furthermore, motivation functioned as an intervening variable that mediated the effects of speed and flexibility on crescent kick performance. Simultaneously, the three variables explained 96.82% of the variance in crescent kick ability, indicating that physical and psychological factors collectively play a crucial role in determining technical performance. Therefore, training programs aimed at improving crescent kick ability should emphasize the development of speed while simultaneously enhancing flexibility and training motivation to achieve optimal performance outcomes.

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