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Research Article

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Contribution of Leg Muscle Explosive Power and Balance to Sickle Kick Speed in Pencak Silat Athletes

Alvia Ahmad[1*], Muhammad Sulfa[2], Yudik Prasetyo[3], Widiyanto[4], Amiruddin[5], Fadel Muhammad[6]
Ilmu Keolahragaan, Universitas Cahaya Prima, Indonesia[12]
Ilmu Keolahragaan, Universitas Negeri Yogyakarta, Indonesia[34]
Departemen Perawatan Proyek, PT Indonesia Morowali Industrial Park, Indonesia[5]
Pendidikan Kepelatihan Olahraga, Universitas Negeri Yogyakarta, Indonesia[6]
Correspondence author: alviaahmad644gmail.com[1]

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ABSTRACT
The sickle kick is one of the most frequently used techniques in pencak silat competitions and yields high scores, making kick speed a critical performance factor. A faster sickle kick is more difficult for opponents to anticipate, parry, or counter. Several physical components support effective sickle kick performance, including strength, flexibility, power, balance, and agility. This study specifically examined the contribution of leg muscle explosive power and balance to sickle kick speed. This research employed a correlational design involving 30 male athletes from the Pencak Silat Student Activity Unit of Universitas Negeri Yogyakarta (UNY), aged 19–23 years. Data were collected through tests and measurements, using the standing broad jump test to assess leg muscle explosive power, the standing stork test to measure balance, and a 10-second sickle kick speed test to evaluate kick performance. Data analysis was conducted using regression analysis to determine the contribution of each variable. The results revealed that leg muscle explosive power contributed 53.1% to sickle kick speed, while balance contributed 45.7%. When analyzed simultaneously, both variables accounted for 53.6% of the variance in sickle kick speed. These findings highlight the importance of developing leg muscle explosive power and balance within structured training programs to enhance sickle kick speed and overall competitive performance in pencak silat athletes.

Keywords: leg muscle, explosive power, balance, sickle kick speed, pencak silat

INTRODUCTION

Pencak silat is a traditional martial art originating from Indonesia that has evolved into an internationally recognized competitive sport (Anifah et al., 2024). Its development accelerated following the establishment of IPSI in 1948, which unified

various schools and promoted global expansion through Persilat, contributing to its wider recognition during the 1980s–1990s (Suhardinata & Indrahti, 2021). In its competitive form, pencak silat encompasses sparring, single, double, and team categories across various age groups (Sudirman et al., 2022; Sad et al., 2023; Syaifullah et al., 2023) As a combat sport, successful performance requires the integration of technical skills and physical conditioning to execute effective attacks (Maghribi et al., 2024; Bahriyanto et al. 2024). Among offensive techniques, kicking plays a crucial role in scoring and influencing match outcomes (Sinulingga et al., 2023). The effectiveness of kicking performance is strongly influenced by physical attributes such as explosive power and balance, which contribute to movement speed, stability, and execution accuracy during dynamic actions (Ihsan et al., 2022; Paillard, 2019).

Pencak silat in the sparring category is a full-body contact sport, meaning that there is direct physical contact between two fighters who face each other throwing attacks and defenses (Saputra & Muzaffar, 2022). The sparring category features a physical contact style of combat that uses strength, speed, endurance, agility, and physical coordination with fast and powerful attacks using kicks and punches to get points (Maghribi et al., 2024). Basic techniques in *pencak silat* include: (1) easel (body position), which is used to maintain balance in static and dynamic positions; (2) step patterns, which align foot and hand movements to approach or avoid opponents; (3) brace movements, which involve body, hand, and foot movements to prepare for an attack or outwit an opponent; (4) defense, which is used to divert or avoid an opponent's attack; and (5) attack, which includes blows with the arms and kicks using various parts of the foot, such as the instep, sole, and heel (Liskustyawati et al., 2019).

In the sparring category, a very important attack technique to master is the kick, because kicks are the attack technique most often used by fighters and tend to be more effective in collecting points (Sinulingga et al., 2023). Some kicks used in the sparring category consist of straight kicks, sickle kicks, T kicks, and back kicks (Hidayat & Haryanto, 2021). However, the sickle kick is one of the kicks that is often used by athletes in every *pencak silat* match (Ihsan et al., 2022). The sickle kick is a kick that uses the instep as a targeting tool with the direction of the trajectory forming a semicircle towards the opponent's body, this kick is very favored by fighters because it is very easy to do (Sinurat, 2020). This kicking technique gives high points, namely 2 points for hitting the opponent and 3 points if the opponent falls, so it is essential to increase the speed of the sickle kick so that it becomes a fast kick and difficult for the opponent to catch (Sitompul & Aisah, 2024).

To obtain good performance and achievement, excellent physical condition is needed. Bahriyanto et al. (2024) state that the physical condition required components in the sparring category of *pencak silat* include endurance, strength, speed, flexibility, coordination, agility, explosive power, reaction speed, balance, and accuracy. And to get an effective sickle kick requires excellent physical condition. Research by Juwanda (2020) states that leg muscle explosive power contributes to sickle kicks. Furthermore, research by Syah et al. (2022) states that leg muscle explosive power and balance can improve front kick ability.

The results of observations made by researchers directly, during routine training athletes Pencak Silat UNY paired up and took turns attacking with sickle kicks. Based on the observations of researchers, the kicks made have good speed because the opposing partner is difficult to catch or parry the kick. However, there are some athletes whose kicks are not fast enough so that they are easily parried, caught, and dropped by their opponent's partner. Therefore, there are several problem

identifications found, namely as follows: (1) the level of sickle kick speed of UNY *Pencak silat* athletes is not optimal, which causes kicks to be easily caught, parried or even counterattacked by opponents; (2) lack of leg muscle explosive power in some athletes, which results in the resulting sickle kick not having a large enough impact; (3) the balance that athletes have is still lacking, less than optimal balance can hinder the athlete's ability to execute kicks quickly and precisely. This is in line with Hayati & Endriani (2021) that when attacking with a sickle kick, the kick must be done quickly so that it is not easily caught by the opponent. In *pencak silat* martial arts, the speed of the sickle kick is very important to gain points in the match (Hidayat et al., 2024). Speed in the sickle kick is very important to create an effective attack method because the faster the kick is performed, the easier it is to get points and the more difficult it is for the opponent to avoid (Ardiansyah, 2023).

Several factors affect sickle kick speed, including leg muscle explosive power and balance. According to Ihsan et al. (2022), the factor that affects the speed of the sickle kick is leg muscle explosive power which plays an important role in increasing the speed of the sickle kick, thus allowing athletes to produce fast and powerful kicks through a combination of muscle strength and speed. Power is one of the most important components to achieve outstanding sporting achievements (Aksović et al., 2021). Power is determined by the strength of muscle contraction, distance, and the number of muscles that contract each minute, so that a person can use maximum strength in the shortest possible time to optimize muscle contraction (Yewen et al., 2024). In the sport of *pencak silat*, a fighter's leg muscle explosive power is very important, especially when performing strong explosive kicks. If a fighter's leg muscle explosive power is low, then the kicks performed will be easy to predict and the opponent can use slam techniques to get points (Rosmawati et al., 2019). In addition, leg muscle explosive power plays a role in sickle kicks because athletes who have good leg muscle explosive power conditions will produce strong sickle kicks with high speed so that the kicks are perfect (Rahmana & Suwirman, 2020).

Balance is also one of the factors that determine whether or not it is good in terms of sickle kick speed (Syarifoeddin, 2016, p. 329). Balance is a person's ability to maintain the attitude and position of his body quickly while standing (static balance) or while moving (dynamic balance) (Tauhidman & Ramadan, 2018, p. 134). Because the sickle kick technique requires movement by standing on one leg and rotating 90 °, the sickle kick requires balance (Ichtiyanto et al., 2022, p. 144). The sickle kick will be effective if the athlete has good balance because when the *pencak silat* athlete uses the sickle kick technique continuously to kick the bag, the balance of the kick is influenced by foot movement, body position, and concentration (emotions and soul) so that the kick can be directed to the desired target (Akmal et al., 2019, p. 23).

Over the past year, the Pencak Silat team of Yogyakarta State University (UNY) has achieved notable accomplishments at national-level competitions. Despite these achievements, further performance enhancement requires a deeper scientific understanding of the physical factors influencing technical execution, particularly kick speed. Previous studies have examined the role of explosive power or balance in sports performance separately; however, limited research has simultaneously analyzed their combined contribution to sickle kick speed in pencak silat athletes. Moreover, most existing studies have focused on general performance outcomes rather than specific kicking techniques using a regression-based approach. Therefore, investigating these variables together provides important insight for evidence-based training development. Based on this research gap, this study aims to determine the contribution of leg muscle explosive power and balance to sickle kick

speed in pencak silat athletes. The findings are expected to support the development of evidence-based training strategies for improving technical performance.

METHODS

This study employed a quantitative approach using a correlational research design to examine the relationship between physical performance variables and sickle kick speed. Correlational research is used to identify the direction and strength of relationships among variables without manipulation (Stockemer, 2018; Bloomfield & Fisher, 2019). This study involved two independent variables, namely leg muscle explosive power (X_1) and balance (X_2), and one dependent variable, namely sickle kick speed (Y). The research design is presented in Figure 1.

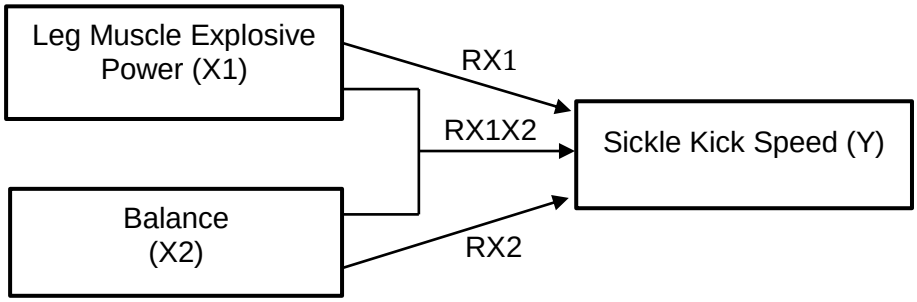

Figure 1. Correlational Design

The population consisted of 50 athletes from the Pencak Silat Student Activity Unit of Universitas Negeri Yogyakarta (UNY). A total of 30 athletes were selected as the sample using purposive sampling. The inclusion criteria were male athletes aged between 19–23 years who competed in the sparring category.

Three instruments were used to measure the study variables. Leg muscle explosive power was measured using the Standing Broad Jump Test (Yudha, 2022). Balance was measured using the Standing Stork Test (Sepdanius et al., 2019). Sickle kick speed was measured using the 10-second sickle kick speed test (Lubis & Wardoyo, 2016).

Data collection was conducted during regular training sessions in an indoor training facility to ensure a controlled and consistent environment. All participants performed the tests after completing a standardized warm-up session. Each test was administered according to its respective testing protocol to ensure measurement consistency. The participants completed the Standing Broad Jump Test, Standing Stork Test, and the 10-second sickle kick speed test with adequate rest intervals provided between tests to minimize fatigue effects.

The collected data were analyzed using multiple regression analysis to determine the contribution of leg muscle explosive power and balance to sickle kick speed. The coefficient of determination (R^2) was used to assess the magnitude of contribution of the independent variables to the dependent variable. Statistical analysis was performed using SPSS version 26 with a significance level of $\alpha = 0.05$.

RESULTS AND DISCUSSION

The data collected in this study came from the measurement of three variables, namely leg muscle explosive power, balance, and sickle kick speed. The following is the data obtained:

1. Descriptive analysis

a. Descriptive statistic

Table 1. Statistical Description

Variables	N	Range	Min	Max	Mean	Std. Deviation
Leg Muscle Explosive Power	30	83	180	263	231.90	17.165
Balance	30	33	15	48	31.33	9.305
Sickle Kick Speed	30	12	18	30	23.97	2.988

Table 1 presents the descriptive statistics of leg muscle explosive power, balance, and sickle kick speed among UNY pencak silat athletes. The results in the table above for more details are as follows:

(1) For data on leg muscle explosive power in athletes of *Pencak Silat* UNY obtained through the results of the standing broad jump test, with a total sample of 30 people obtained a range/distance value of leg muscle explosive power of 83 kg-m/sec. The lowest value of leg muscle explosive power is 180 kg-m/sec. The highest value of leg muscle explosive power is 263 kg-m/sec. The average value of leg muscle explosive power is 231.90 kg-m/sec which indicates the majority of leg muscle explosive power for athletes of *Pencak Silat* UNY. The standard deviation/standard deviation (s) value of leg muscle explosive power is 17.165 kg-m/sec indicates that the value of leg muscle explosive power of some samples is far from the average, which means that the data distribution is uneven.

(2) For balance data on athletes of *Pencak Silat* UNY obtained through the results of the standing stork test, with a total sample of 30 people obtained a range/distance balance value of 33 seconds. The lowest value of balance for 15 seconds. The highest value of balance for 48 seconds. The average value of balance for 31.33 seconds which indicates the majority of the balance of UNY *Pencak Silat* athletes. The standard deviation/standard deviation (s) value of the balance for 9.305 seconds indicates that the balance value of some samples is far from the average, which means that the data distribution is uneven.

(3) For data on sickle kick speed in *Pencak Silat* UNY athletes obtained through the results of the sickle kick speed test for 10 seconds, with a sample size of 30 people, the range value/distance of sickle kick speed was obtained 12 times. The lowest value of sickle kick speed is 18 kicks. The highest value of sickle kick speed is 30 kicks. The average value of sickle kick speed is 23.97 kicks indicates the majority of the balance of UNY *Pencak Silat* athletes. The standard deviation/standard deviation (s) value of sickle kick speed is 2,988 kicks which indicates that the sickle kick speed values of some samples are far from the average, which means that the data distribution is uneven.

b. Descriptive frequency

Table 2. Percentage Frequency Distribution of Leg Muscle Explosive Power

Interval	Frequency	Percent	Category
280 – 315 cm	0	0%	Excellent
254 – 279 cm	4	13.3%	Good
220 – 253 cm	22	73.4%	Moderate
190 – 219 cm	3	10%	Poor
<189 cm	1	3.3%	Very Poor
Total	30	100%	

Based on Table 2 above, it is known that the results of leg muscle explosive power data from 30 athletes are as follows: excellent category as many as 0 athletes (0%), good category as many as 4 athletes (13.3%), moderate category as many as 22 athletes (73.4%), poor category as many as 3 athletes (10%) and very poor category as many as 1 athletes (3.3%). Thus, it can be concluded that the percentage of the final results of leg muscle explosive power of *Pencak Silat* UNY athletes is dominant in the moderate category.

Table 3. Percentage Frequency Distribution of Balance

Interval	Frequency	Percent	Category
>50 *secs*	0	0%	Excellent
41 – 50 *secs*	5	16.7%	Above average
31 – 40 *secs*	9	30%	Average
20 – 30 *secs*	11	36.6%	Below average
<20 *secs*	5	16.7%	Bad
Total	30	100%	

Based on Table 3 above, it is known that the results of balance data from 30 athletes are as follows: excellent category as many as 0 athletes (0%), above average category as many as 5 athletes (16.7%), average category as many as 9 athletes (30%), below average category as many as 11 athletes (36.6%) and bad category as many as 5 athletes (16.7%). Thus, it can be concluded that the percentage of the final results of the balance of UNY *Pencak Silat* athletes is dominant in the below-average category.

Table 4. Percentage Frequency Distribution of Sickle Kick Speed

Interval	Frequency	Percent	Category
> 25	11	36.7%	Excellent
20 – 24	15	50%	Good
17 – 19	4	13.3%	Sufficient
15 – 16	0	0%	Poor
< 14	0	0%	Very Poor
Total	30	100%	

Based on Table 4 above, it is known that the results of the sickle kick speed data from 30 athletes are as follows: excellent category as many as 11 athletes (36.7%), good category as many as 15 athletes (50%), sufficient category as many as 4 athletes (13.3%), poor category as many as 0 athletes (0%), very poor category as many as 0 athletes (0%). Thus, it can be concluded that the percentage of the final results of the sickle kick speed of *Pencak Silat* UNY athletes is dominantly in the good category.

2. Data normality test

Table 5. Data Normality Test

Research Variable	P	Value α	Conclusion
Leg Muscle Explosive Power (X1)	0.062	0.05	Normal
Balance (X2)	0.084		Normal
Sickle Kick Speed (Y)	0.226		Normal

Based on Table 5 above, the normality test using the Shapiro Wilk test, the data on the results of leg muscle explosive power with a significant level of 0.062> 0.05 which means that the leg muscle explosive power data is normally distributed. On balance data with a significant level result of 0.084> 0.05 which means that the balance data is normally distributed. Furthermore, the sickle kick speed data with a significant level result of 0.226> 0.05 which means that the sickle kick speed data is normally distributed. So it can be concluded that all data is normally distributed and can then be analysed using parametric statistical tests.

3. Hypothesis test

After the data on leg muscle explosive power, balance, and speed of the sickle kick were obtained which were then analyzed descriptively. Furthermore, hypothesis testing was carried out from the research that had been carried out.

Table 6. Regression Analysis of Leg Muscle Explosive Power and Speed of the Sickle Kick

Research Variable	**Sig.**	**R**	**R^2**	**R^2x 100%**	**F**	**t count**	**t table**
Leg Muscle Explosive Power	0.000	0.729	0.531	53,1%	31.693	5.630	2.048
Sickle Kick Speed							

The first hypothesis reads that there is a contribution of leg muscle explosive power to the speed of the sickle kick of *Pencak Silat* UNY athletes. Based on the results of data analysis in Table 6 above, the correlation/relationship value (R) is 0.729, it means a strong relationship between leg muscle explosive power and sickle kick speed. Based on the t value of 5.630> t table 2.048, it means there is a contribution of leg muscle explosive power to the sickle kick speed of UNY *Pencak Silat* athletes. Furthermore, the coefficient of determination (R Square) value is 0.531, it means that the contribution of leg muscle explosive power to sickle kick speed is 53.1%. So it can be concluded that there is still a contribution from other factors to the speed of the sickle kick by 46.9%.

Table 7. Regression Analysis of Balance and Speed of the Sickle Kick

Research Variable	**Sig.**	**R**	**R^2**	**R^2x 100%**	**F**	**t count**	**t table**
Balance	0.000	0.676	0.457	45,7%	23.603	4.858	2.048
Sickle Kick Speed							

Furthermore, the second hypothesis reads that there is a contribution of balance to the speed of the sickle kick of *Pencak Silat* UNY athletes. Based on the results of data analysis in Table 7 above, the correlation/relationship value (R) is 0.676, it means a strong relationship between balance and sickle kick speed. Based on the t value of 4.858> t table 2.048, it means there is a contribution of balance to the sickle kick speed of UNY *Pencak Silat* athletes. Furthermore, the coefficient of determination (R Square) value is 0.457, it means that the contribution of balance to

the sickle kick speed is 45.7%. So it can be concluded that there is still a contribution from other factors to the speed of the sickle kick of 54.3%.

Table 8. Regression Analysis of Leg Muscle Explosive Power, Balance and Speed of the Sickle Kick

Research Variable	Sig.	R	R^2	R^2x 100%	F	t count	t table
Leg Muscle Explosive Power Balance Sickle Kick Speed	0.000	0.732	0.536	53.6%	15.617	2.144	2.048

The third hypothesis reads that there is a joint contribution between leg muscle explosive power and balance to the sickle kick speed of UNY *Pencak Silat* athletes. Based on the results of data analysis in Table 8 above, the correlation/relationship value (R) is 0.732, it means a strong relationship between leg muscle explosive power, balance and sickle kick speed. Based on the t value of 2.144> t table 2.048, it means there is a contribution of leg muscle explosive power and balance to the sickle kick speed of UNY *Pencak Silat* athletes. Furthermore, the coefficient of determination (R Square) value is 0.536, it means that the contribution of leg muscle explosive power and balance to sickle kick speed is 53.6%. So it can be concluded that there is still a contribution from other factors to the speed of the sickle kick by 46.4%.

Although the multiple regression model shows a coefficient of determination of 53.6%, the increase in explanatory power compared to the single predictor X1 is relatively small. This may be attributed to the presence of overlapping variance between X1 and X2, indicating that part of their contributions intersects in explaining the variation of the dependent variable Y. Furthermore, these findings suggest the presence of a more dominant predictor, with X1 exerting a stronger influence than X2. From a statistical perspective, this condition is acceptable, as the inclusion of additional predictors that are closely related does not necessarily result in a substantial increase in the R^2 value.

In pencak silat, the effectiveness of kicking techniques, particularly the sickle kick, depends not only on technical mastery but also on supporting physical components such as strength, speed, power, balance, and coordination (Wardoyo & Setiakarnawijaya, 2023). As a full-body contact martial art, pencak silat requires optimal physical conditioning to support the execution of fast and accurate attacking techniques (Satria et al., 2021).

Leg muscle explosive power is essential for performing an effective sickle kick, as it combines strength and speed to produce fast and forceful movements (Juwanda, 2020; Bompa & Buzzichelli, 2019; McGuigan, 2017). Previous studies confirm that lower limb explosive power significantly influences kick speed and performance in pencak silat (Ahmad et al., 2024).

The findings of this study indicate that leg muscle explosive power contributes significantly to sickle kick speed. This suggests that the ability to generate force rapidly plays an important role during the acceleration phase of the kick, where the leg must move from preparation to impact in a short time. However, the contribution value obtained in this study shows that explosive power alone does not fully determine kick speed, indicating that other physical components are also involved in supporting performance.

Balance was also found to contribute significantly to sickle kick speed (Lihawa et al., 2022). In dynamic movements such as kicking, balance plays a crucial role in maintaining postural stability during single-leg support (Shin et al., 2020). This stability allows athletes to transfer force efficiently from the supporting leg to the kicking leg without losing body alignment. Without adequate balance, force generation may not be effectively translated into movement speed, resulting in reduced kicking performance (Paillard, 2019). According to Pontaga et al. (2024), balance consists of static balance (the ability to maintain a stable position while stationary) and dynamic balance (the ability to maintain or regain stability during movement or changes in body position).

When performing a sickle kick, the balance used is dynamic. Dynamic balance refers to a state of balance that is slightly more vulnerable but allows the body to move quickly and flexibly. According to Widiyanto & Hariono (2014), this balance is essential because the sickle kick involves a series of movements performed simultaneously, such as stepping, turning the body, and throwing the leg at the target. An unstable balance allows the pugilist to adjust the body position quickly throughout the kicking process, from preparation to completion. Without good balance, the sickle kick movement will lose efficiency, as the fighter may struggle to maintain body stability when aiming the kick at the target. This dynamic balance also supports a fighter's ability to change positions quickly, which is crucial in avoiding a parry or catch from an opponent.

Compared to previous findings, Juwanda (2020) reported a higher contribution of leg muscle power (76.7%) to sickle kick ability, while Ariansyaha & Rezki (2024) found a contribution of 44.89%. Similarly, Firmanto et al. (2023) reported a combined contribution of balance and leg muscle power reaching 98.2% in T-kick performance. The results of the present study fall within this range but are not as high as some previous reports. These differences may be attributed to variations in participant characteristics, training background, and measurement focus. In this study, the sample consisted specifically of male university athletes aged 19–23 years, which may represent a more homogeneous performance level compared to broader athlete populations examined in earlier studies.

In this study, hypothesis testing confirmed that leg muscle explosive power ($t = 5.630 > 2.048$) and balance ($t = 4.858 > 2.048$) each made a significant contribution to sickle kick speed, and simultaneously both variables also showed a significant combined contribution ($t = 2.144 > 2.048$) among UNY pencak silat athletes. Many supporting components that need to be considered to become a successful *pencak silat* athlete include: physical condition, technique, tactics, and mentality. This study shows that leg muscle explosive power and balance greatly affect the speed of the sickle kick. Thus, leg muscle explosive power and balance have significant contributed to the speed of the sickle kick in *pencak silat*.

From a practical perspective, the results imply that improving sickle kick speed should not rely solely on increasing muscular power. Instead, training programs should integrate explosive strength development with balance-oriented exercises to enhance movement stability during dynamic kicking actions. However, several limitations should be considered when interpreting these findings. First, the relatively small sample size may limit the generalizability of the results. Second, the study focused only on male athletes within a specific age range, which may not fully represent other competitive groups such as female athletes or younger performers. Third, performance was assessed using field-based tests, which may not capture the full biomechanical complexity of kicking movements.

Future research is therefore recommended to involve more diverse participant groups and incorporate biomechanical or motion analysis approaches to better understand the interaction between physical components and technical performance.

CONCLUSION

This study demonstrates that leg muscle explosive power and balance significantly contribute to sickle kick speed in UNY Pencak Silat athletes, with explosive power showing a slightly stronger influence. These findings emphasize the essential roles of force production and postural control in enhancing kicking performance and enrich the scientific understanding of neuromuscular power and stability in combat sport movements. Practically, coaches are encouraged to implement plyometric exercises to improve lower limb explosive power while integrating balance training to enhance postural control during kicking actions. An integrated training approach may optimize sickle kick speed and improve effectiveness in competition. However, since a substantial portion of kick speed is influenced by other factors such as flexibility, agility, coordination, and technical skill, future studies should incorporate these variables to provide a more comprehensive understanding of performance determinants in pencak silat.

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