

# fizjoterapia polska



POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 1/2024 (24) KWARTALNIK ISSN 1642-0136

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- ZABURZENIA CZYNNOŚCIOWE UKŁADU RUCHOWEGO NARZĄDU ŻUCIA;
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# Impact of explosive power, agility, and focus on front kick speed in pencak silat

*Wpływ siły eksplozywnej, zwinności i koncentracji na szybkość kopnięcia frontального w pencak silat*

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## Abstract

**Introduction.** In pencak silat, a front kick is considered the most effective technique for scoring points due to its precision and power.

**Aim.** The purpose of this study was to determine the effect of leg muscle explosiveness, agility, and focus on the speed of the front kick.

**Material and methods.** This type of research is causal associative research. The population in this study comprised pencak silat athletes. 30 pencak silat athletes voluntarily participated in the study. The research instruments used in this study were vertical jumps, shuttle runs, focus grids, and kick speed tests. The analytical technique used to test this research is path analysis with multiple linear regression tests.

**Results.** The results showed that: (1) there was a significant direct effect between the explosive power on the speed of the front kick about 13.6%. (2) Agility has a significant direct effect on the speed of the front kick, accounting for about 21.1%. (3) Focus significantly affects the speed of the front kick, contributing approximately 71.6%. (4) There is an indirect effect of explosive leg muscles on the speed of the front kick, with a focus of approximately 21.4%. (5) There is also an indirect effect of agility on the speed of the front kick among pencak silat athletes, with a focus of about 20.6%. (6) Furthermore, there is a combined effect of explosive leg muscle power, agility, and focus on the speed of the front kick, accounting for approximately 71.2%.

**Conclusions.** It was concluded that the front kick speed was affected by explosive power, agility, and focus by 71.2% while the rest were other variables that were not studied. The results of this study are expected to help coaches, athletes, and performance analysts in developing appropriate training programs by prioritizing explosive power, agility, and focus variables.

## Keywords

explosive power, agility, focus, front kick speed

## Streszczenie

**Wstęp.** W pencak silat kopnięcie frontalne uznawane jest za najskuteczniejszą technikę zdobywania punktów ze względu na jego precyzję i moc. Cel. Celem badania było określenie wpływu siły eksplozywnej mięśni nóg, zwinności i koncentracji na szybkość kopnięcia frontального. Materiał i metody. Niniejsze badanie to badanie przyczynowo-skutkowe. Populację badaną stanowili sportowcy uprawiający pencak silat. W badaniu dobrowolnie wzięło udział 30 sportowców pencak silat.

**Instrumenty badawcze** użyte w tym badaniu to skoki pionowe, biegi wahadłowe, siatki koncentracji oraz testy szybkości kopnięć. Technika analityczną używaną do testowania tego badania jest analiza ścieżki z testami regresji liniowej wielorakiej.

**Wyniki.** Wyniki pokazały, że: (1) istnieje znaczący bezpośredni wpływ siły eksplozywnej na szybkość kopnięcia frontального, około 13,6%. (2) Zwinność ma znaczący bezpośredni wpływ na szybkość kopnięcia frontального, stanowiąc około 21,1%. (3) Koncentracja znacząco wpływa na szybkość kopnięcia frontального, przyczyniając się w przybliżeniu o 71,6%. (4) Istnieje pośredni wpływ siły eksplozywnej mięśni nóg na szybkość kopnięcia frontального, przy koncentracji około 21,4%. (5) Istnieje również pośredni wpływ zwinności na szybkość kopnięcia frontального wśród sportowców pencak silat, przy koncentracji około 20,6%. (6) Ponadto, istnieje łączony efekt siły eksplozywnej mięśni nóg, zwinności i koncentracji na szybkość kopnięcia frontального, stanowiący około 71,2%. **Wnioski.** Wnioskowano, że szybkość kopnięcia frontального była wpływana przez siłę eksplozywną, zwinność i koncentrację w 71,2%, podczas gdy pozostałe zmienne, które nie były badane, stanowiły resztę. Wyniki tego badania mają pomóc trenerom, sportowcom i analitykom wydajności w opracowywaniu odpowiednich programów treningowych, przykładając priorytet do zmiennych takich jak siła eksplozywna, zwinność i koncentracja.

## Słowa kluczowe

siła eksplozywna, zwinność, koncentracja, szybkość kopnięcia frontального

## Introduction

According to Johansyah L and Hendro W [1] pencak silat is the original culture of the Indonesian nation, so it is believed by its warriors and martial arts experts that the Malay community created and used the martial art of pencak silat since prehistoric times. Silat is the essence of the martial art of pencak silat, the science of fighting or defending oneself desperately that is not performed in public [2]. Pencak silat, also known as Silat, is a martial art that utilizes unique self-defense techniques. Pencak is a martial art characterized by various controlled and purposeful body movements, whereas Silat refers to the practical application of these techniques [3]. It can be concluded that pencak silat is a martial art that is used to fight in self-defense using the pencak silat technique. Apart from being a self-defense tool, pencak silat is currently also being competed so that many pencak silat athletes develop technical, tactical, and physical abilities.

In pencak silat competitions, various techniques are employed in accordance with the specific rules and categories of the event. In the competitive category, one crucial technique that a fighter must master to secure victory is the kicking technique. The front kick, executed with one foot or leg moving forward, demands a body position facing the same direction, with the base of the fingers positioned inside, aiming at the solar plexus and chest [1]. Similarly, the straight kick utilizes one foot and leg, moving forward with the body facing in the same direction, and the base of the toes positioned inside, targeting the solar plexus and chin [4]. Proficiency in executing a front kick requires precise technique to ensure both power and accuracy in striking the opponent's body [5].

Front kicks draw significant support from various factors, including endurance, strength, flexibility, speed, agility, coordination, and accuracy [6-10]. These factors prominently manifest in competitive Silat matches, marked by elevated aerobic and anaerobic responses. In pencak silat, executing a front kick involves first selecting the target, then focusing on it while anticipating potential sudden changes in movement direction. This demands swift adjustments during kicking, embodying the concept of agility, defined as the rapid alteration of the entire body's movement in response to stimuli with sudden changes in speed or direction [11]. The concept of agility encompasses six primary dimensions: the ability to change direction swiftly, starting speed, environmental awareness, adaptability, tactical adjustments, and the seamless execution of continuous processes within and across the overall movement process [12].

Constructing an impactful kick necessitates the combination of power and speed, extending from the pivot of the foot to the point of contact with the target. Zemkova's study revealed a notable distinction in average power during the acceleration phase, particularly in athletes incorporating trunk rotation, especially those with lower speeds [13]. Conversely, individuals possessing substantial and robust muscles, yet lacking formal kick training, may execute powerful kicks but struggle with the ability to deliver them repeatedly.

When facing a mobile opponent, they may exhibit sluggishness in performing consecutive kicks. This limitation arises from the absence of refined motor skills required to consistently generate maximal joint strength and speed during the contraction and relaxation phases inherent in each strike [14]. Therefore, the acquisition of experience and consistent practice becomes imperative for skill development [15].

Elite Silat athletes exhibit lower aerobic fitness and grip strength but demonstrate heightened leg explosiveness, as evident in their vertical jump capabilities. Generally, they also display comparable anaerobic capacity in the lower body, while exhibiting significantly lower anaerobic ability in the upper body [16]. Additionally, a critical factor influencing success in a pencak silat match is concentration, which is susceptible to the impact of anxiety. This correlation is negative, indicating that heightened anxiety correlates with diminished levels of focus [17]. Focus assumes a pivotal role in enhancing attention, enabling athletes to deliver optimal performances [18]. Moreover, focus is instrumental in an athlete's execution of techniques [6].

Based on this theoretical study, factors that may have a relationship to success in pencak silat front kicks were identified. So in this study, physical and psychological factors are identified and then tested for their influence on the ability to front kick in pencak silat. The hypotheses proposed are: 1) leg muscle explosiveness affects front kick speed, 2) agility affects front kick speed, 3) focus affects front kick speed, 4) leg muscle explosiveness through focus influences front kick speed, 5) agility through focus has an influence on front kick speed, 6) leg muscle explosiveness and agility through focus have an influence on front kicks.

## Materials and methods

### Study design

The type of research used in this study is a casual associative quantitative study, namely the type of research that seeks to find out the relationship between variables. The aim of looking at the effect of leg muscle explosive power (X1), agility (X2), and focus (Y) on front kick speed (Z).

### Participant

The participants in this study comprised pencak silat athletes affiliated with the pencak silat Perkumpulan Setia Hati Terate (PSHT) Muara Labuh Branch, who met the criteria of having engaged in provincial-level competitions and demonstrated proficiency in executing front kicks with good technique. On average, participants had undergone training for 6.26 years. The sampling approach employed was total sampling, involving the entire population, resulting in a sample size of 30 athletes, with an average age of 19.03 years. The composition of athletes included 21 males and 9 females.

### Instruments

The research instruments used in this study were leg muscle explosive power (X1) using a vertical jump test instrument, agility (X2) using a shuttle run test instrument, focus (Y) using a concentration grid instrument, and kicking ability using a kick speed instrument (Z) Johansyah Lubis.



**Table 1. Research instruments**

| No | Variable                   | Instrument                             |
|----|----------------------------|--|
| 1  | Leg muscle explosive power | Vertical jump from Widiastuti [19]     |
| 2  | Agility                    | Shuttle run from Widiastuti [19]       |
| 3  | Focus                      | Focus grid From Harris and Harris [20] |
| 4  | Kick ability               | Johansyah Lubis' kick speed [1]        |

The implementation of the Vertical Jump begins with the initial achievement, then performs a jump with two legs without a prefix and is carried out three times, then the highest jump is taken. The shuttle run, it is a movement to change direction quickly on a track with a length of 10 meters. This movement is performed four times back and forth. Athletes are given the opportunity for two repetitions and the best time is taken. The test to measure focus in this study used a measuring instrument called the Focus Grid Test (CGT). This instrument has reliability using (a re-test) with a product moment correlation of  $r = 0.79$  ( $p < 0.05$ ).

Table 2 provides an explanation of the normality test for the speed of the pencak silat front kick. The testing procedure involves participants positioning themselves with one foot behind the target line at distances of 50 cm (for girls) and 60 cm (for boys). Upon receiving the 'Yes' signal, the athlete executes a right-footed kick and subsequently returns to the initial position by making contact with the floor behind the line. Following this, the athlete proceeds to perform rapid and consecutive right-foot kicks for a duration of 10 seconds.

**Table 2. Forward kick speed rating**

| Score      | Female (in 10 seconds) | Male (in 10 sec) |
|------------|------------------------|------------------|
| Very well  | >28                    | >30              |
| Well       | 23 – 27                | 25 – 29          |
| Enough     | 18 – 22                | 19 – 24          |
| Not enough | 14 – 17                | 15 – 18          |
| Not much   | <13                    | <14              |

### Statistical analysis

Path analysis is a statistical method used to examine the direct and indirect relationships between variables. The process involves estimating the strength and significance of pathways or direct effects among variables in a hypothesized model. The analytical technique

employed in this research involves the use of path analysis, which incorporates multiple linear regression tests, conducted using SPSS.

### Results

#### Normality test

**Table 3. Variable normality test**

| Variable | Sig.  | Sig. level | Conclusion |
|----------|-------|------------|------------|
| X1 to Z  | 0.692 | 0.05       | Normal     |
| X2 to Z  | 0.635 |            | Normal     |
| Y to Z   | 0.188 |            | Normal     |
| X1 to Y  | 0.803 |            | Normal     |
| X2 to Y  | 0.929 |            | Normal     |

The normality test in this study used the One-Sample Kolmogorov-Smirnov Test. Table 3 show that based on the test results, it was found that all variables were normally distributed. Variable muscle explosive power (X1) with front kick speed (Z) is normally distributed, with a significance value of p-Value  $0.692 > 0.05$ . Variable agility (X2) on front kick speed (Z) with a significance value of p-Value  $0.635 > 0.05$ . The variable focus (Y) on the speed of the front kick (Z) with a significance value of p-Value  $0.188 > 0.05$ . Variable leg muscle explosive power (X1) to focus (Y) with a significance value of p-Value  $0.803 > 0.05$ . And the agility variable

(X2) with focus (Y) with a significance value of p-value  $0.929 > 0.05$ .

#### Linearity test

Based on the results of the linearity test in table 4, it was found that all variables were linear. Variable leg muscle explosive power (X1) to the front kick speed variable (Z), has a significance value  $>$  the significance level of  $0.891 > 0.05$  so it has a linear nature. For the results of the linearity test of the agility variable (X2) on the front kick speed variable (Z) it has a significance value  $>$  the significance level is  $0.403 > 0.05$ , so it

has a linear nature. For the results of the linearity test of the focus variable (Y) on the front kick speed variable (Z) it has a significance value > the significance level is  $0.165 > 0.05$ , so it

has a linear nature. Variable muscle explosive power (X1) to focus (Y) has a significance value > significance that is  $0.823 > 0.05$ , so it has a linear nature.

**Table 4. Linearity test**

| Linearity Test | Value | Sig.  |
|----------------|-------|-------|
| X1 with Z      | 0.05  | 0.891 |
| X2 with Z      |       | 0.403 |
| Y with Z       |       | 0.165 |
| X1 with Y      |       | 0.823 |
| X2 with Y      |       | 0.841 |

## Hypothesis testing

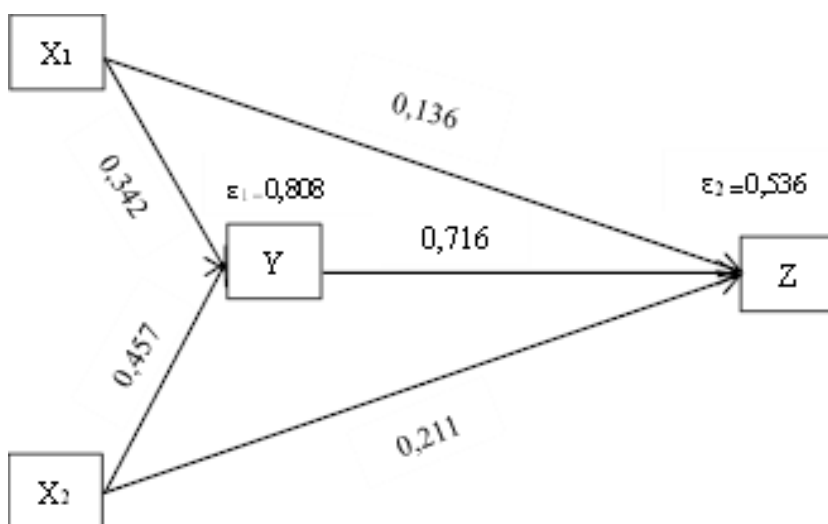
**Table 5. Structural summary model 2**

| Model | R                  | R Square | Adjusted R Square | Std. The error of the estimate |
|-------|--------------------|----------|-------------------|--------------------------------|
| 1     | 0.844 <sup>a</sup> | 0.712    | 0.679             | 5.665                          |

a. Predictors: (Constant), focus, leg muscle explosive power, agility

**Table 6. Structural path analysis test results 2**

| Model 1                     | Unstandardized coefficients |            | Standardized coefficients |  | T     | Sig.         |
|-----------------------------|-----------------------------|------------|---------------------------|--|-------|--------------|
|                             | B                           | Std. Error | B                         |  |       |              |
| (Constant)                  | 6.851                       | 8.842      |                           |  | 0.775 | 0.445        |
| Limb muscle explosive power | 0.186                       | 0.175      | 0.136                     |  | 1.065 | <b>0.047</b> |
| Agility                     | 0.248                       | 0.159      | 0.211                     |  | 1.557 | <b>0.031</b> |
| Focus                       | 0.736                       | 0.150      | 0.716                     |  | 4.890 | <b>0.000</b> |



**Figure 1. Combined path analysis models I and II**

**Hypothesis I. Effect of leg muscle explosive power on front kick speed**  
Based on the test results in table 6, it was found that the significant value of the effect of leg muscle explosive power on kick speed was 0.047 (<0.05), and the coefficient value was 0.136. or 13.6% so  $H_0$  is rejected and  $H_a$  is accepted, meaning that there

is a significant influence between the explosive power of the leg muscles on the speed of the front kick of the pencak silat athlete.

**Hypothesis II. Effect of agility on front kick speed**

Based on the test results in table 6, it was found that the signi-



ficant value of the effect of agility on the speed of the front kick was 0.031 ( $<0.05$ ), and the coefficient of effect was 0.211 or 21.1% so  $H_0$  was rejected and  $H_a$  was accepted, meaning that there was a significant influence between agility against the speed of the front kick of a pencak silat athlete.

### Hypothesis III. Effect of focus on front kick speed

Based on the test results in table 6, it was found that the significant value of the effect of focus on front kick speed was 0.000 ( $<0.05$ ), and the coefficient of effect was 0.716 or 71.6%. So that  $H_0$  is rejected and  $H_a$  is accepted, meaning that there is a

significant influence between the focus on the front kick speed of the athletes in pencak silat.

### Hypothesis IV. The Effect of limb muscle explosion through focus on front kick speed

Based on the results of the coefficient value of the effect of leg muscle explosive power on front kick speed is 0.136. Then we can look for the indirect effect of the explosive power of the leg muscles on the speed of the front kick through focus with a value of 0.214 or 21.4% so that  $H_0$  is rejected and  $H_a$  is accepted, so it is concluded that there is an indirect effect of leg muscle explosion on front kick speed through the focus of pencak silat athletes.

Table 7. Direct effect

|                                    |       |
|------------------------------------|-------|
| The direct effect of X1 on Y (x1y) | 0.136 |
| Effect of X2 on Y (x2y)            | 0.457 |
| The direct effect of Y on Z (yz)   | 0.716 |

Table 8. Indirect effects and contributions

|                              |  |
|------------------------------|--|
| Indirect influence =         | $YX1 + (px2y \times YZ)$<br>$0.136 + (0.457 \times 0.716)$<br>$0.136 + 0.327$<br>$0.463$ |
| Donations <sub>pvx31</sub> = | $0.463^2 \times 100\%$<br>$0.214 \times 100\%$<br>$21.4\%$                               |

### Hypothesis V. The effect of agility through focus on front kick speed

In the results of path analysis calculations, it was found that there was an indirect effect of agility (X2) on front kick speed

(Z) through focus (Y) of 0.206 or 20.6% so  $H_0$  was rejected and  $H_a$  was accepted, meaning that there was an indirect effect of agility on front kick speed. through the focus on martial arts athletes.

Table 9. Direct effect

|                                    |       |
|------------------------------------|-------|
| The direct effect of X2 on Z (zx2) | 0.211 |
| Effect of X1 on Y (x1y)            | 0.342 |
| The direct effect of Y on Z (yz)   | 0.716 |

Table 10. Indirect effects and contributions

|                              |   |
|------------------------------|---|
| Indirect influence =         | $zX2 + (px1y \times Yz)$<br>$0.211 + (0.342 \times 0.716)$<br>$0.211 + (0.243)$<br>$0.45$ |
| Donations <sub>pvx32</sub> = | $0.454^2 \times 100\%$<br>$0.206 \times 100\%$<br>$20.6\%$                                |

### Hypothesis VI. The effect of limb muscle explosion and agility through focus on front kick speed

Testing the hypothesis on substructure 2 is testing the hypothesis regarding leg muscle explosive power (X1), agility

(X2), and focus (Y) on front kick speed (Z). Based on the results of calculations using the SPSS version 26 program, the correlation matrix between variables is obtained. Based on the output of the regression model 2 in the coefficients table,

it is known that the significance of the three variables namely  $x_1 = 0.047$ ,  $x_2 = 0.031$ , and  $y = 0.000$  is smaller than 0.05. These results conclude that regression model 2, namely the variables  $x_1$ ,  $x_2$ , and  $y$  has a significant effect on  $Z$ . The R-squared value in the Model Summary table is 0.712, indicating that the combined contribution of  $x_1$ ,  $x_2$ , and  $y$  to  $Z$  is 71.2%. The remaining 28.8% is attributed to other variables not investigated in this study.

## Discussion

### The effect of leg muscle explosive power on front kick speed

According to the findings of this study, the speed of front kicks in pencak silat is directly influenced by the strength of the leg muscles. The exhibition of the body's capacity for explosive power is notably impacted by both the type of muscle contraction and the specific movement executed [21]. Furthermore, the study reveals a correlation between variations in explosive power training for leg muscles and the resultant speed of the front kick in pencak silat athletes [22]. Notably, explosive power is cultivated through a rigorous and sustained training process. The researcher's discoveries indicate a significant enhancement in muscle explosive performance following a 10-week period of high-frequency Plyometric Leg Power (PLP) training [23].

### The effect of agility on front kick speed

According to the findings, agility plays a significant role in the success of the front kick in pencak silat, accounting for 21.1% of its effectiveness. Agility, defined as the ability to swiftly move between locations [24], encompasses various elements according to Bustomi. It involves an athlete's capacity to respond rapidly to stimuli, initiate quick and efficient movements, execute correct movements, and remain consistently prepared to change or cease activity swiftly, promoting swift, smooth, effective, and repetitive play [25] [26]. Agility is widely acknowledged as a crucial aspect of performance in team sports and is considered a distinguishing factor between highly skilled individuals and their less proficient counterparts [27]. Previous studies indicate that agility encompasses more than just speed-related abilities. In addition to simple reaction speeds, accelerations, and decelerations accompanied by changes in movement direction, it involves a perceptual component characterized by complex reactions to unpredictable and variable stimuli encountered during sports games [28]. Examining the concept of agility in relation to various determining factors—namely cognitive, technical, and physical—as comprehensively analyzed [29]. Other research underscores that running and jumping are influential factors in determining Change of Direction Speed (CODS) [30]. In light of these findings, possessing good agility in pencak silat correlates with the athlete's ability to execute swift front kicks. The proficiency of the front kick speed improves with better agility, highlighting a positive correlation between the two.

### The effect of focus on front kick speed

According to the study findings, a significant portion, specifically 71.6%, of the success of the front kick is attributed to psychological variables, primarily focus. The impact of focus

is particularly noticeable when an athlete initiates a kick, as it directs their attention to the precise execution of the kick. Maintaining focus during training or competition holds paramount importance for athletes. Cognitive and perceptual factors are deemed crucial for understanding the nuances of skilled performance [31] [32]. The level of an individual's focus directly correlates with their ability to anticipate and navigate various possibilities encountered [6]. Given its pivotal role across activities, athletes must consistently practice to enhance their concentration. Focus is categorized within cognitive ability, a profoundly influential factor affecting physical abilities such as agility. The research underscores that cognitive factors serve as a differentiator between the highest and lowest levels of achievement [33].

### The effect of limb muscle explosion through focus on front kick speed

According to the study findings, focus-driven explosive power significantly influences the front kick in pencak silat, accounting for 21.4% of its effectiveness. This can be attributed to the fact that training with a focus on high contraction skills stands out as a primary method to enhance muscle explosive power [34]. These results underscore the substantial impact of explosive power in the leg muscles on the overall efficacy of the kicking ability. The conclusion drawn is that, during the upward movement of the leg, concentric work by the extensor muscles of the hip and knee emerges as the most crucial muscle activity, resulting in the highest levels of explosive power and energy output for these muscles [35].

However, contrasting findings emerge from other studies. Research indicates that distinctions in Rate of Force Development (RFD) between explosive athletes and control groups stem from variations in neural activation rather than the intrinsic contractile properties of the muscle-tendon units [36]. Cahayono & Purbodjati further highlight a notable correlation between the contribution of leg muscle explosive power and kick speed in pencak silat athletes, specifically in the context of PSHT Rayon GBI Surabaya [37]. These diverse research outcomes emphasize that achieving optimal results in explosive power necessitates support from related factors to enable the best performance in pencak silat kick ability, as indicated by the findings of the present study.

### The effect of agility through focus on front kick speed

The ability of the body to swiftly move and change direction between points necessitates complete concentration for effective execution. Common instances of motion failure in front kicks occur when athletes struggle to identify and lock onto their targets. Consequently, the eccentric and concentric processes within the muscles are not optimized, resulting in suboptimal directional changes [38]. The consequence is a limitation in the quick and precise execution of kicking abilities, hindering achievement according to the intended target. Success in this regard also relies on meeting the mechanical demands of changing direction, bolstering strength, and applying impulse at a rate commensurate with the pace of direction change [39]. The study's results underscore that agility, facilitated by focused attention, influences the successful execution of front kicks by



20.6%. Additionally, there may be other variables influencing agility that were not examined in this study.

### The effect of limb muscle explosion and agility through Focus on front kick speed

Limb muscle power and agility operate in unison during the execution of front kicks in pencak silat, working simultaneously to optimize performance. These two interconnected components play a pivotal role in achieving optimal outcomes in front kick execution. Furthermore, these physical factors are intricately tied to the focus variable, essential for eliciting an immediate response. The results highlight the substantial influence of these three components, accounting for a significant 72% of the total factors shaping front kick implementation. The remaining percentage encompasses other variables not scrutinized in this study. The substantial impact of these variables is rooted in their physiological basis, aligning with the essential movements required for pencak silat front kicks, which include explosiveness, speed, precision, balance maintenance, directionality, and repetition. Notably, agility training is employed to enhance both

muscle explosiveness and dynamic athletic performance [40]. Additionally, lower limb explosive strength emerges as a robust predictor of agility [41].

### Conclusion

Based on the results of the analysis, it was concluded that the explosive power of the leg muscles and agility through focus had a significant effect on the ability of the pencak silat front kick. These three components together have a very large contribution to the ability of the front kick. It is clear that with such a large contribution, it is necessary to give sufficient attention to building physical abilities of explosive power, agility, and good focus skills to produce the achievement of pencak silat front kicks.

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