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The Effect of Sabit Kick Training Program with High Intensity Interval Training (HIIT) on Speed and Agility

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Abstract

The sabit kick, a crucial technique in Pencak Silat, is a high-scoring attack in competitions, where speed and agility play key roles in its effectiveness. However, many athletes struggle to achieve optimal speed due to a lack of training programs to enhance muscle explosiveness and motor response. This study aims to analyze the effect of High-Intensity Interval Training (HIIT) on the speed and agility of sickle kicks for pencak silat athletes. The study method was a quasi-experiment with one group with a pre-test and post-test design, involving 20 athletes from Pagar Nusa who college underwent 12 training sessions in one month, training The Speed, Agility, and Quickness (SAQ). A combination of Tabata Speed and Data was collected through a 20-meter sprint test, Illinois agility test, and kick speed measurements before and after the intervention. The analysis results with paired sample t-test showed a significant increase ($p < 0.05$) in sickle kick speed and agility after HIIT. The study concludes that HIIT effectively enhances the performance of Pencak Silat athletes, particularly in speed and agility. These findings suggest that coaches should incorporate HIIT into training programs and encourage further research to determine the optimal duration and intensity for improving fighting techniques.

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INTRODUCTION

Pencak Silat is a widely practiced martial art known for its unique movements, which combine self-defense with artistic expression (Nandana, 2020). While each sport has distinct characteristics that must be mastered, all require consistent and optimal training (Maulana, 2023). Additionally, talent and interest are crucial in skill development and athletic achievement. Today, Pencak Silat is integrated into the physical education curriculum to promote broader awareness and enhance athlete performance (Irawan et al., 2021). Pencak Silat features several fundamental kicking techniques, including front kicks, T-kicks, and sickle kicks. This study focuses on sickle kicks, which are commonly used in competitions. The execution of a sickle kick involves key elements such as agility, speed, coordination, and leg muscle strength (Moh et al., 2022). Factors like muscle strength, movement techniques, and mental endurance significantly impact speed (Riski, M Wijaya et al., 2023). A structured training program is essential to developing effective and energy-efficient movements. The success of a technique depends on reaction speed and execution quality, both of which influence the effectiveness of kicks in sparring (Sinulingga et al., 2023). In Pencak Silat sparring, mastering the sickle kick is crucial, as it is a high-scoring technique, earning two points when successfully landing on an opponent (Saputro & Siswantoyo, 2018). When attacking using a sickle kick, athletes must try to use power and maximum speed (Hayati & Endriani, 2021). Kicking is an attack technique that is quite often used in matches. The majority of Pencak silat athletes use the sickle kick technique quite often to collect as many points as possible to win (Adnadia et al., 2022). According to Lubis & Wardoyo (2014), "attacks with the feet or kicks that are included in the assessment are attacks that hit the target (body) using attack techniques using the feet with fast and powerful crescent kicks, so that they cannot be caught and are not blocked by parries or avoidance.

Athletes must undergo intensive and comprehensive training programs to enhance their physical abilities, as these directly impact agility and speed (Gökkurt & Kıvrak, 2021). HIIT effectively improves speed and anaerobic endurance, influencing kicking techniques (Coates et al., 2023). In Pencak Silat competitions, the sickle kick is a key strategy due to its effectiveness, ease of execution, and ability to generate clear points. Therefore, developing speed and agility is crucial for optimizing sickle kick performance. Various factors, including a structured and sustainable training process, influence athletic achievements. To attain high-level sports performance, consistent and intensive training is essential (Fauzi et al., 2020). Flexibility must be developed to the highest level for an optimal sickle kick, alongside maximizing kicking speed (Ihsan, 2020). The HIIT protocol is an alternative training model to enhance specific endurance capacity and improve technical performance, particularly in Pencak Silat (Hassan et al., 2024).

Martial arts sports such as pencak silat require increased energy and focus as well as good physical condition, to achieve this, high-intensity interval training is needed (Munandar, 2022). HIIT training is designed to improve the physical performance of athletes with a focus on developing strength, endurance, speed, and agility. Method This is performed with short intervals of high intensity followed by longer ones (Warthadi et al., 2022). Recovery or rest Another advantage of High Intensity Interval Training is the duration of the training. One workout session of this type can be done in 20-25 minutes, unlike endurance training which requires up to twice as long (Sinulingga et al., 2023). Although there is no set HIIT session time, this exercise generally lasts less than 30 minutes because it utilizes the anaerobic energy system usually used in short and fast activities (Chandu & Johnson, 2021). Adjustments in the volume of HIIT to train are needed to achieve more optimal results (Ojeda-Aravena et al., 2021). Increased kick speed can be achieved by implementing a structured and optimal training program and through specific techniques in pencak silat designed to develop movement speed (Umar et al., 2023). HIIT training contributes to increasing the stamina of athletes, which directly affects the increase in speed and agility of sickle kicks during competition (Khotimah et al., 2023).

Martial arts sports such as pencak silat require HIIT, which increases the athlete's stamina to the maximum and helps him maintain performance during competition against opponents (Demirman et al., 2024). HIIT accelerates recovery mechanisms between rounds and sessions, allowing athletes to perform optimally during long bouts (Vasconcelos et al., 2020).

HIIT-specific techniques have been shown to enhance athletes' physical abilities, particularly in agility and speed (Song & Sheykhlouvand, 2024). However, besides physical fitness, Pencak Silat athletes must also develop intense technical skills (Studi et al., 2023). Measuring kick speed is a crucial step in assessing an athlete's initial condition before training and evaluating progress after the intervention. This comparison helps determine improvements in both physical and technical abilities, which are essential for competitive performance (Damrah et al., 2023). Speed plays a vital role in enabling athletes to execute punches, kicks, and evasive movements swiftly, making it more challenging for opponents to launch attacks (Akhmad et al., 2021). To enhance agility and striking effectiveness in Pencak Silat, fighters must focus on developing leg muscle explosiveness and speed (Rachman et al., 2019)

From the results of observations at the Pencak Silat Pagar Nusa College, it can be seen that the current training method has not focused on improving the increased physical condition of athletes with agility and speed, especially in the basic technique of the sickle kick. When competing attacks are easily anticipated by opponents. The importance of this research is that it is carried out because the ability of agility and speed of the sickle kick are crucial aspects in the sport of Pencak silat. Therefore, the ability to kick agility must be given more attention, and the athlete must be trained in a structured manner with the right training program. High-intensity interval training (HIIT) has been shown to increase athletes' speed and acceleration significantly. A study conducted by (Gökkurt & Kıvrak, 2021) showed that an eight-week HIIT program statistically significantly improved soccer players' speed and acceleration ($p < 0.05$). Therefore, similar methods can be applied in other sports such as pencak silat to improve the execution speed of sickle kicks and athletes' response in matches.

Based on the results of data collection research on pre-tests and post-tests, the speed of kicks, especially in the sickle kick, and athletes can be concluded to be still lacking slow. Slow and less fast kicks will make it easier for opponents to catch incoming, therefore the opponent will be straightforward to carry out the process and can continue the slam so that the opponent can get superior points. The slam point can benefit the opponent because the points earned compared to the kick are more significant than the slam. Therefore the kick must be done quickly to get points, and the opponent cannot catch the incoming kick, this is due to the lack of training in motor components, especially in the aspects of agility and speed in athletes. Based on the description above, it is necessary to solve the problem of increasing the speed and agility of athletes who do a good sickle kick. The solution provided by the author is to provide high-intensity training with the SAQ (Speed, Agility, and Quickness) and TABATA Speed training programs for approximately one month, namely 12 meetings. This exercise is expected to help maximize the speed and agility of sickle kicks for pencak silat athletes when competing. SAQ stands for Speed, Agility, and Quickness, a type of exercise that simultaneously increases speed, agility, and response (Akhmad & Hasibuan, 2020).

Although many studies have examined the effectiveness of high-intensity interval training in improving athlete performance, there is limited understanding of its effects on kick technique development in pencak silat. High-intensity interval Training (HIIT) has been shown to improve anaerobic capacity and muscle explosiveness (Buchheit & Laursen, 2013). However, its use to improve sickle kicks in pencak silat has rarely been studied. In addition, study Munandar (2022) examined the impact of HIIT on the agility of martial arts athletes but did not compare its effectiveness with other methods, such as Speed, Agility, and Quickness (SAQ) in the context of sickle kick technique. Most previous studies have also focused on the short-term effects of high-intensity training. In contrast, the long-

term effects on neuromuscular adaptation and the potential risk of injury from explosive training have been minimally addressed (Vasconcelos et al., 2020). Ojeda-Aravena et al. (2021) found that martial arts training based on Pencak Silat techniques can enhance change-of-direction ability and kick power. However, there is still a lack of research examining how interval training can be integrated with technical skill development in Silat. This gap highlights the need for further studies on the effectiveness of high-intensity interval training (HIIT) in improving sickle kick speed, agility, and endurance, as well as how it compares to other training methods. A deeper understanding of the optimal combination of training approaches could contribute to more effective training strategies for Pencak Silat athletes. Therefore, this study aims to assess the impact of high-intensity training on sickle kick performance by considering key factors such as training frequency, recovery duration, and physiological adaptation. The initial hypothesis suggests that high-intensity training plays a crucia l role in enhancing the speed and accuracy of sickle kicks, particularly when incorporated into a structured training program that accounts for biomechanical principles and competition techniques. The findings of this study are expected to provide evidence-based recommendations for coaches and athletes in optimizing Pencak Silat training programs.

METHODS

This study used a quasi-experimental design with pre-and post-tests and purposive sampling. design variables in this study consist of independent variables, namely High-Intensity Interval Training (HIIT), Speed Agility And Quickness (SAQ), and Tabata Speed. The dependent variable is agility and speed, with a population of 20, martial arts athletes from the Pagar Nusa college the population is small, the entire population is being sampled, with the criteria 11 men and 9 women, aged 11-15 years. The data collected in this study are pretest data on agility and speed of sickle kicks before treatment and data posttest after treatment.

Pretest and posttest data collection procedures are used to measure agility and speed through high-intensity interval training (HIIT), speed, agility, and quickness (SAQ) exercises, and a combination of Tabata speed exercises. Data analysis statistics using descriptive statistical techniques and analyzed using the help of the SPSS (Statistical Program for Social Science) 27.0. The test computer program data prerequisite uses a data normality test and test (Shapiro Wilk) and data homogeneity (Levene statistic). While the hypothesis test uses the T-test (paired sample t-test). To determine the magnitude of the difference in the effect of training on improving the dependent variable before and after. The average pretest and post-test results were compared using the T-test (paired sample t-test).

The subjects in this study involved 20 pencak silat athletes, all athletes were sampled using the total sampling technique due to the small population. The characteristics of the participant population include 11 female athletes and 9 male athletes with age stages between 11 and 15 years. The average age of female athletes is 43.81 ± 8.91 kg, while men are 44.14 ± 15.93 kg. The average height of female athletes is 152.27 ± 6.97 cm and men 161.11 ± 11.1 cm. The body mass index (BMI) of all samples was normal with an average of 18.84-18.85 kg/m².

The participant selection procedure was carried out on specific inclusion criteria using the targeted sample method, namely active athlete status, not injured during data collection, and included in the 11-15 years age category. In the 20 athletes selected, all participants were active athletes who had at least one year of training experience, and had no history of physical disability, all (100%) agreed to participate in this study. The implementation of this study took place at one of the pencak silat schools in Semarang City, Central Java. All data collection intervention sessions and tests took place in the field of the hermitage. Prior to data collection and testing, the researcher provided an understanding regarding the research procedures in detail, then the participants

expressed their willingness with the approval of the coach/guardian. Researchers did not provide compensation in the form of money, but athletes received consumption and also additional training sessions that supported their performance.

In this study, materials and equipment were used to measure the two main variables, namely the agility and speed of sickle kicks of pencak silat athletes. The main instruments used included a hand box (kick target), digital stopwatch, leader drill, cone, and hurdle. The hand box (kick target) was used to measure and stimulate the speed and power of the sickle kick. The stopwatch is used to write the time on the 20 meter sprint test and the illinois agility test to measure the athlete's speed and agility skills. Leader drill serves as an assessment and trains the explosive power and reaction of the legs during the kick. While cones and hurdles function to form obstacles and track paths in coordination training and change the direction of motion in the agility test. But in the measurement of sickle kicks focused on in this study, the training design has been specifically developed by the researcher to ensure that all kicks are performed with one purpose, so that the data generated is more consistent and objective. The utilization of this tool is not only to train accuracy, but allows for relative response time and power through direct observation. Although no sophisticated electronic recording devices were used, the use of stopwatches and observers were able to provide sufficient accuracy to measure athlete performance.

The instruments used in this study are a series of tests of agility and speed of sickle kicks, which aim to determine the kicking ability of pencak silat athletes. The equipment includes a Stopwatch to measure time, a *Cone* and *leader drill* to measure and train agility, Target (*hand box*) for sickle-kicking training. Researchers also conducted *pre-tests* and *post-tests,* including *speed and agility*. Speed is measured using a 20-sprint meter test. Athletes *start* with standing, then the time is recorded when they have crossed the 20 finish line meter. Then *agility* is measured using the *Illinois agility test*, a fast run with a combination of changes in direction through a series of *cones*, then the time is recorded using a stopwatch. total The distance traveled is 20 meters. The Exercise Program approximately was conducted for 12 meetings in 1 month, with a frequency of 3 times a week with a duration of 150 minutes. exercise program This consists of three main components:

1. Tabata Speed Training (performed 4 sessions in one month)

   Athletes perform a sabit kick with the rules:

   - Perform a right sabit kick for 10 seconds x 3 sets
   - Perform a left sabit kick for 10 seconds x 3 sets
   - Perform alternating right-left sabit kicks 10 seconds x 3 sets
   - Rest 30 seconds in each set

2. Speed, Agility, Quickness (SAQ) (4 meetings per month)

   SAQ 1:Training Form

   - Athletes run from the start along 20 meters to the ladder
   - Motor coordination on the ladder
   - Zig-zag run through the cones
   - Toward the hurdle, perform one leg 2 times leg high knee right and left
   - Sprint to the finish line
   - Performed as many as two sets x 5 repetitions

   SAQ Exercise 2:Form

   - On the line starting, do a high knee 5x, then do a side-to-side movement by touching the cone then run.
   - Perform coordinated movements on the ladder
   - Towards the hurdle, perform 2-legged jumping movements 3 times
   - Perform a right-left sabit kick

Performed as many as two sets x 5 repetitions

Analysis data

The data was analyzed with 1) descriptive for mean and standard deviation, 2) normality and homogeneity test for continue to the hypothesis test, 3) paired test to analyze significant changes before and after intensive exercise ($p < 0.05$). Percentage of effectiveness the change between before and after intervention (%).

RESULTS AND DISCUSSION

The result of the intensive training tabata and high intensity interval training on twenty athletes showed in table 1.

Table 1. Characteristics of data subject

Variables	Gender	N	Mean ± SD
Age (years)	Male	9	14.00 ± 0. 707
	Female	11	12.55 ± 0.820
Weight (kg)	Male	9	44.14 ± 15.925
	Female	11	43.81 ± 8.907
Height (cm)	Male	9	161.11 ± 11.185
	Female	11	152.27 ± 6.973
Body Mass Index (Kg/m^2)	Male	9	18.84 ± 1.657
	Female	11	18.85 ± 3.373
Agility Pre (second)	Male	9	18.53 ± 1.662
	Female	11	20.50 ± 1.521
Agility Post (second)	Male	9	19.04 ± 1.815
	Female	11	21.14 ± 1.561
Right Kick Pre (a sum of kick/minutes)	Male	9	15.33 ± 2.062
	Female	11	14.09 ± 1.814
Right Kick Post (a sum of kick/minutes)	Male	9	18.67 ± 2.062
	Female	11	17.27 ± 1.555
Left Kick Pre (a sum of kick/minutes)	Male	9	14.33 ± 2.236
	Female	11	14.00 ± 1.612
Left Kick Post (a sum of kick/minutes)	Male	9	18.22 ± 1.716
	Female	11	16.73 ± 1.555

Table 2. Normality Test

Shapiro Wilk		
Variables	Total (n=20) Significance	Description
Agility	0.215	Normally Distributed
Right Kick	0.268	Normally Distributed
Left Kick	0.117	Normally Distributed

Table 2 showed the variables data distribution was normal, because $p > 0.05$.

Table 3. Homogenitity Test

Variables		Levene Statistic	df1	df2	Sig.	Description
Agility	Pretest	0.026	1	18	0.874	Homogeneous
	Posttest	0.001	1	18	0.977	Homogeneous
Right Kick	Pretest	0.017	1	18	0.898	Homogeneous
	Posttest	0.341	1	18	0.567	Homogeneous
Left Kick	Pretest	0.021	1	18	0.888	Homogeneous
	Posttest	0.307	1	18	0.587	Homogeneous

Table 3 showed the analysis of the homogeneity that the variable not significant $p > 0.05$, it meant the data was homogeneous.

Table 4. Hypothesis Analysis

Variable	Pre-test Mean ± SD	Post test Mean ± SD	95% CI		Sig (2-Tailed)	Description
			Lower	Upper		
Agility	19.61 ± 1.841	20.19 ± 1.955	0.372	0.787	0.000	Significant
Right Kick	14.65 ± 1.981	17.90 ± 1.889	-4.147	-2.353	0.000	Significant
Left Kick	14.15 ± 1.872	17.40 ± 1.759	-4.147	-2.353	0.000	Significant

Table 4 presented that all variables agility, right kick and left kick have a significant difference between before and after intensive training ($p < 0.05$).

Table 5. Percentage of effectiveness of intensive training program

Variable	Female (%)	Male (%)	95% CI		Sig (2-Tailed)	Description
			Lower	Upper		
Agility	3.12	2.75	-0.786	-0.369	0.000	Significant
Right Kick	22	26	-4.147	-2.353	0.000	Significant
Left Kick	18	27	-4.147	-2.353	0.000	Significant

The table 5 showed the male percentage both left and right kick higher than female. The agility showed male faster than female.

The intervention of High-Intensity Interval Training (HIIT) showed significant difference between pre and post intensive training on increasing of speed and agility of sabit kick in pencak silat. This study found that the HIIT improving performance of athletes after intensive program, directly related to the research objective, which is to assess the effectiveness of the HIIT method in improving athlete performance, especially in aspects of speed and agility. Both male and female increased the speed of agility than before intensive training program, the percentage male faster than female. The kick speed both left and right kick male 27% and 26% higher than female18% dan 22%. This improvement is attributed to the physiological mechanisms due to high-intensity interval training, which contributes to increased anaerobic capacity and leg muscle explosiveness, as described in previous research (Coates et al., 2023).

These results can be scientifically explained by the neuromuscular adaptations and increased efficiency of energy metabolism that occur during high-intensity exercise. HIIT has increased ATP production through the anaerobic pathway, essential in supporting explosive movements such as the sabit kick (Buchheit & Laursen, 2013). Additionally, this exercise also accelerates the recruitment of fast-twitch fibers,

directly impacting the increase in kicking speed (Sinulingga et al., 2023). This study's results align with a study conducted by Munandar (2022), which revealed that the combination of HIIT with speed and agility training, such as Speed, Agility, and Quickness (SAQ), is proven to be optimal. When improving the performance of martial arts athletes compared to previous research, these findings strengthen the evidence that HIIT is efficacious in improving speed and agility across a range of sports that demand quick responses and muscle explosiveness. The study by Vasconcelos et al. (2020) showed that HIIT significantly contributed to increasing VO2 max and anaerobic capacity, which positively impacted the speed and agility of martial arts athletes. Meanwhile, research by Ojeda-Aravena et al. (2021) found that specific interval training can improve the ability to change direction and accelerate movement, which is very relevant in developing martial arts techniques.

This study differs significantly from previous research, particularly in the training methods used. While most prior studies have primarily examined the effects of HIIT on aerobic capacity and muscular endurance, this research specifically focuses on its impact on sickle kick technique. Buchheit & Laursen (2013) highlighted that although HIIT effectively enhances anaerobic capacity, it must be combined with sport-specific technique training to maximize the transfer of physiological adaptations into actual performance. Building on this insight, this study introduces a new approach by integrating HIIT with specialized training methods such as Tabata Speed and SAQ. These methods are more effective in improving sickle kick speed than conventional training approaches. Based on the results obtained, this study confirms that HIIT training is under the initial hypothesis, which significantly increases the speed and agility of sickle kicks of pencak silat athletes. The scientific arguments support the understanding that the HIIT method can be an effective training strategy for martial arts athletes, especially in high-intensity competitions. Therefore, these findings provide recommendations for coaches to include HIIT in the training programs of pencak silat athletes by considering the most optimal duration, frequency, and combination of training methods to improve the performance of competitive techniques.

CONCLUSION

This study concluded that a structured High-Intensity Interval Training (HIIT) program, when integrated with Speed, Agility, and Quickness (SAQ) and Tabata Speed drills, significantly increased the speed and agility of sabit kicks in young pencak silat athletes both male and female. The improvements observed reflect not only physiological adaptations such as enhanced anaerobic capacity and muscle explosiveness but also the effectiveness of combining conditioning with technique-specific drills. This approach provides a practical, evidence-based training model for coaches and sports institutions aiming to elevate athlete performance in martial arts.

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