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International Journal of Human Movement and Sports Sciences

ISSN: 2381-4381 (Print) ISSN: 2381-4403 (Online)

Acceptance Letter

Dear Yafi Velyan Mahyudi ,

Congratulations! As a result of the reviews and revisions, we are pleased to inform you that your following paper has been accepted for publication.

Paper Title: Plyometric Exercise and Speed on the Power of Sabit Kick in Pencak Silat

Paper ID: 19931251

Contributor (s): Albadi Simulingga, Ahmad Muchlisin Natas Pasaribu, Sabaruddin Yunis Bangun, Desy Tya Maya Ningrum, Yafi Velyan Mahyudi

It is scheduled for publication on International Journal of Human Movement and Sports Sciences , Vol 11 , No 3 .

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Evaluation Report

General Comments	**The article consists of a text in which the results of a study based on performance identification and development are published. In this sense, it is a scientific study that can contribute to the relevant field. It is a consistent text with its definitions, references, research methods and findings and results. Publishing will be an example of the studies based on performance measurement and evaluation as well as in the relevant sports field. Should be published.**
Advantage & Disadvantage	**advantage: the scope of the article is based on scientific research and results. disadvantage: instead of repeating text information in the result section, recommendations can be expanded slightly. letter errors should be reviewed in the text.** of the foot, in order to, it is important for a pencak silat athlete to continue, a pencak silat athlete needs to, participants, conduct an experiment, a duration of, given an explanation regarding, were given an explanation of. in order, anova, has an effect, in accordance with, to, between, acknowledgments, pencak
How to improve	**2. Under the title of material and method, a section of a paragraph can be written. Suggestions can also be included in the results section.** The plyometric standing jump, box drill, and depth jump methods do have an effect in increasing the explosive power of the limbs. The coach can choose from these three methods according to the training program and the athlete's needs. Even though it has a significant effect, this method should be used as a training companion in the pre-match phase because it does not require a lot of equipment. For the general preparation phase, the plyometric training method should be supported with resistance training to avoid injury when the athlete lands after the jump.

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PLYOMETRIC EXERCISE AND SPEED ON THE POWER OF SABIT KICK IN PENCAK SILAT

Albadi Sinulingga[1], Ahmad Muchlisin Natas Pasaribu[2], Sabaruddin Yunis Bangun[3], Desy Tya Maya Ningrum[4], Yafi Velyan Mahyudi[5]

[1]Department of Sports Coaching Education, Faculty of Sport Science, Universitas Negeri Medan, Indonesia email: father@unimed.ac.id
[2]Department of Sports Coaching Education, Faculty of Education, Universitas Bhayangkara Jakarta Raya, Indonesia email: ahmad.muchlisin@dsn.ubharajaya.ac.id
[3]Department of Physical Education, Health and Recreation, Faculty of Sport Science, Universitas Negeri Medan, Indonesia email: unisbgn@unimed.ac.id
[4]Department of Sports coaching education, Faculty of Education, Universitas Bhayangkara Jakarta Raya, Indonesia, desy.tya@dsn.ubharajaya.ac.id
[5]Department of Physical Education, Postgraduate, Universitas Negeri Jakarta, Indonesia yafialetta11@gmail.com

Corresponding Author: yafi velyan mahyudi, universitas negeri Jakarta, yafialetta11@gmail.com

Abstract: The purpose of this study was to determine changes during plyometric exercises on sickle kicks. The research method used was an experimental study conducted for 8 weeks. The research design is to compare the plyometric standing jump (A1), box drill (A2), and depth jump (A3) training methods with the speed factor (B) in increasing kick power. The instrument for measuring the explosive power of the leg muscles is by using a punching pad. A total of 25 male participants were selected based on their qualifications for this study. The participants performed sickle kicks three times with each different media. Activities are recorded using a camera with video results and instruments that have been formed. The results show that plyometric standing jump, box drill, and depth jump exercises can increase the explosive power of sickle kicks in *pencak silat* athletes. In addition to the plyometric training factor, there is a speed variable that can also affect kick power. In this case, it can be interpreted that the three plyometric training methods can be used to increase the explosive power of the leg muscles. This study found that the standing jump training method was better or superior to the box drill and depth jump. However, in general, these three methods can increase the explosive power of the leg muscles with the exercise program applied. This can be seen in the program's training results, which lasted for 8 weeks, showing that the standing jump training method is superior to box drills and depth jumps in increasing kick power.

Keywords: Plyometric, power, 8 weeks training, *pencak silat*

1. Introduction

Pencak silat is a contemporary term used by both Indonesians and Malaysians as a form of traditional and modern martial arts, as a cultural heritage that is demonstrated both with art and fighting [1], [2]. When fighting in this sport, the kicking technique is the most important component that must be mastered [3]–[5]. This is because the fighting aspect of *pencak silat* uses the feet more often in attacking, and also tends to be more effective in collecting points and achieving attack targets [6]. But the fact is that many athletes still have average kicking abilities, especially in sickle kicks in terms of their suitability in carrying out the technique [7]. In addition, the physical components needed to do this are speed and strength [8].

The *sabit* kick is one of the most widely used types of kicks in *pencak silat* [9]. This kick has the characteristic of using the back of the foot with a circular trajectory inward towards the target of all parts [10]. Details of the position of the impact on the back of the sole or the base of the toe [11]. Some of the factors that affect the sickle kick are the target distance, the balance of the foot on which it is supported, body position, kicking leg straight, the direction of the kick trajectory, hip rotation, and final position [12], [13]. That way the position of the feet needs to be trained properly to create an effective and efficient automation movement in the use of power. Because the level of effectiveness of the technique on reaction time, response time, and performance time will have an impact on the results of the kick [14].

The successful performance of martial athletes is very important in strength performance. A pencak silat athlete must be able to maintain his strength performance during the match. At the time after the competition they also have to maintain their performance. A *pencak silat* athlete needs to continue to develop the characteristics of strength, speed, endurance, flexibility and technique. The

process of practicing techniques and tactics is specifically separated by increasing the practice of matches among friends with the same characteristics or better than them. Plyometric training exercise explosive power, muscle contractility, and electromechanical efficiency of the lower limbs were markedly improved [15]. Plyometric exercise is beneficial over resistance training for improving power but contains an inherently higher risk for injuries, which should be considered when designing programs [16]. The effect of plyometric training is one of the studies to determine the usefulness of the exercise.

Previous studies have discussed leg height in the Bulgarian split squat exercise [17]. This also encourages researchers to examine more deeply related kicking exercises which are carried out by looking at the height aspect of the media used. Because the height of the media is an important aspect in determining the effectiveness of the exercises used [18]. Therefore, the purpose of this study was to compare and analyze the effect of different media heights on the effectiveness of sickle kick training.

2. Materials and Methods

2.1 Participants

Samples were taken based on the qualifications of the participants who were at the *pencak silat* training venue, with the condition that the participants still had a basic level of training and had carried out training for at least 2 years, with a total of 25 male participants (average age 20.15 years, height (cm) 164.5 and BMI 19.25). This was taken because sickle kick training is one of the basic techniques that must be mastered by fighting athletes and with the media used it is hoped that it will become a point in implementing effective and efficient sickle tending exercises. Before the implementation took place participants explained the purpose and procedure of the test used. The criteria observed in carrying out the sickle kick were seen from the technical aspects, especially observations on the hip and knee joints.

2.2 Instruments

To find out the effectiveness of the right moves to use in training, measurements were made by observing how to kick the sickle. Leg power is measured by the athlete kicking on a punching pad that has a sensor installed [19]. If the punching Pad has been kicked, the display will display the power, force, and speed values of the kick. Furthermore, measurements were carried out by analyzing the group that became the sample in this study. The group taken is based on the height that has been adjusted to get accurate results (can be seen in table 1). This becomes a reference for the height of the pacing pad and box used. The height of the Pecing Pad and the box is measured using a tape measure with a height of 80 cm. Then the participants were guided to do crescent kicks repeatedly at intervals of 10 seconds each session. The process can be seen in the following image:

Figure 1. *Sabit* Kick Activity Measurement

2.3 Experimental Procedure

In this cross-sectional study, each participant was asked to experiment 3 (three) times in a separate form. Before carrying out the test, participants were asked to warm up first for 5 minutes to anticipate injury in the implementation. In the first session, the participants explained the purpose and implementation procedure and afterward gave a test by doing sickle kicks 3 (three) times with the same media height. Taking pictures is done with the help of a camera with video results, to make it easier for researchers to analyze more deeply. The media used in the sickle kicking activity are pacing ped and boxes which are measured at different heights. Measurements were analyzed starting from the Initial Attitude, the Position of the Subject, and the Final Attitude. The instrument was prepared by involving experts as a form of expert judgment or validation of the instrument.

2.4 Data Collection

To see the results of the sickle kick between the media used. The team measured through motion observations based on the video results taken. Measurements are carried out with instruments that have been validated legally. These results are then analyzed by looking at the movement repeatedly to get accurate data results by involving experts in analysis. The results obtained from 3 repetitions were then collected to take the average data acquisition for each person. To minimize muscle fatigue when performing sickle kicks between measurements, competitors are given 10 seconds to prepare the return.

2.5 Statistical Analysis

The data collected from the experiment were analyzed using SPSS ver. 20 for Windows. The Shapiro-Wilk test was used to determine whether the data followed a normal distribution to approve the use of parametric techniques. To test the crescent kick technique based on the media used, namely A: Pecing Pad without Box and B: Pecing Pad using boxes with the same target height, then a paired sample t-test is used with a significance level of 0.05.

3. Results

Testing the hypothesis in the study was processed and analyzed using a two-way analysis of variance (ANOVA) technique with a 3 x 2 factorial treatment design. The analysis was to determine the main effect between the training method treatment (A) and speed (B) and to test the interaction between the two variants (interaction effect) are training methods with speed (Interaction AB). After that, it was continued by using the t-Dunnet test to find out the difference between the training method treatment group (A) and speed (B). The following will present a hypothesis analysis based on ANOVA statistical calculations.

Table 1. Summary of Variant Sources

Statistics	A1B1	A2B1	A3B1	A1B2	A2B2	A3B2	Total
n	9	9	9	9	9	9	54
∑Yi	272,42	259,68	251,72	254,48	264,02	247,78	1550,10
$\sum Yi^2$	8251,18	7494,49	7048,62	7198,92	7749,62	6832,88	44575,70
$\sum yi^2$	5,327	1,860	8,289	3,357	4,446	11,21	34,49
x	30,27	28,85	27,97	28,28	29,34	27,53	172,233

Table 2. Summary of Anava 3 x 2 Calculation Results

Source	JK	db	RJK	Fo	F α (0,05)
Between A	1,001	2	2,5003	3,478	3,17
Between B	5,697	1	5,6973	7,927	4,02
Interaction AB	38,029	2	19,0145	26,456	3,17
Inside	34,499	48	0,719		
Total	79,226	53			

Based on table 2, it is found that F (A) = 3.478 > F $\alpha_{,(0,05)}$ = 3.17, so there is a significant difference between the standing jump, box drill, and dept jump training methods on the kick power of *pencak silat* athletes. There is a difference in the average kick power between athletes who have high and low speed with Fo (B) = 7.927 < F $\alpha_{,(0,05)}$ = 4.02. There is an interaction effect between the standing jump, box drills, and dept jump plyometric training factors (A) with speed (B) on the explosive power of sickle kicks using statistical calculations to obtain Fo (AB) 26.456 < F $\alpha_{,(0,05)}$ 3.17. The magnitude of the influence of the interaction between plyometric training factors (A) and speed (B) can explain the effect of 32.04% on kick power in martial arts athletes. After knowing the main effect and the interaction effect of the training method on speed, the researchers looked at and analyzed the differences between the treatment groups. This aims to see in detail (simple effect) differences between treatment groups. The differences between the training method treatment groups (A) and speed (B) can be seen in the table below.

Table 3. Summary of Simple Effect Calculation Results of Anava 3x2

Values	(Se)	t_0	t $\alpha_{,(0,05)}$	Decision
A1B1 and A2B1	0,111	15,028	1,67	Significant
A1B1 and A3B1	0,111	24,417	1,67	Significant
A2B1 and A3B1	0,111	9,389	1,67	Significant
A1B2 and A2B2	0,111	11,253	1,67	Significant
A1B2 and A3B2	0,111	1,503	1,67	Not significant
A2B2 and A3B2	0,111	19,156	1,67	Significant

There are differences in the effect of the standing jump training method between athletes who have low and high speeds on the explosive power of kicks in martial arts athletes. There are differences in the effect of the box drill training method between athletes who have low and high speeds on the explosive power of *sabit* kicks martial arts athletes. There are differences in the effect of the Dept Jump training method between athletes who have low and high speeds on the explosive power of *sabit* kicks in

martial arts athletes. There are differences in the effect of standing jump and box drill training methods between athletes who have high speed on the explosive power of *sabit* kick in martial arts athletes. There are differences in the effect of standing jump and depth jump training methods between athletes who have high speed on the explosive power of *sabit* kicks in martial arts athletes. There are differences in the effect of box drill and depth jump training methods between athletes who have high speed on the explosive power of *sabit* kicks in martial arts athletes. There are differences in the effect of the standing jump and box drill training methods between athletes who have low speed on the explosive power of *sabit* kick martial arts athletes. There is no difference in the effect of the standing jump and dept jump training methods between athletes who have low speed on the explosive power of *sabit* kicks in martial arts athletes. There are differences in the effect of box drill and depth jump training methods between athletes who have low speed on the explosive power of crescent *sabit* in martial arts athletes.

The plyometric standing jump, box drill, and depth jump methods do have an effect in increasing the explosive power of the limbs. The coach can choose from these three methods according to the training program and the athlete's needs. Even though it has a significant effect, this method should be used as a training companion in the pre-match phase because it does not require a lot of equipment. For the general preparation phase, the plyometric training method should be supported with resistance training to avoid injury when the athlete lands after the jump.

4. Discussion

This study examines the effect of plyometric standing jump, box drill, and depth jump exercises applied by trainers to martial arts athletes for 8 weeks to be effective in increasing the explosive power of sickle kicks in martial arts sports. In addition, the applied plyometric exercises can also maintain athlete performance in the short term. The design of plyometric exercises made by the trainer is also adjusted so that the objectives of the exercise can be achieved optimally. Implementation of strength training to improve medium and long-distance performance, especially through increasing maximum power, maximum strength, and on static balances [20] [21]. The results of previous studies stated that plyometric exercises can increase jump height, 20 m sprint speed, and endurance in soccer players [22]. Plyometric training resulted in a significant increase in sprint acceleration performance, thus seeing the importance of movement patterns and speed of contraction [23]. Plyometric training recorded success (96.7%) and provided positive feedback from the benefits felt by the athlete [24].

The three plyometric exercises standing jump, box drill, and depth jump at low or high speed also affect the increase in the explosive power of sickle kicks in martial arts athletes. Of the three training methods, the aim is to compare the effectiveness of the standing jump, box drill, and depth jump plyometric training methods which include periodization of volume, exercise frequency, and plyometric intensity applied to martial arts athletes during 8 weeks of practice. Increased load and speed of exercise would lead to relatively higher erector spinae activity on boxes of tibia height [18]. It is evident from the results of the exercises carried out that there is an effect of increasing explosive power felt by athletes. The following will be discussed according to the hypothesis proposed in this study.

The hypothesis on the training method variable states that standing jump, box drill, and depth jump plyometric exercises can affect the athlete's kick power. This is consistent with research that states that plyometric training for 8 weeks appears to be effective for improving variables related to power and strength in untrained children [25]. Short-term, high-intensity strength plyometric training twice a week improves many factors relevant to athletic performance (sprint, ability to change direction, vertical jump, power, strength, and neuromuscular adaptation) [26]. The frequency of plyometric training for 8 weeks affects on the jumping ability of male soccer players [27]. The program design and intensity of plyometric exercises are suitable for those who require significant horizontal strength in sports [28]. Based on previous studies, plyometric exercises can increase strength. This is following research findings that one of the exercises to increase leg power in martial arts can use plyometric exercises adapted to a technical training program.

The average difference obtained can be seen from the data when the *sabit* kicking technique was performed. When using the box the hip position becomes more elevated because there is a box that becomes a hindrance when kicking, besides that the movement of the hip joint which is more lifting is also a point in doing it. Hip joint flexibility plays an important role when kicking [29], [30]. In addition, the average difference is also known when the position of the target distance and the displacement of the hips are also points in the advantages of using box kick exercises. This is following previous studies which also explain that adjusting the target distance will affect the displacement of the hip pivot, hip flexion, and rotation of the pelvis, and affect the control of pelvic reach and balance [31]. At the time of displacement of the pelvis will also affect the acceleration of rotation of the hip, and this provides an understanding of the action of injury and the efficiency of movement performance [32]. Balance is needed when standing on one leg and when in a rotational position. This position also greatly affects the balance in performing kicking movements [33].

In addition, leg strength also plays an important role when doing rotations, because strength will affect the style of the feet that rest on the ground [34].

The measurement values of body coordination and speed from the experimental group found that there was an influence on the explosive power of the *sabit* kick. The findings suggest that the improvements observed in all three groups may be due to the children always taking part in periods of development and training. Martial arts coaches provide them with effective training so that athletes' performance when competing can increase [35]. It is also stated in the literature that, when the effect of the plyometric training program is applied, the results show more improvement compared to the group that did not take part in the training session in a statistically significant way. In addition, it was stated that taekwondo kick skills, running speed, and agility skills in physically active athletes were higher compared to children who were not physically active. Kicks performed with high power may use ballistic, plyometric, and speed-based training to improve performance [36]. In this study, regular sickle kick training was applied to improve the skill-related fitness components so that the developmental value increased significantly not only in terms of martial arts skills.

The effect of training methods is indeed the main key to increasing the explosive power of the leg muscles, but the researchers analyzed other influences such as speed which had an effect of 32.04% in increasing explosive power. This is also in line with research which states that the strength and anaerobic characteristics of taekwondo and karate athletes are compared, there are differences between the two branches, namely differences in match times, training programs, training methods, and physical requirements of sports [37] [38]. Kicks specific to the sport of combat and simulated fighting twice a week for 8 weeks provided a small incremental gain on key performance parameters [39]. Respiratory muscle training increases aerobic and anaerobic strength capacity in taekwondo youth athletes [40]. Long-term training had an effect on strength, flexibility, and agility that was applied over 8 weeks of training [41]. The 8 weeks of training given to children in the 7-10 age group improved body coordination, strength, and agility in both girls and boys [42].

5. Conclusions

From the results of an investigation into kick training without using a box and using a box, the average difference between the two is obtained. However, the statistical data does not yet have a significant difference. The activity was carried out with a sample of 25 participants with existing qualifications. All participants involved are participants who already have experience for at least 2 years and are still at the basic level. Although the difference is not statistically significant, the results show that doing kicking technique exercises with the help of a box is better than those who do not use a box or only use a pacing pad. Therefore, it is recommended in training to use media boxes as a kick barrier so that athletes can get used to lifting the thighs and hip joints higher.

However, this research still has weaknesses. This is because in this study the participants used were participants with training activities who had undergone training for at least 2 years, and this had not been tested on participants who were just about to start training in *pencak silat*. Based on this research and research that has been done before, further research should aim to see the angle of the upper leg based on biomechanical analysis, so that the results obtained are more detailed from this study. Or it can also be done by investigating the joints that play a role by looking at the height aspect of the media used or between using box media and without using box media, as in this study.

Acknowledgments

We are very grateful to the Faculty of Sports Science, Medan State University, and also all participants. We are also very grateful to all the lecturers and the team for their continuous encouragement, good advice during research and for good advice and assistance.

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Manuscript ID:	**19931251**
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Evaluation Report

General Comments	**The scientific problem is interesting and deserves publication. However, it requires corrections and additions.**
Advantage & Disadvantage	**I have no objections to the methodological side. However, in the Discussion, more works on similar topics should be included (I give the suggested ones).** **The language needs markup and corrections. Also the bibliographic record - for example, item 7 in the References list is missing the names of all co-authors.** M. I. Lihawa, U. H. Rafiater, and S. Hidayat, "Analysis of Sickle Kick Movement in Pencak Silat Athletes at SMK Negeri 1 Gorontalo,
How to improve	**It should be included in the Introduction and Discussion - discuss similar studies and compare your own results with them.** Implementation of strength training to improve medium and long-distance performance, especially through increasing maximum power, maximum strength, and on static balances, Increased load and speed of exercise would lead to relatively higher erector spinae activity on boxes of tibia height, Based on previous studies, plyometric exercises can increase strength. This is in accordance with research findings that one of the exercises to increase leg power in martial arts can use plyometric exercises adapted to a technical training program. The successful performance of martial athletes is very important in strength performance. A pencak silat athlete must be able to maintain his strength performance during the match. At the time after the competition they also have to maintain their performance. It is important for a pencak silat athlete to continue to develop the characteristics of strength, speed, endurance, flexibility and technique. The process of practicing techniques and tactics is specifically separated by increasing the practice of matches among friends with the same characteristics or better than them. Plyometric training exercise explosive power, muscle contractility, and electromechanical efficiency of the lower limbs were markedly improved (Zubac et al., 2019). Plyometric exercise is beneficial over

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Plyometric Exercise and Speed on the Power of Sabit Kick in Pencak Silat

Albadi Sinulingga[1], Ahmad Muchlisin Natas Pasaribu[2], Sabaruddin Yunis Bangun[3], Desy Tya Maya Ningrum[4], Yafi Velyan Mahyudi[5,*]

[1]Department of Sports Coaching Education, Faculty of Sport Science, Universitas Negeri Medan, Indonesia
[2]Department of Sports Coaching Education, Faculty of Education, Universitas Bhayangkara Jakarta Raya, Indonesia
[3]Department of Physical Education, Health and Recreation, Faculty of Sport Science, Universitas Negeri Medan, Indonesia
[4]Department of Sports Coaching Education, Faculty of Education, Universitas Bhayangkara Jakarta Raya, Indonesia
[5]Department of Physical Education, Postgraduate, Universitas Negeri Jakarta, Indonesia
[*]Corresponding Author: yafialetta11@gmail.com

Received; Revised March 30, 2023; Accepted

Cite This Paper in the Following Citation Styles

(a): *[1] Albadi Sinulingga, Ahmad Muchlisin Natas Pasaribu, Sabaruddin Yunis Bangun, Desy Tya Maya Ningrum, Yafi Velyan Mahyudi , "Plyometric Exercise and Speed on the Power of Sabit Kick in Pencak Silat," International Journal of Human Movement and Sports Sciences, Vol. 11, No. X, pp. XXX - XXX, 2023. DOI: 10.13189/saj.2023.1101XX.*

(b): *Albadi Sinulingga, Ahmad Muchlisin Natas Pasaribu, Sabaruddin Yunis Bangun, Desy Tya Maya Ningrum, Yafi Velyan Mahyudi (2023). Plyometric Exercise and Speed on the Power of Sabit Kick in Pencak Silat. International Journal of Human Movement and Sports Sciences, 11(X), XXX - XXX. DOI: 10.13189/saj.2023.110XXX.*

Abstract The purpose of this study was to determine changes during plyometric exercises on sickle kicks. The research method used was an experimental study conducted for 8 weeks. The research design is to compare the plyometric standing jump (A1), box drill (A2), and depth jump (A3) training methods with the speed factor (B) in increasing kick power. The instrument for measuring the explosive power of the leg muscles is ~~by using~~ a punching pad. A total of 25 male participants were selected based on their qualifications for this study. The participants performed sickle kicks three times with each different media. Activities are recorded using a camera with video results and instruments that have been formed. The results show that plyometric standing jump, box drill, and depth jump exercises can increase the explosive power of sickle kicks in *pencak silat* athletes. In addition to the plyometric training factor, there is a speed variable that can also affect kick power. In this case, it can be interpreted that the three plyometric training methods can be used to increase the explosive power of the leg muscles. This study found that the standing jump training method was better or superior to the box drill and depth jump. However, in general, these three methods can increase the explosive power of the leg muscles with the exercise program applied. This can be seen in the program's training results, which lasted for 8 weeks, showing that the standing jump training method is superior to box drills and depth jumps in increasing kick power.

Keywords Plyometric, Power, 8 Weeks Training, *Pencak Silat*

1. Introduction

Pencak silat is a contemporary term used by both Indonesians and Malaysians as a form of traditional and modern martial arts, and as a cultural heritage that is demonstrated both with art and fighting [1], [2]. When fighting in this sport, the kicking technique is the most important component that must be mastered [3]–[5]. This is because the fighting aspect of *pencak silat* uses the feet more often in attacking, and also tends to be more effective in collecting points and achieving attack targets [6]. But the fact is that many athletes still have average kicking abilities, especially in sickle kicks in terms of their suitability in carrying out the technique [7]. In addition, the physical components needed to do this are speed and strength [8].

The *sabit* kick is one of the most widely used types of kicks in *pencak silat* [9]. This kick has the characteristic of using the back of the foot with a circular trajectory inward towards the target of all parts [10]. The position kick of the

impact on the back of the sole or the base of the toe [11]. Some of the factors that affect the sickle kick are the target distance, the balance of the foot on which it is supported, body position, kicking leg straight, the direction of the kick trajectory, hip rotation [12], [13]. That way the position of the feet needs to be trained properly to create an effective and efficient automation movement in the use of power. Because the level of effectiveness of the technique on reaction time, response time, and performance time will have an impact on the results of the kick [14].

The successful performance of martial athletes is very important in strength performance. A pencak silat athlete must be able to maintain his strength performance during the match. At the time after the competition they also have to maintain their performance. A *pencak silat* athlete needs to continue to develop the characteristics of strength, speed, endurance, flexibility and technique. The process of practicing techniques and tactics is specifically separated by increasing the practice of matches among friends with the same characteristics or better than them. Plyometric training exercise explosive power, muscle contractility, and electromechanical efficiency of the lower limbs were markedly improved [15]. Plyometric exercise is beneficial over resistance training for improving power but contains an inherently higher risk for injuries, which should be considered when designing programs [16]. The effect of plyometric training is one of the studies to determine the usefulness of the exercise.

Previous studies have discussed leg height in the Bulgarian split squat exercise [17]. This also encourages researchers to examine more deeply related kicking exercises which are carried out by looking at the height aspect of the media used. Because the height of the media is an important aspect in determining the effectiveness of the exercises used [18]. Therefore, the purpose of this study was to compare and analyze the effect of different media heights on the effectiveness of sickle kick training.

2. Materials and Methods

2.1. Participants

Samples were taken based on the qualifications of the participants who were at the *pencak silat* training venue, with the condition that the participants still had a basic level of training and had carried out training for at least 2 years, with a total of 25 male participants (average age 20.15 years, height (cm) 164.5 and BMI 19.25). This was taken because sickle kick training is one of the basic techniques that must be mastered by fighting athletes and with the media used it is hoped that it will become a point in implementing effective and efficient sickle tending exercises. Before the implementation took place participants explained the purpose and procedure of the test used. The criteria observed in carrying out the sickle kick were seen from the technical aspects, especially observations on the hip and knee joints.

2.2. Instruments

To find out the effectiveness of the right moves to use in training, measurements were made by observing how to kick the sickle. Leg power is measured by the athlete kicking on a punching pad that has a sensor installed [19]. If the punching Pad has been kicked, the display will display the power, force, and speed values of the kick. Furthermore, measurements were carried out by analyzing the group that became the sample in this study. The group taken is based on the height that has been adjusted to get accurate results (can be seen in table 1). This becomes a reference for the height of the pacing pad and box used. The height of the Pecing Pad and the box is measured using a tape measure with a height of 80 cm. Then the participants were guided to do crescent kicks repeatedly at intervals of 10 seconds each session. The process can be seen in the following image:

Figure 1. *Sabit* Kick Activity Measurement

2.3. Experimental Procedure

In this cross-sectional study, each participant was asked to experiment 3 (three) times in a separate form. Before carrying out the test, participants were asked to warm up first for 5 minutes to anticipate injury in the implementation. In the first session, the participants explained the purpose and implementation procedure and afterward gave a test by doing sickle kicks 3 (three) times with the same media height. Taking pictures is done with the help of a camera with video results, to make it easier for researchers to analyze more deeply. The media used in the sickle kicking

activity are pacing ped and boxes which are measured at different heights. Measurements were analyzed starting from the Initial Attitude, the Position of the Subject, and the Final Attitude. The instrument was prepared by involving experts as a form of expert judgment or validation of the instrument.

2.4. Data Collection

To see the results of the sickle kick between the media used. The team measured through motion observations based on the video results taken. Measurements are carried out with instruments that have been validated legally. These results are then analyzed by looking at the movement repeatedly to get accurate data results by involving experts in analysis. The results obtained from 3 repetitions were then collected to take the average data acquisition for each person. To minimize muscle fatigue when performing sickle kicks between measurements, competitors are given 10 seconds to prepare the return.

2.5. Statistical Analysis

The data collected from the experiment were analyzed using SPSS ver. 20 for Windows. The Shapiro-Wilk test was used to determine whether the data followed a normal distribution to approve the use of parametric techniques. To test the crescent kick technique based on the media used, namely A: Pecing Pad without Box and B: Pecing Pad using boxes with the same target height, then a paired sample t-test is used with a significance level of 0.05.

3. Results

Testing the hypothesis in the study was processed and analyzed using a two-way analysis of variance (ANOVA) technique with a 3 x 2 factorial treatment design. The analysis was to determine the main effect between the training method treatment (A) and speed (B) and to test the interaction between the two variants (interaction effect) are training methods with speed (Interaction AB). After that, it was continued by using the t-Dunnet test to find out the difference between the training method treatment group (A) and speed (B). The following will present a hypothesis analysis based on ANOVA statistical calculations.

Based on table 2, it is found that F (A) = 3.478 > F $\alpha_{,(0,05)}$ = 3.17, so there is a significant difference between the standing jump, box drill, and dept jump training methods on the kick power of *pencak silat* athletes. There is a difference in the average kick power between athletes who have high and low speed with Fo (B) = 7.927 < F $\alpha_{,(0,05)}$ = 4.02. There is an interaction effect between the standing jump, box drills, and dept jump plyometric training factors (A) with speed (B) on the explosive power of sickle kicks using statistical calculations to obtain Fo (AB) 26.456 < F $\alpha_{,(0,05)}$ 3.17. The magnitude of the influence of the interaction between plyometric training factors (A) and speed (B) can explain the effect of 32.04% on kick power in martial arts athletes. After knowing the main effect and the interaction effect of the training method on speed, the researchers looked at and analyzed the differences between the treatment groups. This aims to see in detail (simple effect) differences between treatment groups. The differences between the training method treatment groups (A) and speed (B) can be seen in the table 3.

Table 1. Summary of Variant Sources

Statistics	A1B1	A2B1	A3B1	A1B2	A2B2	A3B2	Total
n	9	9	9	9	9	9	54
∑Yi	272,42	259,68	251,72	254,48	264,02	247,78	1550,10
$\sum Yi^2$	8251,18	7494,49	7048,62	7198,92	7749,62	6832,88	44575,70
$\sum yi^2$	5,327	1,860	8,289	3,357	4,446	11,21	34,49
x	30,27	28,85	27,97	28,28	29,34	27,53	172,233

Table 2. Summary of Anava 3 x 2 Calculation Results

Source	JK	db	RJK	Fo	F α (0,05)
Between A	1,001	2	2,5003	3,478	3,17
Between B	5,697	1	5,6973	7,927	4,02
Interaction AB	38,029	2	19,0145	26,456	3,17
Inside	34,499	48	0,719		
Total	79,226	53			

Table 3. Summary of Simple Effect Calculation Results of Anava 3x2

Values	(Se)	t_0	$t\ \alpha_{,(0,05)}$	Decision
A1B1 and A2B1	0,111	15,028	1,67	Significant
A1B1 and A3B1	0,111	24,417	1,67	Significant
A2B1 and A3B1	0,111	9,389	1,67	Significant
A1B2 and A2B2	0,111	11,253	1,67	Significant
A1B2 and A3B2	0,111	1,503	1,67	Not significant
A2B2 and A3B2	0,111	19,156	1,67	Significant

There are differences in the effect of the standing jump training method between athletes who have low and high speeds on the explosive power of kicks in martial arts athletes. There are differences in the effect of the box drill training method between athletes who have low and high speeds on the explosive power of *sabit* kicks martial arts athletes. There are differences in the effect of the Dept Jump training method between athletes who have low and high speeds on the explosive power of *sabit* kicks in martial arts athletes. There are differences in the effect of standing jump and box drill training methods between athletes who have high speed on the explosive power of *sabit* kick in martial arts athletes. There are differences in the effect of standing jump and depth jump training methods between athletes who have high speed on the explosive power of *sabit* kicks in martial arts athletes. There are differences in the effect of box drill and depth jump training methods between athletes who have high speed on the explosive power of *sabit* kicks in martial arts athletes. There are differences in the effect of the standing jump and box drill training methods between athletes who have low speed on the explosive power of *sabit* kick martial arts athletes. There is no difference in the effect of the standing jump and dept jump training methods between athletes who have low speed on the explosive power of *sabit* kicks in martial arts athletes. There are differences in the effect of box drill and depth jump training methods between athletes who have low speed on the explosive power of crescent *sabit* in martial arts athletes.

The plyometric standing jump, box drill, and depth jump methods do have an effect in increasing the explosive power of the limbs. The coach can choose from these three methods according to the training program and the athlete's needs. Even though it has a significant effect, this method should be used as a training companion in the pre-match phase because it does not require a lot of equipment. For the general preparation phase, the plyometric training method should be supported with resistance training to avoid injury when the athlete lands after the jump.

4. Discussion

This study examines the effect of plyometric standing jump, box drill, and depth jump exercises applied by trainers to martial arts athletes for 8 weeks to be effective in increasing the explosive power of sickle kicks in martial arts sports. In addition, the applied plyometric exercises can also maintain athlete performance in the short term. The design of plyometric exercises made by the trainer is also adjusted so that the objectives of the exercise can be achieved optimally. Implementation of strength training to improve medium and long-distance performance, especially through increasing maximum power, maximum strength, and on static balances [20] [21]. The results of previous studies stated that plyometric exercises can increase jump height, 20 m sprint speed, and endurance in soccer players [22]. Plyometric training resulted in a significant increase in sprint acceleration performance, thus seeing the importance of movement patterns and speed of contraction [23]. Plyometric training recorded success (96.7%) and provided positive feedback from the benefits felt by the athlete [24].

The three plyometric exercises standing jump, box drill, and depth jump at low or high speed also affect the increase in the explosive power of sickle kicks in martial arts athletes. Of the three training methods, the aim is to compare the effectiveness of the standing jump, box drill, and depth jump plyometric training methods which include periodization of volume, exercise frequency, and plyometric intensity applied to martial arts athletes during 8 weeks of practice. Increased load and speed of exercise would lead to relatively higher erector spinae activity on boxes of tibia height [18]. It is evident from the results of the exercises carried out that there is an effect of increasing explosive power felt by athletes. The following will be discussed according to the hypothesis proposed in this study.

The hypothesis on the training method variable states that standing jump, box drill, and depth jump plyometric exercises can affect the athlete's kick power. This is consistent with research that states that plyometric training for 8 weeks appears to be effective for improving variables related to power and strength in untrained children [25]. Short-term, high-intensity strength plyometric training twice a week improves many factors relevant to athletic performance (sprint, ability to change direction, vertical jump, power, strength, and neuromuscular adaptation) [26].

The frequency of plyometric training for 8 weeks affects on the jumping ability of male soccer players [27]. The program design and intensity of plyometric exercises are suitable for those who require significant horizontal strength in sports [28]. Based on previous studies, plyometric exercises can increase strength. This is following research findings that one of the exercises to increase leg power in martial arts can use plyometric exercises adapted to a technical training program.

The average difference obtained can be seen from the data when the *sabit* kicking technique was performed. When using the box the hip position becomes more elevated because there is a box that becomes a hindrance when kicking, besides that the movement of the hip joint which is more lifting is also a point in doing it. Hip joint flexibility plays an important role when kicking [29], [30]. In addition, the average difference is also known when the position of the target distance and the displacement of the hips are also points in the advantages of using box kick exercises. This is following previous studies which also explain that adjusting the target distance will affect the displacement of the hip pivot, hip flexion, and rotation of the pelvis, and affect the control of pelvic reach and balance [31]. At the time of displacement of the pelvis will also affect the acceleration of rotation of the hip, and this provides an understanding of the action of injury and the efficiency of movement performance [32]. Balance is needed when standing on one leg and when in a rotational position. This position also greatly affects the balance in performing kicking movements [33]. In addition, leg strength also plays an important role when doing rotations, because strength will affect the style of the feet that rest on the ground [34].

The measurement values of body coordination and speed from the experimental group found that there was an influence on the explosive power of the *sabit* kick. The findings suggest that the improvements observed in all three groups may be due to the children always taking part in periods of development and training. Martial arts coaches provide them with effective training so that athletes' performance when competing can increase [35]. It is also stated in the literature that, when the effect of the plyometric training program is applied, the results show more improvement compared to the group that did not take part in the training session in a statistically significant way. In addition, it was stated that taekwondo kick skills, running speed, and agility skills in physically active athletes were higher compared to children who were not physically active. Kicks performed with high power may use ballistic, plyometric, and speed-based training to improve performance [36]. In this study, regular sickle kick training was applied to improve the skill-related fitness components so that the developmental value increased significantly not only in terms of martial arts skills.

The effect of training methods is indeed the main key to increasing the explosive power of the leg muscles, but the researchers analyzed other influences such as speed which had an effect of 32.04% in increasing explosive power. This is also in line with research which states that the strength and anaerobic characteristics of taekwondo and karate athletes are compared, there are differences between the two branches, namely differences in match times, training programs, training methods, and physical requirements of sports [37] [38]. Kicks specific to the sport of combat and simulated fighting twice a week for 8 weeks provided a small incremental gain on key performance parameters [39]. Respiratory muscle training increases aerobic and anaerobic strength capacity in taekwondo youth athletes [40]. Long-term training had an effect on strength, flexibility, and agility that was applied over 8 weeks of training [41]. The 8 weeks of training given to children in the 7-10 age group improved body coordination, strength, and agility in both girls and boys [42].

5. Conclusions

From the results of an investigation into kick training without using a box and using a box, the average difference between the two is obtained. However, the statistical data does not yet have a significant difference. The activity was carried out with a sample of 25 participants with existing qualifications. All participants involved are participants who already have experience for at least 2 years and are still at the basic level. Although the difference is not statistically significant, the results show that doing kicking technique exercises with the help of a box is better than those who do not use a box or only use a pacing pad. Therefore, it is recommended in training to use media boxes as a kick barrier so that athletes can get used to lifting the thighs and hip joints higher.

However, this research still has weaknesses. This is because in this study the participants used were participants with training activities who had undergone training for at least 2 years, and this had not been tested on participants who were just about to start training in *pencak silat*. Based on this research and research that has been done before, further research should aim to see the angle of the upper leg based on biomechanical analysis, so that the results obtained are more detailed from this study. Or it can also be done by investigating the joints that play a role by looking at the height aspect of the media used or between using box media and without using box media, as in this study.

Acknowledgments

We are very grateful to the Faculty of Sports Science, Medan State University, and also all participants. We are also very grateful to all the lecturers and the team for their continuous encouragement, good advice during research and for good advice and assistance.

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