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Analysis of the effect of training on the explosive power of the pencak silat sickle kick: a comparative study of plyometric and conventional exercises

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ABSTRACT

This study aimed to find out the differences between the effects of plyometric and conventional exercises on the explosive power of the spark. This study used an experimental method where the sample is given treatment. The subjects in this study were 4th semester students of the STKIP Setiabudhi Sports Education study program. The sampling technique used cluster random sampling, so a sample of 40 students was obtained. The study was conducted for 14 meetings with a training frequency of twice a week. The sample was given treatment in the form of plyometric training to increase the explosive power of the sickle kick. The data obtained was analyzed using the SPSS version 26 application. The results of the comparison between plyometric and conventional exercises for low hand-foot coordination were reviewed. The study indicated that the value of Qcount = 12.96 exceeded Qtable = 4.90, or Qcount > Qtable, suggesting significant differences, with the plyometric exercise method proving superior to conventional exercise. Further, the results of the comparison of plyometric and conventional exercises were reviewed for high hand-foot coordination and the results showed that the value of Q_{count} = 6.65 was greater than Q_{table} = 4.90, or $Q_{count} > Q_{table}$, indicating

significant differences favoring the plyometric exercise method over conventional exercise. The plyometric training method and the conventional training method have an influence on the explosive power of the sickle kick. However, the plyometric training method is more influential, effective, and good for the explosive power of the sickle kick than the conventional training method.

KEYWORDS

Plyometric Exercises; Conventional Exercise; Explosive Power; Pencak Silat

1. INTRODUCTION

Sport is generally defined as a physical activity that is very useful for maintaining a healthy quality of life. Sports can be done by various groups (Suryadi et al., 2022; Suryadi et al., 2023), and become an activity to maintain fitness (Rubiyatno et al., 2023; Suryadi et al., 2023), and gross motor skills (Samodra et al., 2023). In addition, sports are also a place for cultural preservation, which can be one of the branches in sports such as pencak silat (Saputra & Riyoko, 2023). Pencak silat is a martial art sport that grew out of local and well-known cultures (Neil, 2019). This traditional martial art is the result of East Asia's reaction to imperialism and western modernity (Lorge, 2016). The introduction of pencak silat through television, movies, and cinema created a title in martial arts sports history (Barry, 2016). The popularity of this martial art is a clear example of an indigenous cultural product in a local environment. Hence, pencak silat is a valuable martial arts sport (Lorge, 2016).

Pencak silat is performed dynamically and aggressively with a variety of movements, including punches and kicks (Nugraha et al., 2014), slams, blocks, locks, and dodges (Noviatmoko, 2016). One of the movements that is often used in pencak silat is the kick. Given that kicking is one of the movements used in carrying out attacks using the feet (Satria et al., 2021). Kicking requires good speed and muscle strength to give an athlete success (Sudirman, 2015). Lower limb explosive power is an important factor that can affect the performance of track and field athletes (Liu & Zeng, 2023).

Explosive power is the ability to release a great amount of strength in a short period of time (Maffiuletti et al., 2016), which is vital for athletes when competing. When making attacks with kicks in pencak silat contests, explosive power is required. Due to the high value of kicks and the difficulty of anticipating the opponent, explosive leg muscle strength is required; yet, if the lower leg

muscles lack explosive power, the kick will be feeble, making the opponent easily anticipate (Suwirman, 2019). As a result, explosive power is regarded as a crucial aspect of a match (Wang et al., 2023). Exercises that are well-organized and pay attention to duration, repetition, and intensity will improve physical condition (Bompa & Buzzichelli, 2015).

According to the research study conducted by Wang et al. (2023) on plyometric and complicated training, they have been widely employed in training for strength and explosive power. The impact of these training approaches on explosive power varies. Traditional resistance training can be used to build maximal strength as well, although it is less effective at increasing explosive power (Sudirman et al., 2022). Because the joints reach a specific angle in resistance motion, muscular strength is diminished and movement speed is lowered, which is known as the sticky zone (Kompf & Arandjelović, 2016). As a result, the decrease in force and speed is detrimental to the development of explosive power. Another study looked at how pressure training and traditional resistance training affected the development of lower-body explosive power in adolescent athletes (Che, Li, Yang, et al., 2022). In this study, the training evaluation was based on the lower limb explosive power index through 30-meter running, standing long jump, and standing vertical jump activities.

Research studies on plyometric training and complex training conducted by Behm et al. (2017); Morris et al. (2022); Pardos-Mainer et al. (2021) have their respective roles in the effectiveness of increasing explosive power. However, according to the force-velocity curve, force and velocity have an inverse relationship (Taber et al., 2016). This is an obstacle to increasing strength and speed (explosive power). The results of research conducted by Hammami et al. (2019) showed that complex training has a better effect on improving jumping ability, sprinting, and maximum strength than plyometric training. Furthermore, some other studies say that plyometric training methods and complex training have no significant difference in improving jumping performance (da Silva et al., 2015; Lloyd et al., 2016; Sánchez-Sixto et al., 2021). The results of a study conducted by Lloyd et al., (2016) confirmed that there was no significant difference between the two training methods in improving adolescent sprinting ability.

In a previous study in Banten Province, Indonesia, in a match, the leg attack technique (sickle kick) was most dominant and often launched to get points (Sudirman et al., 2022). According to several of these study investigations, different responses to the celurit kick method in pencak silat. As a result, it is critical to boost the explosive power of the celurit kick in pencak silat. This, of course, tries to get good outcomes in a contest. To create a good sickle kick in the sport of pencak silat, the

correct training regimen is required. Whereas earlier research has solely focused on the impact offered (Ihsan et al., 2022). However, few people compare or observe a more appropriate training approach, particularly in the sport of pencak silat. Based on these issues, the purpose of this study is to examine the differences in the effects of plyometric and circuit training methods on kick power sickle.

2. METHODS

2.1. Participants

This research was conducted at Setiabudhi College of Teacher Training and Education, Rangkasbitung, Lebak-Banten, in 2021. The subjects in this study were 4th semester students in the Sports Education study program. The sampling technique used cluster random sampling, so a sample of 40 students was obtained. Furthermore, the division of treatment groups into pliometric exercises and conventional exercises was carried out.

2.2. Instruments

This research used an experimental method with a quasi-experimental design. Based on the university lecture schedule, the research was done across 14 meetings with a training frequency of twice a week. Plyometric and conventional training methods were used for each group's training materials. Furthermore, with the Sabit kick practice. After a sufficient number of treatments had been administered, the final action was to administer tests to all sample members. A sickle-kick explosive power test on a specified target is performed.

The research instrument used in this study is the kick explosive power test (Johansyah & Hendro, 2016). This test was prepared by researchers and tested first to obtain validation and reliability. The test is measured in centimeters (cm), and each sample has more than one opportunity, and then the best value is taken.

When the teste kicks towards the black bag, the explosive power is immediately recorded as the amount of action that lands on the black bag, thanks to the "dynamometric punching-kicking bag with an embedded accelerometer." Force (f) per Newton (N) is the unit of impact explosive power. The tester officer is made up of 1 (one) person who gives the signal and 2 (two) persons who record the participant's best distance for three times the opportunity. Next, using a prestest test to seek

instrument validation, the criteria used to assess validity are considered valid if the correlation coefficient $r_{count} > f_{table}$ with a significant threshold of $\alpha = 0.05$.

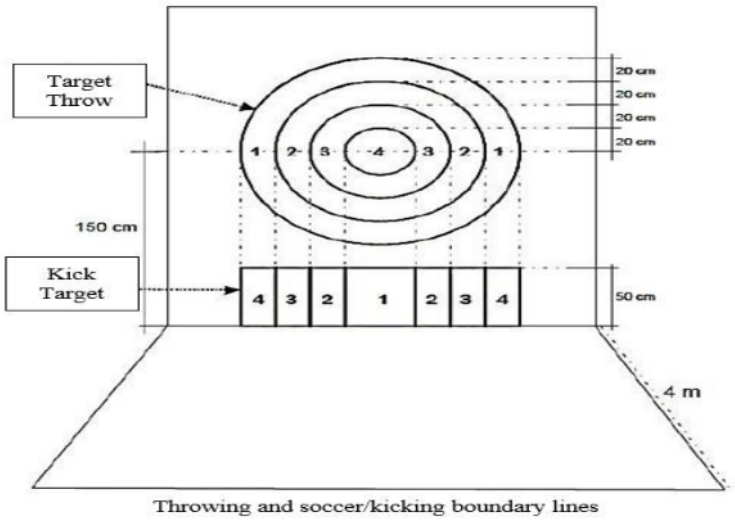

Figure 1. Hand-Foot-Eye Coordination Test

2.3. Statistical analysis

Analysis of variance (ANOVA) is used to test hypotheses. However, before the analysis can begin, certain tests must be completed. The Lilliefors test was used to calculate the data received from the results of the explosive power of the sickle kick during the normality test stage, and the Bartlett test was utilized for the homogeneity test. The analysis in this study was assisted by using the SPSS version 26 application.

3. RESULTS

The results of the study, which will be presented sequentially, include a description of the research data, testing of analytical requirements, hypothesis testing, discussion, and research limitations. Based on Table 1, there are 6 students, or 60%, who get a score range of 200-236, then 1 student, or 10%, who gets a score of 237–73; 274-310 and 2 students, or 20%, who get a score of 311-344.

Table 1. Frequency Distribution of Plyometric Training Method/Score with High Hand Foot Eye Coordination

No	Interval Class	Absolute Frequency	Relative Frequency (%)

1	200-236	6	60
2	237-273	1	10
3	274-310	1	10
4	311-344	2	20
		10	100

Table 2. Frequency Distribution of Plyometric Training Method/Scores with Low Hand-Foot Eye Coordination

No.	Interval Class	Absolute Frequency	Relative Frequency (%)
1	187-217	3	30
2	218-248	5	50
3	249-279	0	0
4	280-310	2	20
		10	100

According to Table 2, three students (30%) scored 187–217, five students (50%) scored 218–248, and two students (20%) scored 280–310.

Table 3. Frequency Distribution of Conventional Training Method/Scores with High Hand-Foot Eye Coordination

No	Interval Class	Absolute Frequency	Relative Frequency (%)
1	172-205	4	40
2	206-239	1	10
3	240-273	1	10
4	274-307	4	40
		10	100

Based on Table 3, there were 4 students or 40% who scored 172-205, then 1 student or 10% who scored 206-239, 1 student or 10% who scored 240-273, and 4 people who scored 274-307.

Table 4. Frequency Distribution of Conventional Training Method/Scores with Low Hand-Foot Eye Coordination

No	Interval Class	Absolute Frequency	Relative Frequency (%)
1	158-193	1	10
2	194-229	4	40
3	230-265	1	10
4	266-301	4	40
		10	100

Based on Table 4, there are 1 student, or 10%, who scored 158-193, then 4 students, or 40%, who scored 194-229, and 1 student, or 10%, who scored 230-265, then 4 students, or 40%, who scored 266-301. The findings from evaluating the normality of the full group of research data demonstrate that the greatest Lo price of all treatment groups is less than the Lt Price, implying that the sample comes from a population with a normal distribution. Table 5 displays the results.

Table 5. Lilliefors Normality Test

Group	N	L_0	L_t	Conclusion
Plyometric 1	10	0.206	0.2616	Normal
Plyometric 2	10	0.224	0.2616	Normal
Conventional 1	10	0.185	0.2616	Normal
Conventional 2	10	0.127	0.2616	Normal

The Bartlett test was used to assess for homogeneity in each treatment group at a significance level of α= 0.05. The study's results in Table 6 indicate a significance value of p> 0.05, indicating that the data is homogeneous. Furthermore, hypothesis testing will be performed to determine the effect provided.

Table 6. Summary of Bartlet Test Calculation Results α = 0.05

Group	dk	1/dk	si2	Log Si	(dk) Log Si
Plyometric 1	9	0.111	0.90	-0.04576	-0.41182
Plyometric 2	9	0.111	1.79	0.252583	2.27325
Conventional 1	9	0.111	1.43	0.156347	1.407125
Conventional 2	9	0.111	0.99	-0.00485	-0.04367

According to the research hypothesis, there is a difference between the results of the sickle kick explosiveness training method in the student group that received the plyometric training method treatment and the conventional training method group. The findings of additional tests in terms of hand-eye coordination of strong legs and low legs are summarized in Table 7.

Table 7. Tukey test of plyometric training method treatment and conventional training method groups in terms of high hand-foot-eye coordination at the α = 0.05 level

Pairs of groups being	Q count	Q table	Conclusion

compared			
Plyometric and conventional exercises	12.96	4.90	Significant

According to Table 7, the price of Q_{count} = 12.96 is greater than Q_{table} = 4.90 or $Q_{count} > Q_{table}$ at a significant level of 0.05. So the null hypothesis (Ho) is rejected and the alternative hypothesis (H1) is accepted, indicating that there is a difference in the results of the sickle kick explosive training method between the student group who received the plyometric training method treatment and the conventional training method group in terms of hand-eye coordination. Based on these findings, it is possible to conclude that the sickle kick explosiveness training method outcomes of the student group who received the plyometric training method treatment were superior to those of the traditional training method group. The outcomes are observed from a high-leg position.

Based on table 8, the price of Qcount = 6.65 is greater than Qtable = 4.90 or Qcount > Qtable at a significant level α 0.05, thus the null hypothesis (Ho) is rejected and the alternative hypothesis (H1) is accepted. Meaning that overall there is a difference between the results of the method of training the explosive power of the scythe kick of the group of students who received the treatment of the plyometric training method and the circuit training method group in terms of hand-eye coordination and weak legs. Based on these results, it provides evidence that the sickle kick explosiveness training method of the group of students who received the plyometric training method treatment was better than the circuit training method group in terms of low hand-foot-eye coordination.

Table 8. Tukey test of plyometric training method treatment and conventional training method groups in terms of low hand-foot-eye coordination at the level of α = 0.05

Pairs of groups being compared	Q count	Q table	Conclusion
Plyometric and conventional exercises	6.65	4.90	Significant

4. DICUSSION

The results of the above examination showed that both plyometric and conventional methods of exercise are equally detrimental to the explosive increase in side-shock power. In-depth, it was stated that exercises using plyometrics resulted in more effective results than practices with

conventional methods. It turns out that this result is consistent with the research conducted by Suchomel et al. (2016), which stated that plyometrics influenced the increased explosive power. As the explanation of this plyometric exercise occurs during the stretching-shortening cycle (SSC), this process converts the potentially elastic energy at the time of contracting into a concentric contraction (Ramirez et al., 2020). Furthermore, more loads of these plyometric exercises will increase the pressure on the ground during the eccentric phase at the time of the SSC and the load on the muscle at the time the muscle performs the concentrated movement of the SSC. At the same time, this will have a better effect on increased explosive power adaptation (Negra et al., 2020). Other speculative evidence is more convincing that inter-plyometric exercise and complex training are excellent for explosive power increases if both are compared to weight training (Behm et al., 2017; Morris et al., 2022; Pardos-Mainer et al., 2021).

Based on the results of the research that has been done, plyometric training is proven to have a better and more effective influence on increasing explosive power. Plyometric training is a type of high-speed strength training that has been extensively studied in young athletes (Zubac et al., 2019). The implications of plyometric training include: 1) positive adaptation of neural drive to agonist muscles; 2) increased muscle activation patterns; 3) changes in muscle size and structure; and 4) optimization in single fiber kinetics (Markovic & Mikulic, 2010). In making an exercise program, the plyometric training method must pay attention to the implementation guidelines so that the training is directed and systematic (Bishop et al., 2012). This is because a coach must know the physical condition of each athlete he is coaching to make a good training program plan, and besides that, the effectiveness and time efficiency of plyometric training must also be taken into account in producing the explosive ability of the sickle kick. According to existing research data, no sports injuries were found in plyometric exercises loaded with 0%–25% extra body weight (Coratella et al., 2018; Negra et al., 2020; Rosas et al., 2016). It is recommended that coaches choose plyometric training loads carefully according to the athlete's special situation.

There are forms of plyometric exercises that can be used, such as jumping up, quick leaps, and box jumps (Arif et al., 2021).. Plyometric training basically focuses on activating the cycle of stretching and shortening quickly to produce maximum power (Subekti et al., 2020). Other research results after plyometric training showed a significant difference in the speed of the sickle kick (Satria et al., 2021; Sudirman, 2015). Research studies conducted by Wang et al. (2023) regarding plyometric training conducted for 10 weeks showed a good impact on increasing the explosive power of the lower limbs. This is different from some previous studies (Hammami et al., 2019; Zghal et al.,

2019). Further research on the application of plyometric training in seniors shows a significant effect on increasing explosive power and muscle contractibility after 8 weeks of training (Zubac et al., 2019). This is because the output produced is greater, namely muscle strength, resulting in a low level of weakness in the elderly (Aagaard et al., 2010).

The results of this study also state that conventional training has an influence on the explosive power of sickle kicks, but not as much as plyometric training. Conventional exercises have an effect on explosive power, this is in line with relevant research conducted by (Che et al., 2022; Zheng & Zhang, 2021), which states that conventional exercises such as half-squatting weight-bearing, half-squatting jumping weight-bearing, and leapfrog provide a stimulus to the lower limb muscles to encourage the development of the strength of the lower limb muscles. In addition, the external pressure exerted on athletes during exercise can also significantly reduce the oxygen content in the athlete's blood, allowing more metabolites to accumulate in the athlete's body during exercise (Liu & Zeng, 2023). The more metabolites accumulated, the stronger the metabolic stimulation transmitted to the athlete's nervous system, and the nervous system will drive more muscle fibers to participate in exercise (Zhou et al., 2021).

The effects of plyometric training and traditional training methods on explosive power vary. More than 10 weeks of training may be good for explosive power development, according to possible data. In general, during a short season, low-load training at high intensity is advised because it does not generate training weariness or influence competition performance (Zhou & Zhang, 2017).

5. CONCLUSIONS

The results of this study illustrate the conclusion that training using the plyometric method is more effective in increasing side kick power in pencak silat compared to conventional methods. Furthermore, it can be concluded that plyometric training significantly develops maximal power capabilities. Based on the results of this study, it is recommended that plyometric training be done either with no load or with a light load with the aim of increasing explosive power in a short training period. Explosive power ability will be effective if you pay attention to the recommended effective duration to increase explosive power for more than 10 weeks. Further research recommendations are recommended to add variables by providing more samples.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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