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Plyometric training and circuit training in terms of eye-hand coordination: how it affects the explosive power of sickle attacks?

Entrenamiento pliométrico y entrenamiento en circuito en términos de coordinación mano-ojo: ¿cómo afecta la potencia explosiva de los ataques con hoz?

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Abstract. Background and Study Aim. The explosive power of sickle kicks is one indicator of the success of an athlete in a match. Where the sickle kick is one of the foot attacks that is often used in martial arts peak fights. Therefore, proper training design is needed to achieve better performance. This study aims to determine differences in the effect of methods exercise plyometric and circuit training methods on kick power scythe in terms of hand eye coordination. Materials and Methods. This research is using experimental method. 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 that a sample of 40 students was obtained. The study was conducted in 14 meetings with a frequency of exercise twice a week. Samples were given treatment in the form of plyometric training and circuit training to increase the explosive power of sickle kicks. The instruments in this study waited for a hand-foot-eye coordination test. Furthermore, the data obtained were analyzed using the SPSS version 26 application. Results. Plyometric exercises and circuit training in terms of high eye-hand foot coordination show a significance value of (.004 < .05). Based on these results provide evidence that plyometric training and circuit training show a significant difference. Next, the results of plyometric training and circuit training in terms of low eye-hand-foot coordination show a significance value of (.003 <.05). Based on these results provide evidence that plyometric training and circuit training show a significant difference. Conclusions. Where these results provide for the fact that plyometric training is better than circuit training in terms of high and low eye-hand foot coordination on the explosive power of sickle attacks. That way plyometric exercises can be applied to increase the invulnerability of sickle kicks. Future research can add n other variables that can affect research results.
Keywords: Plyometric training, circuit training, explosive power, sickle attacks

Resumen. Antecedentes y objetivo del estudio. La potencia explosiva de las patadas de hoz es un indicador del éxito de un atleta en un combate. La patada de hoz es uno de los ataques con el pie que se utilizan a menudo en los combates máximos de artes marciales. Por lo tanto, es necesario un diseño adecuado del entrenamiento para lograr un mejor rendimiento. Este estudio tiene como objetivo determinar las diferencias en el efecto de los métodos de ejercicio pliométrico y métodos de entrenamiento de circuito en la guadaña de potencia de patada en términos de coordinación mano-ojo. Materiales y Métodos. Esta investigación está utilizando el método experimental. Los sujetos de este estudio fueron estudiantes de 4º semestre del programa de estudios de Educación Deportiva STKIP Setiabudhi. La técnica de muestreo utilizada fue el muestreo aleatorio por conglomerados, por lo que se obtuvo una muestra de 40 estudiantes. El estudio se realizó en 14 encuentros con una frecuencia de ejercicio dos veces por semana. Las muestras recibieron tratamiento en forma de entrenamiento pliométrico y entrenamiento en circuito para aumentar la potencia explosiva de las patadas de hoz. Los instrumentos de este estudio esperaban una prueba de coordinación mano-pie-ojo. Además, los datos obtenidos se analizaron mediante la aplicación SPSS versión 26. Resultados. Los ejercicios pliométricos y el entrenamiento en circuito en términos de alta coordinación ojo-mano-pie muestran un valor de significación de (.004 <.05). Estos resultados demuestran que el entrenamiento pliométrico y el entrenamiento en circuito presentan una diferencia significativa. A continuación, los resultados del entrenamiento pliométrico y el entrenamiento en circuito en términos de baja coordinación ojo-mano-pie muestran un valor de significación de (.003 <.05). Basándose en estos resultados, se demuestra que el entrenamiento pliométrico y el entrenamiento en circuito muestran una diferencia significativa. Estos resultados demuestran que el entrenamiento pliométrico y el entrenamiento en circuito presentan una diferencia significativa. Conclusiones. Donde estos resultados proporcionan para el hecho de que el entrenamiento pliométrico es mejor que el entrenamiento de circuito en términos de alta y baja coordinación ojo-mano-pie en la potencia explosiva de los ataques de hoz. De esta forma los ejercicios pliométricos pueden ser aplicados para aumentar la invulnerabilidad de las patadas de hoz. Futuras investigaciones pueden añadir n otras variables que pueden afectar a los resultados de la investigación.
Palabras clave: Entrenamiento pliométrico, entrenamiento en circuito, potencia explosiva, ataques de hoz

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Introduction

Sport is a physical activity that is easily carried out by various groups, including the elderly (Suryadi, Gustian, & Fauziah, 2022). Where physical activity through sports has a positive impact on body fitness (Mashud et al., 2024; Rubiyatno et al., 2023; Suryadi, Suganda, et al., 2023), durability (Hardinata et al., 2023), gross motor skills (Samodra, Suryadi, et al., 2023; Suryadi et al., 2024), and to improve health (Kapoor, Chauhan, Singh, Malhotra, & Chahal, 2022). With good physical fitness it will make it easier to carry out daily life properly (Suryadi, 2022). In addition, sports activities are also one that is needed by the body. This is because with sports activities you will get

physical fitness and performance, so that this can grow your workload properly (Haïdara, Okilanda, Dewintha, & Suryadi, 2023; Supriatna, Suryadi, Haetam, & Yosika, 2023). Based on this explanation, it can be concluded that physical fitness has a positive impact on performance in sports. So it is important to improve achievement, one of the sports achievements is Pencak Silat.

Pencak Silat is a contemporary umbrella term used in Indonesia, Malaysia, and other Southeast Asian countries to refer to hundreds of traditional and modern martial arts practiced either by single players or duels, with or without background music (Hadiana, 2022). Pencak means Search, Silat means Gathering, when the two meanings of the word are combined, Pencak Silat means Searching for Gathering (Sudirman et al., 2022). Then it expanded in all directions. Pencak Silat martial arts in Indonesia itself is referred to as one of the cultural heritages from the ancestors (Sampurna, 2021). Where Pencak Silat is also considered a martial art, because every movement that is considered is art.

Furthermore, a study says that Pencak Silat is a genuine Indonesian martial art that contains noble values (Saputra & Riyoko, 2023). In addition, Pencak Silat also symbolizes the sport of the ancestral assets of the Indonesian nation which has become an icon of unity in oneness in the reflection of the Indonesian nation (Ihsan et al., 2022). Lately, the sport of Pencak Silat has increasingly shown positive developments (Sudirman et al., 2022). This is evidenced by the increasing number of regional, national and international Pencak Silat competitions held. In Pencak Silat sports more emphasis on locking techniques, walking or swinging, dropping, punching, kicking (Saputra & Riyoko, 2023).

The basic technique of kicks in Pencak Silat is often neglected because of the consideration of increasing the athlete's level and not competence or skill (Irawan, 2021). In order to get maximum results in kicking, the explosive power factor of the leg muscles also needs to be considered. This statement is reinforced by previous research which states that in the sport of Pencak Silat, leg muscle explosive power is very important. Where the explosive power of the leg muscles must be trained in earnest because it is the dominant factor (Ihsan et al., 2022). Therefore, a child talent identification program needs to be carried out before carrying out an achievement-oriented training process (Syaifullah, 2020). As with somatotype measurements (Samodra, Gustian, et al., 2023), leg muscle explosive power is also needed (Ihsan et al., 2022), because it can be a reference in providing the right training program.

A previous study in the Province of Banten in Indonesia, in a match the foot attack technique (sickle kick) was the most dominant and was often used to get points (Sudirman et al., 2022). This statement was also reinforced by Amrullah in his research showing that 90% of points were obtained through kick attacks (Amrullah, Dlis, & Hernawan, 2020). So this result gave rise to various opinions among fighters where the sickle kick is an easy kick to learn. But in fact, if you do the sickle kick technique without being accompanied by high speed and good leg muscle explosive power, your opponent will be easily knocked down (Sudirman et al., 2022). As is the case with previous research which says leg muscle explosiveness and flexibility are important in performing sickle kicks (Ihsan et al., 2022).

Based on some of these research studies which provide various responses to the sickle kick technique in Pencak Silat. So it will be important to increase the explosive power of sickle kicks in Pencak Silat martial arts. This of course also aims to obtain good results in a match. Therefore, the right training program is needed to produce good crescent kicks in the sport of Pencak Silat. Where from various previous studies only focused on the effect given (Ihsan et al., 2022). Nevertheless, a limited number of individuals have undertaken a comparative evaluation or identified a potentially more suitable training approach, particularly within the realm of Pencak Silat. Furthermore, this investigation of the crescent kick's explosive power encompasses both high hand-foot-eye coordination and low hand-foot-eye coordination. Hence, this can serve as an additional innovative aspect in this research. Given these issues, the primary objective of this study is to assess disparities in the impact of plyometric and circuit training methodologies on the power of the sickle kick.

Materials and Methods

Participants

This research was conducted at the Setiabudhi Rangkasbitung College of Teacher Training and Education. The subjects in this study were 4th semester students of the Sports Education study program. The sampling process employs the cluster random sampling method, wherein classes are randomly selected to serve as the research sample. Through a random draw, four classes were selected, and from these, two classes were designated as the research sites. This selection considered the students' similar characteristics in terms of age and class training, aiming for proximity or equivalence to the average training outcomes of students in the fourth semester (lV). The results of the drawing of the two selected classes determined that Class A would receive the Plyometric training method, while Class B would undergo treatment with the circuit training method, resulting in a sample of 40 students. Within this research, a group of 20 participants was selected for the high limb explosive power category, and another 20 individuals were chosen for the low limb explosive power category, with each category undergoing either plyometric training or circuit training. Furthermore, the distribution of the treatment groups with plyometric exercises and circuit training was carried out.

Research Design

This study employed an experimental approach, wherein the sample received a designated treatment. The research spanned 14 sessions, conducted according to the university lecture schedule, with training sessions occurring

twice a week. The plyometric training methods encompassed activities such as jumps in place with two-foot ankle hop, standing jump over barrier, multiple hop and jump barrier hop, box drill front box jump, and box drill multiple box to box jumps. Additionally, the circuit training method involved various stations, including squats, pull-ups, abdominal crunches, bar dips, diverse rowing movements, step-ups, speed squats, one-leg squats, jumping lunges, and resistance runs, utilized for the training regimen in each group. Subsequently, crescent kick training was administered. Following a sufficient duration of treatment, the final step involved conducting tests to evaluate the explosive power of the crescent kick on a specific target for all sample participants.

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

When the teste kicks towards the black bag, explosive power is immediately recorded as the amount of action that lands on the black bag, thanks to a "dynamic punch-kick bag with embedded accelerometer". Force (f) per Newton (N) is the unit of impact explosive power. The testing officers consist of 1 (one) signal giver and 2 (two) participants' best distance recorders for three occasions. Furthermore, by using the restest test to find instrument validation, the criteria used to assess validity are considered valid if the correlation coefficient rcount > ftable with a significant threshold ($\alpha = .05$).

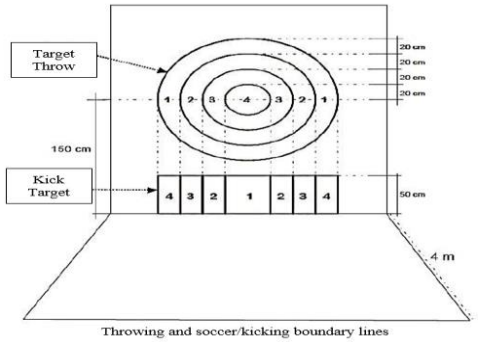

Figure 1. Hand-Foot-Eye Coordination Test

Statistical Analysis

The analysis in this study was carried out after obtaining data on the results of the pretest and posttest crescent kick explosive power. The analysis in this study is through the stages of normality test, homogeneity test and hypothesis testing. Where the hypothesis test is carried out to determine the effect given after being given treatment. Data analysis in this study was assisted by the SPSS 26 application.

Results

The data description of the research results aims to provide an overview of the distribution of data, both in the form of a measure of the location of the frequency distribution. The summary of the results of statistical calculations is as follows:

Based on table 1 above, there are 6 students, or 50%, who get a score of 200-236, then 1 student, or 20%, 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	class intervals	Absolute Frequency	Relative Frequency (%)
1	200-236	5	50
2	237-273	2	20
3	274-310	1	10
4	311-344	2	20
		10	100

According to Table 2, three students (40%) scored 187–217, five students (20%) scored 218–248, and two students (20%) scored 280–310.

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

No.	class intervals	Absolute Frequency	Relative Frequency (%)
1	187-217	4	40
2	218-248	2	20
3	249-279	2	20
4	280-310	2	20
		10	100

Based on table 3 above, there were 4 students or 70% who got a score of 187-219 then 2 students or 20% who got a score of 253-285, then 1 student or 10% who got a score of 286-318.

Table 3.
Frequency Distribution of Circuit Training Method Scores with Coordination Eye Hand Foot Tall

No.	Class intervals	Frequency Absolute	Frequency Relatively
1	187-219	7	70
2	220-252	0	0
3	253-285	2	20
4	286-318	1	10
		10	100

Based on table 4 above, there is 1 student or 10% who gets a score of 149-186, then 6 students or 60% who gets a score of 187-224, 2 students or 20% who gets a score of 225-262. Furthermore, 1 student with a percentage of 10% gets a score of 263-300.

Table 4.
Frequency Distribution of Circuit Training Method Scores with Coordination Hand Eyes Foot Low

No.	Class intervals	Frequency Absolute	Frequency Relatively
1	149-186	1	10
2	187-224	6	60
3	225-262	2	20
4	263-300	1	10
		10	100

Based on table 5, it shows the results of the normality test with the Shapiro-Wilk formula, namely the overall value of p> 0.05, it can be said that the data is normally

distributed. The homogeneity test results for high eye-hand-foot coordination showed a significance value of (.173) and for low eye-hand-foot coordination (.282). These results reveal (p> .05), so the data can be said to be homogeneous. The results can be seen in table 6. Next, we will proceed with a different test.

Based on table 7, the results show a significance value of (.004 <.05). Based on these results, it provides evidence that plyometric training and circuit training in terms of high-hand-eye coordination show a significant difference. Where these results provide the fact that plyometric training is better than circuit training in terms of high eye-hand-foot coordination on the explosive power of sickle attacks.

Based on table 8, the results show a significance value of (.003 <0.05). Based on these results, it provides evidence that plyometric training and circuit training in terms of low eye-hand-foot coordination show a significant difference. Where these results provide the fact that plyometric training is better than circuit training in terms of low eye-hand-foot coordination to the explosive power of sickle attacks

Table 5.
Shapiro-Wilk Normality Test

Results	Statistics	df	Sig.
High Eye Hand Foot Coordination Plyometrics	.954	10	.717
Low Eye Hand Foot Coordination Plyometrics	.909	10	.275
High Hand Foot Eye Coordination Circuit	.966	10	.854
Lower Hand Ankle Coordination Circuit	.883	10	.142

Table 6.
Homogeneity Test Based on CoordinationHand Eyes Foot High and Low

Crescent Kick Explosiveness	Results	Levene Statistics	df1	df2	Sig.
High Eye Hand Foot Coordination	Based on Means	2,014	1	18	.173
Low Eye Hand Foot Coordination	Based on Means	1,237	1	18	.282

Table 7.
Difference Test Based on CoordinationHand Eyes Foot Tall

Results	Variants	F	Sig.	t	df	Sig. (2-tailed)
Plyometric Exercises - Circuit Training Based on High Eye Hand Foot Coordination	Equal variances assumed	1,350	0.260	3,259	18	0.004

Table 8.
Difference Test Based on CoordinationHand Eyes Foot Low

Results	Variants	F	Sig.	t	df	Sig. (2-tailed)
Plyometric Exercises - Circuit Training Based on Low Eye Hand Foot Coordination	Equal variances assumed	9,350	0.007	3,457	18	0.003

The description of the results of crescent kick explosive power using high eye-hand-foot coordination plyometric exercises shows a higher mean value than high eye-hand-foot coordination circuit exercises. The results also show that plyometric exercises with low eye-hand-foot coordination show a greater mean value than circuit exercises with low eye-hand-foot coordination. Based on these results it can be concluded that plyometric training is better than circuit training to increase the explosive power of crescent kicks in Pencak Silat athletes. The results can be seen in table 9 and figure 2.

Table 9.
Descriptive Results of Sickle Kick Explosion

Results	N	Means	std. Deviation	Minimum	Maximum
High Eye Hand Foot Coordination Plyometrics	10	291,40	29,785	250	340
High Hand Foot Eye Coordination Circuit	10	250,50	41,148	191	300
Low Eye Hand Foot Coordination Plyometrics	10	236,40	44,282	149	298
Low Eye Hand Foot Coordination Circuits	10	201,10	18,681	172	240
Total	40	244.85	46,919	149	340

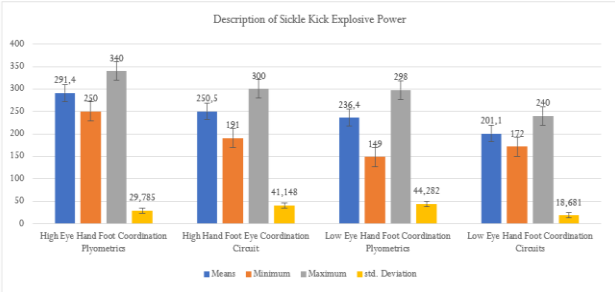

Figure 2. Description of Sickle Kick Explosive Power with Plyometric Exercises and Circuit Training

Discussion

This study aims to determine differences in the effect of methods exerciseplyometric and circuit training methods on kick power sickle. The results of the study provide evidence that plyometric training and circuit training in terms of hand-eye coordination show significant differences. The results also show that the mean value of plyometric training is greater than that of circuit training in relation to the explosive power of crescent kicks. These findings indicate that plyometric training yields superior outcomes compared to circuit training concerning both high and low eye-hand foot coordination in executing powerful sickle attacks. Con-

sistent with previous research, it is established that the implementation of plyometric training contributes to an enhancement in explosive power (Suchomel, Nimphius, & Stone, 2016). This is further supported by additional studies demonstrating that plyometric exercises occurring within stretching-shortening cycles can convert elastic potential energy during contractions into concentric contractions (Ramirez Campillo et al., 2020).

Several other studies, supported by more compelling speculative evidence, suggest that incorporating plyometric exercises and complex exercises is highly effective. This approach results in a substantial improvement in explosive power compared to traditional weight training methods (Behm et al., 2017; Morris, Oliver, Pedley, Haff, & Lloyd, 2022; Pardos-Mainer, Lozano, Torrontegui-Duarte, Cartón-Llorente, & Roso-Moliner, 2021). The accumulated research findings consistently demonstrate that plyometric training is more impactful and efficient in enhancing explosive power. Plyometric training, recognized as a form of high-speed strength training, has been extensively studied, particularly in young athletes (Zubac, Paravlić, Koren, Felicita, & Šimunič, 2019). Furthermore, the development of a plyometric training program requires meticulous attention to implementation guidelines to ensure that the training is both targeted and systematic (Bishop, Smith, Smith, Mcgill, & Bishop, 2012).

Furthermore, a coach must know the physical condition of each athlete he coaches to plan a good training program (Suryadi, Okilanda, et al., 2023; Yogi, Perdana, Supriatna, & Haïdara, 2023). Thus the effectiveness and time efficiency of plyometric training must also be taken into account in producing the explosive power of sickle kicks. According to available 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). Therefore, it is recommended that coaches select plyometric training loads carefully according to the athlete's specific situation. Research suggests there are forms of plyometric training that can be used, such as jumping up, quick leaps, and box jumps (Arif, Aimang, & Nurhikmah, 2021).

The results of this study also stated that circuit training had an influence on the explosive power of sickle kicks, but plyometric training was superior. 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 probable data. In general, during the short season, high-intensity low-weight training is recommended as it does not cause training fatigue or affect competitive performance (Zhou & Zhang, 2017).

Conclusions

The results of this study have a strong foundation regarding exercises to increase the explosive power of sickle kicks. These results have been listed from several theories in the results and discussion. The results showed that plyometric training and circuit training had an effect on sickle kick explosive power, both in terms of high and low eye-hand-foot coordination. The results also show that there are differences in the effect given between plyometric training and circuit training. Where the results of plyometric training show better results compared to using circuit training. However, other factors are no less important in influencing the results of the study. As well as the condition of athletes in carrying out the crescent kick explosive power test. This research has provided additional references to strengthen studies in the sport of Pencak Silat, and of course helps coaches prepare their athletes for achievement levels. Further research is urgently needed to include other variables that affect the results of this study, as well as a wider sample size to validate the results of this study.

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Conflict of interest

There is no conflict of interest.

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