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Speed and power of martial athletes: Does plyometrics affect active-passive recovery?

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Abstract

In addition to good physical and psychological conditions, recovery is another important component that athletes must meet to support success in the field. This study aims to determine the effect of active and passive recovery on plyometric exercises on speed and power. The type used in this study is quasi-experimental. The sample of this research is 44 athletes from Lampung Province who will compete for Pekan Olahraga Nasional (PON) 2021 Papua. The plyometric exercises applied are plyometric exercises (multiple hops and jump variations). After doing the plyometric exercises, active and passive recovery is applied. The speed research instrument is the 30 m sprint test for power using a vertical jump. Analysis of the data used: paired test analysis and independent sample test. The results obtained are that plyometric exercises on active and passive recovery affect athletes' speed and power abilities. Although it affects performance, in the effectiveness test, the speed of active recovery is better than passive recovery. As for power, both of them do not have the level of effectiveness between passive and active recovery. The study's results are expected to be a reference to be included in the training program using the plyometric model with active and passive recovery to support the success of the Lampung Province athletes in 2021.

Keywords: plyometric, recovery, active, passive, martial, athlete.

INTRODUCTION

Plyometric is one of the training methods often used in several types of sports, which is intended to increase the ability of explosive muscle power. In line with this statement, Plyometrics is an exercise model commonly used by athletes from various types of sports to add strength, especially the power/explosive power section (Mirzaei et al., 2013). Plyometrics is an exercise that involves and utilizes the muscle stretch reflex mechanism to increase the efficiency of force production in a joint (muscles,

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bones, and joints) or improve physical work performance (Akbar et al., 2021). Sammoud et al., (2021) explained that the main purpose of plyometric training is to train muscles to produce strength and speed by utilizing shortening and stretching cycles (SSC), when a combination of muscles and tendons is stretched rapidly, as is the case in fast eccentric movements, the nervous system responds by recruiting most of the muscle fibers to produce more power in an attempt to reverse the direction of movement (Derek Hansen, 2017)

Previous literature studies revealed that martial arts often perform high-intensity plyometric training models to achieve success when competing, as described above or before this paragraph. In the line paragraph continuing with this statement, several previous studies related to plyometric exercises (Ioannides et al., 2020) explained that high-intensity sports training using plyometric modalities could improve the performance of MMA athletes' abilities. Akin & Kesilmiş, (2020) revealed that if training using plyometric models in taekwondo athletes can improve strength and balance to kick quickly and change direction, these motor skills are important for success. Pal, A Joginder, Σ, Kalra, & Sindhu, (2020) if the combination of plyometric training models in the application during competition affects the strength, speed, power, balance, and agility of athletes. Training using a 6-week model of specific plyometric training improves lower body strength and strength as well as upper body strength performance in young Karate athletes (Ioannides et al., 2020).

Based on previous findings in both martial arts and other types of sports, many have revealed that plyometric exercises only focus on improving physical performance abilities. The results of the research (Poomsalood & Pakulanon, 2015), Plyometric training for four weeks can be an effective training program to improve agility, speed, and leg muscle strength in basketball players. Taheri, Nikseresht, & Khoshnam, (2014) recommend that plyometric exercises lead to increased power in subjects with rapid strength and speed production and nervous system improvement after eight weeks. Eight weeks of plyometric training added to a standard

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athletic program is likely to increase young athletes' lower limb speed and explosive power (Fischetti et al., 2018). Exercise using the plyometric model can improve lower leg stability (Porrati-Paladino & Cuesta-Barriuso, 2021).

Talking about the plyometric exercise model from the previous literature review, there are still at least found research results related to effective recovery methods in the form of active and passive recovery after doing plyometric exercises. Recovery itself is an important thing in the athlete's training process. (Bompa, 2019) explained that about 50% of an athlete's best performance depends on his recovery ability. For the greatest effectiveness, athletes should use recovery techniques after each training session, and even more so during the special preparation and competitive phases (Bompa, 2019). Thus, it is necessary to consider setting up a recovery model for both active and passive recovery to ensure maximum adaptation of an exercise process (Lorenzo-Trueba et al., 2018). Recovery is a process directly related to the training load used. The coach should try to determine an effective and better recovery method for each training session (Schreiner, 2017).

Based on the discussion and problems seen from the plyometric training model on how to make a recovery after training on the plyometric model. The contribution made from this research is that it is still very rare for research results to reveal and report how the results of active and passive recovery after doing plyometric training models are related to athletes' leg speed and power, especially in the Lampung Region, Indonesia. Therefore, this study aimed to examine the effect of active and passive recovery after plyometric training on athletes' speed and power. The test was carried out during plyometric training on the performance of athletes' speed and power; this study aims to provide information and input in performing athlete recovery after doing plyometric training models to get the athlete's maximum physical condition.

METHOD

Types of research

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This study uses an experimental method with a quasi-experimental approach (quasi-experimental), as explained by (Fraenkel et al., 2012) that the experimental method is a research method that reveals causal relationships between variables that can be tested in research.

Research Participant

A total of 44 Martial Arts athletes participated as a sample in this study. The sample size used in this study was based on the following criteria: (1) athletes participating in the provincial training center program, (2) male, and (3) average age of 21 to 24 years. At the stage of dividing the sample of the experimental group, it was done by dividing it into two experimental groups using an ordinal scale according to the initial test performance rating. Furthermore, experimental group one was given an active plyometric-recovery exercise intervention (PRA; n=22), and the second experimental group was given a passive-recovery plyometric exercise intervention (PRP; n=22). All athletes who participated in this study were informed and informed in advance of the purpose of this study. All procedures carried out in this study were approved by the Indonesian National Sports Committee (KONI) Lampung Province.

Active Recovery

The active recovery method aims to restore energy and gradually reduce muscle fatigue while still activating muscle performance to accelerate blood circulation back to normal. This active recovery method is carried out by active movements with light movement intensity, aiming to restore energy and gradually reduce muscle fatigue while still activating muscle performance to accelerate blood circulation back to normal. This active recovery method is carried out by performing active movements with light movement intensity, aiming to restore energy and gradually reduce muscle fatigue while activating muscle performance to accelerate blood circulation back to normal. The active recovery carried out in this study was by continuing to do light sports activities after the athlete did exercise using Plyometrics for 90 minutes. After heating for 15-20 minutes while practicing material art in sprint test, limb power test, and vertical jump variations of the

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upper and plyometric movements. Active recovery provided in this study, athletes continued to carry out light-intensity sports activities such as cooling down after plyometric exercise.

Recovery Passive

The passive recovery method is a recovery method that is carried out in a state of the body, or the body is not done by sitting, lying, or standing, which aims to restore energy to its original state with complete or total rest. This is to reduce the effects of muscle fatigue, reduce lactate after exercise and return to homeostasis. Passive recovery meant in this study is after athletes perform plyometric sports activities. After heating for 15-20 minutes while practicing material art in sprint tests, limb power tests, and vertical jump variations of the upper and plyometric movements, athletes do not perform additional movements or cool down afterward. The athlete is at complete rest. Passive recovery method given aims to restore energy to its original state with complete or total rest. This is to reduce the effects of muscle fatigue, reduce lactate after exercise and return to homeostasis.

Speed Test - Sprint 30m test

Measurement of speed in this study using the Sprint 30 m test. Before the 30-meter sprint test, athletes warm up and stretch their muscles to prevent injury or muscle cramps (Trigo et al., 2020). The distance from the start and finish lines was marked using a cone, and the researcher used a stopwatch to measure the fastest time the participants got.

Limb Power Test - Vertical Jump

Leg power is measured by measuring the height of the jump, which is done vertically. In doing vertical jumps, athletes immediately do it in the sense that there is no square-off in doing vertical jumps to measure the ability of leg power.

Measurements were carried out in two stages, namely, pre-test and post-test.

Research procedure

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The procedures carried out in this study were plyometric exercises (multiple hops and jump variations) using active exercise recovery and two plyometric exercises (multiple hops and jump variations) using passive exercise recovery. Both groups were given the same treatment for eight weeks (2x per week). Samples are grouped randomly and divided into three groups, including 22 matrial art athletes plyometric experimental group with active recovery and 22 matrial art athletes plyometric experimental group with a passive recovery. In each training session, the experimental group was trained for 90 minutes. After warming up for 15-20 minutes, the experimental group was given plyometric exercises before practicing 15 variations of upper and lower plyometric movements.

Meanwhile, Furthermore, after training, the experimental group was given active and passive recovery for 10-20 minutes after every eight weeks of plyometric exercise. Then after active and passive recovery for eight weeks, the researcher will conduct a post-test to see the results of the active and passive recovery methods and whether there is an impact on athletes or not.

The tests carried out in this study were in the form of a 30-meter sprint speed test in seconds and a power test in the form of a vertical jump test in Watts. Active recovery is rest by continuing to do movement activities using a light intensity of 20-50% of the theoretical standard. Passive recovery is complete rest by not doing any activity after exercise, and passive recovery can be given using relaxation methods. By utilizing active and passive recovery when doing high-intensity exercise, it is hoped that you can see the effect that occurs on increasing speed and power.

Research Data Analysis

For statistical data analysis used in this study, IBM SPSS Statistics 22 software was used with a significance level of $p < 0.05$ using paired test analysis and independent sample tests, which aim to detect or evaluate differences in each variable between groups and find out which one is more effective. On speed and leg power of athletes.

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RESULTS

The study's results will reveal how active and passive recovery is in doing plyometric exercises. The study's results will reveal how passive and active exercise is for speed and how passive and active are for leg power. Once it is known how the relationship and the effect of the two will be carried out, an effective test regarding which recovery is more effective in increasing the speed and power of the legs in athletes in Lampung Province. The results of the study are presented in table 1 below, which contains descriptive research results:

Table 1. Information anthropometric of participants in each group (Mean±SD)

Variable	Experiment plyometric with active recovery (n=22)	Experiment plyometric with passive recovery (n=22)
	Mean ± SD	Mean ± SD
Age (year)	21.8±1.78	21.7±2.53
Height (m)	1.70±0.06	1.71±0.06
Weight (kg)	71.1±13.5	63.8±10.1

After obtaining the anthropometric data, the data from the pre-and post-test results on active and passive Plyometrics. Based on table 1 above, which reveals the anthropometry of athletes, it is found that the average age of these martial arts athletes is 21.8, height 1.70, and weight 71.1 for data on experimental athletes in plyometric training with active recovery. Meanwhile, athletes with passive recovery plyometric experiments got an average age of 21.7, a height of 1.71, and a weight of 63.8 kg.

Table 2. Comparison of average power and speed values between groups

Variable		Group PA				Group PP			
		(Mean±SD)	T	F	P	(Mean±SD)	T	F	P
Power	Pre-Test	68.0±15.5	-1.457	2.124	0.152	66.9±16.8	-2.166	4.692	0.036
	Post-Test	74.2±12.5				77.5±15.8			
Speed	Pre-Test	4.35±0.27	4.731	22.386	0.000	4.38±0.43	2.631	6.922	0.012
	Post-Test	3.89±0.36				4.04±0.40			

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Based on the descriptive analysis of the leg power variable in the active recovery group, the pre-test had a mean value of 68.0 and a standard deviation of 15.5, while the post-test had a mean value of 74.2 and a standard deviation of 12.5. Furthermore, in the passive recovery group, the pre-test had a mean value of 66.9 and a standard deviation of 16.8, while the post-test had a mean value of 77.5 and a standard deviation of 15.8. Furthermore, the descriptive analysis of the speed variable in the active recovery group pre-test had a mean value of 4.35 and a standard deviation of 0.27, while the post-test had a mean value of 3.89 and a standard deviation of 0.36. Furthermore, in the passive recovery group, the pre-test had a mean value of 4.38 and a standard deviation of 0.43, while the post-test had a mean value of 4.04 and a standard deviation of 0.40.

Next, analyze the results of the paired sample test that has been carried out on all variables in the active and passive recovery groups. Based on the analysis results, there is one indicator with a significance value of 0.152 > 0.05, namely the power variable in active recovery. So it can be assumed that power does not significantly affect active recovery. Still, the other variables studied in this study have a significance value of <0.05 so it can be assumed to have a significant effect.

DISCUSSION

Based on the data analysis research data presented in the research results sub-chapter, it is known that plyometric exercises with active and passive recovery both affect speed and power. Although it affects speed and power, the level of effectiveness of the plyometric exercise model on the speed of active recovery is better than passive recovery exercise. Athletes who are given active recovery have more effective speed than athletes who are given passive recovery after doing plyometric exercises. For power, neither one is more effective, even though both affect the performance of Lampung athletes. The effectiveness of active training at speed is based on the side effects caused by the stretch reflex mechanism after doing plyometric exercises. The absence of an effective level that affects power in active and passive recovery is based on plyometric

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exercises on power due to a direct effect, or the main purpose of plyometric training is to train the lower body. The results of the analysis obtained when associated with the theory regarding plyometric exercises have continuity, namely, the nature of plyometric exercises that utilize the stretch reflex mechanism (direct effect) can lead to power so that there is no difference in the level of effectiveness of the active and passive recovery sides. But for speed, the effectiveness level has a difference due to the accumulation (indirect effect) of the stretch reflex during plyometric training. It will greatly impact speed, so active recovery is better for the athlete's speed factor.

The analysis results obtained when associated with previous research studies have several similarities, which state that active recovery has a higher level of effectiveness than passive recovery on speed. Research results, Giboin, Amiri, Bertschinger, & Gruber (2018) explained that active recovery was able to increase the athlete's speed in the running. He continued, although increasing the speed of active recovery does not completely affect muscle performance. Wiewelhove et al., (2018) explained that active recovery is best applied in high-intensity training because it can improve the athlete's movement mechanism in doing speed. There is a difference in the effectiveness of the 100m runner between active and passive recovery. Active recovery affects the speed of athletes running 100 m (Sinaga & Nasution, 2018).

Active and passive recovery is carried out to test the performance level of soccer athletes with the small side games training model. SSG with passive and active rest can be used for soccer-specific aerobic endurance training. Furthermore, all SSGs with active recovery should be performed to improve player and team performance and the athlete's running capacity for the next bout (Arslan et al., 2017). Mota et al., (2017) explained that active recovery presents a higher rate of lactate removal than passive recovery Kaynak, Eryilmaz, Aydoğan, & Mihailov, (2017) explained that the active recovery carried out by volleyball athletes in a 5 x 20 M running exercise with active recovery or rest for 20 seconds was able to improve the athlete's aerobic ability compared to the athlete's recovery or passive rest (Gutierrez-

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Gutierrez，L.，Barrales-Molina, 2018) explained that plyometric exercises performed using active recovery time during exercise were able to increase the athlete's maximum strength and speed. Active recovery is made by stopping for 45 seconds but moving the body before continuing to advanced exercises.

After effective active recovery on speed, the results of another analysis, which revealed that plyometric exercises with passive recovery affect speed, are in accordance with some previous literature reviews. Research result, D'Amico & Paolone, (2017) Passive recovery performed during the 800 M running exercise has an effect on changes in the athlete's direction. Although it has an influence, it does not effectively improve the athlete's performance at his best. Active recovery is one way that is considered effective in reducing muscle tension during exercise so that it can affect the running speed of athletes. Although it affects speed, the effectiveness of active recovery is better than passive recovery in athletes running 100m (Ningsih & Puspitaningrum, 2018). Passive recovery carried out by means of sports massage can help athletes restore endurance to be able to participate in advanced training programs. The sports massage that is carried out can also affect the athlete's appearance (Musrifin & Andi Anshari Bausad, 2018).

Souissi et al., (2020) Passive recovery performed by athletes in high-intensity exercise models is one of the important factors that must be carried out to avoid free radical damage due to continuous exercise. After athletes perform passive recovery, it is expected to be able to provide additional energy to help their best performance. Passive recovery puts more emphasis on external loading so that passive recovery is able to have an impact on athletes by the ability to follow advanced training (Ade et al., 2020). Rubiono & Setiawan, (2020) revealed that doing high-intensity exercise after passive recovery was able to help athletes recover the energy that had been used during exercise. Furthermore, passive recovery can provide encouragement to do other high-intensity sports activities.

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The analysis also revealed that active and passive recovery affected the athlete's leg power ability. Furthermore, the analysis results revealed that although it affected, none of the two recoveries was more effective for the athlete's leg power ability. The results of the study, when associated with a literature review, have similarities which reveal that active and passive recovery affect the athlete's leg power Peake et al., (2017) explained that carrying out an exercise program by making active recovery affects minimizing inflammation and stress responses in muscles after endurance training so that it affects the athlete's performance for advanced training. Active recovery helps rid the muscles of the lactic acid that causes pain and fatigue. It can be done with jogging activities. Active recovery can help to have an effect, i.e., muscle soreness can go away more quickly. It also helps muscles repair damaged tissue (Atradinal & Sepriani, 2017).

The results of previous literature reviews also have issues regarding passive recovery affecting athletes' leg power. In line with this statement, Passive recovery can help improve the recovery of leg muscle strength after plyometric training. And in this study, it is proven that passive recovery using local lower extremity massage affects the recovery of leg muscle strength (Pratama & Roepajadi, 2019). Andriana et al., (2022) revealed that passive recovery carried out by means of water immersion (CWI), and water contrast therapy (CWT) had no effect after conventional resistance training sessions.

Syarifudin & Roepajadi, (2020) explained that there was a significant effect on post-training leg muscle strength by UNESA Ju Jitsu athletes after receiving treatment for recovery in the form of massage on the legs. Massage is an example of passive recovery. Active recovery helps restore performance and improve endurance and leg power of athletes after high-intensity exercise (Bafadal et al., 2021). Dupuy, Douzi, Theurot, Bosquet, & Dugué, (2018) explained that passive recovery has a good effect on recovery in delayed onset muscle pain (DOMS), perceived fatigue, muscle damage, and markers of inflammation after physical exercise. He continued

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that athletes can continue their training program after passive recovery with better and improved endurance, strength, and power conditions.

CONCLUSION

Based on the analysis results, it can be concluded that the active and passive recovery performed after training with the plyometric model affects the speed and leg power of martial arts athletes in Lampung Province, Indonesia. Even though both of these recoveries affect the speed and power of the legs, the effectiveness of active recovery is better than the passive recovery at speed. Meanwhile, the power of these two recoveries does not have prominent effectiveness, meaning that active and passive recovery affect, but neither is more effective when compared to the two. This research can be improved by adding samples and not just focusing on teams being prepared for a championship level. It is hoped that further research can cover more samples and add research variables. The research variables include power and speed. The study results are expected to be a reference for coaches to pay attention to recovery that will affect the performance of athletes. Expected to provide a good recovery when doing exercise models with certain intensities.

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