The effect plyometric training with active-passive recovery for 8 weeks on performance physical abilities male judo athletes

by Taufiq Hidayah

ORIGINAL ARTICLE

The effect plyometric training with active-passive recovery for 8 weeks on performance physical abilities male judo athletes

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Background and Study Aim Judo is a popular sport with dynamic characteristics and requires high physical abilities to achieve achievement. The purpose of this study was to analyze the effects of plyometric exercises with active-passive recovery for eight weeks to improve the physical ability of male judo athletes.

Material and Methods This study used an experimental method. A total of 36 male judoka participated as samples and were randomly divided into three groups. The plyometric experimental group with active recovery (21.8±1.78 years, 1.70±0.06 m, 71.1±13.5 kg), plyometric experimental group with passive recovery (21.7±2.53 years, 1.71±0.06 m, 63.8±10.1 kg), and the control group (21.4±2.30 years, 1.72±0.05 m, 67.4±7.76 kg). The training program was conducted for eight weeks with a frequency of 3 times/week. The experimental group was treated with plyometric training after warm-up, judo training, and post-exercise active-passive recovery intervention. The control group continued regular judo training. The statistical analysis procedure used the ANOVA test to determine the difference and comparison of the pre-test and post-test mean values in the control and experimental groups with a significance level ($p<0.05$).

Results The results showed differences in the average value of experimental and control groups found significant to the VO_2Max endurance and leg power. Meanwhile, no significant difference occurred in left and right grip strength, flexibility, and speed.

Conclusions: The study concluded that plyometric training with active-passive recovery positively affects male judoka's VO_2max endurance and leg power.

Keywords: plyometric training program, active-passive recovery, performance physical ability

Introduction

Judo is a martial art sport that originated in Japan. Judo is one of Indonesia's most popular martial arts sports because it competed in various single-event and multi-event national championship competitions. To get the best achievement or maximum points in a judo match. A judoka must have optimal physical performance resulting from the training process [1]. Periodization of the training program is a strategic step in training process to maintain and control the condition of athletes during training, as well as maximize athlete performance during matches [2]. One component of the martial arts training program is applying appropriate stress levels to optimize adaptation (improvement) and developing various physical qualities of athletes for competition preparation [3]. Thus, the given training program must focus on the load to be given [4], and athletes achieve maximum physical ability because training aims to improve performance based on morphological and functional adaptations [5].

The characteristics of the sport of judo are dynamic and require good physical strength [6]. When practicing or competing, judo athletes need much randori, uchikomi, slamming, and ground techniques to defend and attack opponents [7, 8]. Judo sport characteristics require strength, speed, flexibility, power, VO2Max endurance, and anaerobic also plays an essential role as an energy system to support Judoka performance [9, 10]. In addition, in judo training, there will be an increase in heart rate (HR) which causes instability in body condition. This, of course, requires a proper recovery process and is needed to accelerate the decrease in heart rate after exercise [11]. T.O. Bompa and Buzzichelli [12] explained, their ability to recovery influences about 50% of athletes' best performance.

Recovery is a process that is directly related to the training load used [13]. Trainers must understand the needs, determine effective recovery methods [14], to restore lost energy, and repair damaged muscle tissue systems after exercising [15]. The impact resulting from proper recovery after exercise will increase physical quality; an athlete needs a good recovery process to return his physical condition to its original state [16]. It is still challenging to find an appropriate recovery method that incorporates plyometric training in judo training from previous plyometric training. As stated by Yamagishi [17] that, it is essential to determine recovery methods in the form of active and passive appropriate post-exercise to facilitate maximum achievement, prevent neuromuscular disorders, and plyometric training has been shown to increase the anaerobic power output of athletes [18, 19].

This experimental study aims to analyze the effect

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of plyometric training with active-passive recovery on judoka physical abilities. The involvement of judoka in the scope of study aspect distinguishes it from other studies related to plyometric training with active-passive recovery. This study also aims to provide information and input on the effective use of plyometric training with active-passive recovery to obtain top judoka physical ability performance.

Material and Methods

Participants

A total of 36 experienced male judoka participating in the provincial level training camp voluntarily participated as a sample in the study. Samples were grouped randomly and divided into three groups, including 11 judoka plyometric experimental groups with active recovery (21.8±1.78 years, 1.70±0.06 m, 71.1±13.5 kg), 11 judoka plyometric experimental groups with passive recovery (21.7±2.53 years, 1.71±0.06 m, 63.8±10.1 kg), and 11 judokas in the control group (21.4±2.30 years, 1.72±0.05 m, 67.4±7.76 kg).

Design and Procedure

This research is an experimental study with a quasi-experimental approach design [20]. This study was previously confirmed through ethical stage clearance on the health research ethics commission institution State University of Semarang. To avoid data bias in the study, collecting research data was carried out before and after giving treatment for eight weeks. Data collection instruments were carried out in the form of tests and measurements, including anthropometric measurements (height and weight), VO2Max endurance (multistage fitness test), hand-grip strength (hand-grip dynamometer), body flexibility (sit and reach test), speed (30-meter speed test), and leg power (force plate test) [21,22]. The following describes the procedure for the treatment protocol in the study:

Training Protocol

The judo training program was applied to the three groups for eight weeks (3 days/week). In each training session, the experimental group and the control group were trained for 90 minutes. After warming up for 15-20 minutes, the experimental group was given plyometric training before practicing judo in 15 variations of upper and lower plyometric movements. Meanwhile, the control group immediately did regular judo exercises. Furthermore, after the training, the experimental group was given active and passive recovery interventions for 10-20 minutes. 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. While the 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.

Statistical Analysis

They were testing statistical data of this study using ANOVA test on IBM SPSS V.25 and Microsoft Excel software licensed. The purpose of using the ANOVA test was to compare the average value of each group before and after being given treatment and test the difference in the post-test mean value between the experiment group and control group with the criteria for a testing significance level of $p<0.05$.

Results

A good training program will affect the output of changes in the athlete's physical ability performance. At baseline measurement, there was no significant difference between any of the physical characteristic variables Table 1. Thus, it provided an acceptable homogeneity among the groups.

Comparing pre-test and post-test parameters Table 2. The plyometric experimental group with active recovery and plyometric experimental group with passive recovery resulted in a significant effect comparison ($p<0.05$) on increasing VO2Max endurance, left-hand grip strength, right-hand grip strength, flexibility, speed, and leg power. In the control group, the comparison of significant effect ($p<0.05$) was on the strength of the right-hand grip, while the comparison of insignificant effect ($p>0.05$) was on VO2Max endurance, left-hand grip strength, flexibility, speed, and leg power.

Furthermore, according to parameter difference test post-test results of Table 3. Experimental and control groups showed that the experimental group with active recovery plyometric, plyometric with passive recovery, and a control group make a significant effect ($p<0.05$) on endurance VO2Max and leg power. While the differences

Table 1. Information on The Characteristics of Participants in Each Group (Mean±SD)

Variable	Experiment plyometric with active recovery (n=11)	Experiment plyometric with passive recovery (n=11)	Control Group (n=11)
	Mean±SD	Mean±SD	Mean±SD
Age (year)	21.8±1.78	21.7±2.53	21.4±2.30
Height (m)	1.70±0.06	1.71±0.06	1.72±0.05
Weight (kg)	71.1±13.5	63.8±10.1	67.4±7.76

Table 2. Parameter comparison of pre-test and post-test experimental group and control group

Variable Test	Group	Pre-test (n=11)	Post-test (n=11)	t	p
		Mean±SD	Mean±SD		
VO_2Max Endurance	Plyometric with active recovery	43.9±3.18	50.6±2.02	-7.586	0.000
	Plyometric with passive recovery	49.0±3.70	51.9±2.89	-3.963	0.003
	Control group	46.2±6.66	45.7±6.16	0.837	0.422
Left-hand grip strength	Plyometric with active recovery	39.8±3.24	43.2±2.43	-6.983	0.000
	Plyometric with passive recovery	40.5±3.55	42.9±3.38	-5.157	0.000
	Control group	40.3±3.79	40.8±4.08	-1.376	0.199
Right-hand grip strength	Plyometric with active recovery	42.3±4.51	46.2±5.25	-3.793	0.004
	Plyometric with passive recovery	41.1±4.97	45.9±5.45	-8.820	0.000
	Control group	41.5±4.54	46.8±6.08	-4.537	0.001
Flexibility	Plyometric with active recovery	17.5±3.18	22.6±4.41	-5.916	0.000
	Plyometric with passive recovery	21.3±4.03	23.4±4.60	-3.266	0.008
	Control group	21.7±3.88	21.3±3.52	0.793	0.446
Speed	Plyometric with active recovery	4.59±0.31	4.32±0.43	4.441	0.001
	Plyometric with passive recovery	4.84±0.61	4.47±0.47	4.509	0.001
	Control group	4.68±0.36	4.71±0.31	-0.359	0.727
Leg power	Plyometric with active recovery	71.1±9.45	79.3±15.7	-2.946	0.015
	Plyometric with passive recovery	78.8±13.9	84.8±15.5	-3.854	0.003
	Control group	56.5±8.61	57.1±9.57	-0.715	0.491

Table 3. Parameters of difference in post-test results of the experimental group and control group

Variable Test	Group	Mean±SD	F	p
VO_2Max Endurance	Plyometric with active recovery	50.6±2.02	6.888	0.003
	Plyometric with passive recovery	51.9±2.89		
	Control group	45.7±6.16		
Left-hand grip strength	Plyometric with active recovery	43.2±3.38	1.690	0.202
	Plyometric with passive recovery	42.9±3.38		
	Control group	40.8±4.08		
Right-hand grip strength	Plyometric with active recovery	46.2±5.25	0.072	0.931
	Plyometric with passive recovery	45.9±5.45		
	Control group	46.8±6.08		
Flexibility	Plyometric with active recovery	22.6±4.41	0.707	0.501
	Plyometric with passive recovery	23.4±4.60		
	Control group	21.3±3.52		
Speed	Plyometric with active recovery	4.32±0.43	2.466	0.102
	Plyometric with passive recovery	4.47±0.47		
	Control group	4.71±0.31		
Leg power	Plyometric with active recovery	79.3±15.7	12.145	0.000
	Plyometric with passive recovery	84.8±15.5		
	Control group	57.1±9.57		

are not significant, the effect ($p > 0.05$) is found on the left-hand grip strength, right-hand grip strength, flexibility, and speed.

Discussion

This study was designed through a quasi-experimental design approach which was carried out in a controlled manner. To obtain the best results, the purpose of this study was to examine differences in the effect of VO_2Max endurance, left and right-hand grip strength, flexibility, speed, and leg power of male judo athletes before and after being treated for eight weeks between the plyometric with active recovery (PAR), plyometric with passive recovery (PPR), and control group (GC).

The findings of this study confirm that treatment in the experimental group of plyometric with active recovery (PAR) and plyometric with passive recovery (PPR) resulted in a significant change effect on VO2Max endurance, left and right-hand grip strength, flexibility, speed, and leg power. Meanwhile, the control group (GC) only compared a significant increase in the right-hand grip test results. The findings of this study support the conclusions of previous literature that there is a significant relationship between speed and VO2Max endurance in aerobic and anaerobic energy systems to maximize judo athlete performance and adaptation to fatigue levels [23]. Furthermore, the findings carried out [24, 25] concluded, speed and leg power contribute to movement transfer techniques, fast throws, and handgrip strength; flexibility is needed to regulate an opponent's reach and distance.

This study conducted Çelik and Soyal [26] concluded that strength training carried out for six weeks caused significant handgrip strength and creatine kinase changes in judo athletes, and these changes came from duration scope, frequency, and severity training content. In addition, high-intensity judo training affects changes in heart rate, flexibility, and strength of the neck muscles, and adequate rest after exercise can help prevent injuries to judo athletes [11]. In addition, the findings of this study further confirm that there is a significant difference between the effect of plyometric training with active recovery (PAR), plyometric with passive recovery (PPR), and control group (GC) on VO_{2Max} endurance change and leg power. Meanwhile, there were no significant differences in handgrip strength, flexibility, and speed.

This study results conducted Péter-Zsolt Szabó et al. [27] concluded that repetition speed does not significantly affect the judo training period, and speed is not the main determining factor in judo training. The findings study Logeswaran [28] concluded, strength training carried out for eight weeks resulted in significant changes in the leg power of judo athletes. Furthermore, Franchini et al. [29] concluded that the aerobic fitness profile is essential as a basis for maximal oxygen absorption (VO_{2Max}), good recovery during rest periods, and is relevant to the performance of judo athletes. In addition, recovery can be an effective method in improving the performance of the physical condition of judo athletes, and the post-exercise recovery method currently widely used in judo training is using passive recovery with relaxation techniques that aim to relax muscle tension after exercise [30]. The findings of another study conducted Lesmana et al. [31] concluded that active recovery carried out by reducing 20% to <50% DNM using the walking or jogging method after high-intensity exercise will keep the hormone epinephrine secreted. The hormone epinephrine has a function as a guard for the heart muscle to keep contracting (systole) and not to suddenly decrease the heart's performance. In addition, active recovery by jogging for 10 minutes after doing anaerobic exercise will reduce 31.7% of lactic acid levels in the blood [32].

Conclusions

Based on the results of an analysis that has been carried out, it can be concluded that the ability of VO_2Max endurance, handgrip strength, flexibility, speed, and leg power of judoka men experienced significant changes after being treated for eight weeks. Furthermore, the different test parameters confirmed that the experimental group was given the treatment, and the control group produced a significant difference in VO_2Max endurance and leg power. In comparison, no significant differences occur in handgrip strength, flexibility, and speed. Furthermore, the results of this study are expected to be a reference or reference for coaches to be able to design, implement, and develop plyometric training programs, as well as pay attention to the post-exercise recovery process both in active and passive forms that can affect the performance of judo athletes' physical abilities, and gain performance—maximum during the match.

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Disclosure Statement

The authors declare no conflict of interest.

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