EFFECTS OF PLYOMETRIC TRAINING COMBINED WITH RESISTED SPRINT TRAINING ON SPEED AND ANAEROBIC PERFORMANCE

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Abstract

The purpose of this research was to determine the effects of plyometric training combined and resisted sprint training on speed and anaerobic performance. The participants were 26 males with average age at 18.44 years old, who were studying at sport talented school in Lao P.D.R. The participants were divided into two groups; Experimental group and Control group. The experimental group was assigned to train the plyometric training combined with a resisted sprint together with a regular training program, two days per week, for eight weeks, while the control group was assigned to perform a regular training program in the same period. Data were analyzed by using a basic statistic test and One-way repeated measure to compare differences between two groups. Significance level was set at 0.05. The result revealed that after eight weeks of training, the average speed (40 yards sprint) of the experimental group was significantly different from the control group at 4.92 and 5.11 seconds respectively. The anaerobic performance of the experimental group (483.34 watts and 407.81 watts) was significantly different ($p<.05$) from the control group (419.31 watts and 362.03 watts) in anaerobic power and anaerobic capacity. It could be concluded from the existing data that the plyometric training combined with resisted sprint training could improve speed and anaerobic performance.

Keywords: Anaerobic Performance, Plyometric Training, Resisted Sprint Training, Speed

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Introduction

Nowadays, many kinds of sports require fast-moving with extreme physical strength in a short time known as “Power”, exercising repeatedly and continuously such as sprint running, weightlifting, football, basketball, volleyball. Therefore, athletes of these sports normally use energy from the anaerobic energy system. According to Thanomwong Kritpet (2011) the production of anaerobic energy system occurred by the combustion of glucose and glycogen in muscles to generate phosphocreatine (PC) and adenosine triphosphate (ATP), it was an effective way of energy production in a short period. However, if the activities last from 15 seconds to 2 minutes, then it begin to build up lactic acid in the muscles and blood cells which could cause athletes’ muscles cramped and fatigued.

In order to utilize the knowledge of anaerobic energy system to enhance athlete’s performance, it is important and essential to creatively design a training program to improve speed performance and anaerobic performance, most well - known and popular training of which is called Plyometrics. Chu (1992) mentioned that plyometrics were pieces of trainings or exercises involving strength and speed movement in a rapid manner. Many jump exercises are popularly used in plyometric trainings including a depth jump which focused on the reaction of stretch reflex to increase speed - strength power basing on the belief that a muscle extension to a contraction in a rapid or explosive movement will generate great strength at a high speed. In accordance with Yongsak Na Songkhla (2001) who studied the effects of plyometric exercise at different intensity levels upon speed on 100-meter running found that the 3 experimental groups trained by a regular running program combining plyometric exercise with 2 - footed jumping over different 50 cm, 60 cm and 70 cm high fences had better average 100 - meter running speed than the control group only trained by a regular running program. Moreover, the research showed that the experimental group trained by a regular running program combining plyometric exercise with 2-footed jumping over 70 cm high fences had better average 100 - meter running speed than the experimental groups trained by a regular running program combining plyometric exercise with 2 - footed jumping over 60cm and 50cm high fences respectively.

In addition to plyometric training, the resisted sprint training is one training method for enhancing sprint performance. In previous study of Alcaraz, Palao, Elvira, & Linthorne (2008) aimed to compare the kinematics of sprinting at maximum velocity to the kinematics of sprinting when using 3 types of resisted sprint training devices (sled, parachute, and weight belt). It revealed that the 3 types of resisted sprint training devices were appropriate for training the maximum velocity phase in sprinting. Kawamori, Newton, Hori, & Nosaka (2014) used weighted sled towing, a commonly used form of resisted sprint training, which using the inertia of a sled and the friction between the sled and the ground surface as external resistance to improve sprint acceleration ability. Many researches were continuously studied on the resisted sprint training, Martinez et al., (2015) conducted the research to analyze the effect of sled towing at 10%, 15% and 20% of body mass (BM) on sprint performance and force production during

the acceleration phase. The result showed that a sprint time increase of approximately 5% in 20m and 30m sprint time with 10% BM, and a 10% increase with 20% BM. The Rate of Force Development peak (RFDpeak) with 15% and 20% BM significantly increased when compared to the 10% BM condition.

Therefore, the researcher was highly interested in studying the effects of plyometric training combined with resisted sprint training on speed and anaerobic performance which would be beneficial to improve and enhance the athletes' skill and performance.

Purpose of Research

The purpose of this study was to compare the effects of plyometric training combined with resisted sprint training on speed and anaerobic performance between the experimental group and the control group on Pre - test, Mid - test (4 weeks) and Post - test (8 weeks).

Hypothesis of Research

The effects of plyometric training combined with resisted sprint training on speed and anaerobic performance were different between the experimental group and the control group on Pre - test, Mid - test (4 weeks) and Post - test (8 weeks).

Materials and Methods

Participants

The population of this research were male students of the Sport Talented School in Lao P.D.R. the participants were 26 male students from various sports, they played different natural kinds of sports and used different sugar glycogen dosages who voluntarily participated in the research and passed the test of the criteria. The participants were divided into two groups of each 13 participants using random assignment based on the test scores on speed and anaerobic performance for the experimental group and the control group. All participants were informed about the practices and possible risks of the research. They were requested to fill in the consent form in accordance with the Ethical Committee of the Burapha University (Research project code: Sci 038/2562.).

Table 1 Demographic data of the participants.

Demographic	n	$\bar{x}$	S.D.
Age (years)	26	18.44	2.50
High (cm)	26	167.41	4.84
Weight (kg)	26	57.97	5.44

Table 1 showed the average demographic information of 26 participants with age at 18.44 ± 2.5 years old, height at 167.41 ± 4.84 cm and weight at 57.97 ± 5.44 kg.

Materials

1. 40 - yard Sprint Test (Triplett, 2012).

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2. Running - Based Anaerobic Sprint Test (Draper & Whyte, 1997).
3. Plyometric training combined with resisted sprint training.

Methodology

The control group was practiced with a regular training program of each sport for total of 8 weeks while the experimental group was assigned to train the plyometric training combined with a resisted sprint training twice a week together with a regular training program of each sport.

Every Monday, the experimental group was assigned to perform a circuit training starting by depth jump continuously on 3 boxes of height 40cm (increase to 60 cm and 80 cm in Week 5 and Week 7 respectively), rested for 1 minute, then performed a sprint in place with resistance elastic band for 5 seconds (to count the steps), rested for 1 minute, and then performed a speed bounding 30m (increase to 40 m and 50 m in Week 5 and Week 7 respectively).

Every Thursday, the experimental group was assigned to perform a circuit training starting by Pogo jump continuously on 5 hurdles of height 20cm then jump over 3 hurdles of height 76.2cm (increase to 84 cm. and 91.4 cm. in Week 5 and Week 7 respectively), rested for 1 minute, then performed a sprint 50m with weighted sled towing at 5% of body weight (increase to 10%, 15% and 20% of body weight in Week 3, Week 5 and Week 7 respectively), rested for 1 minute and performed a sprint 20m.

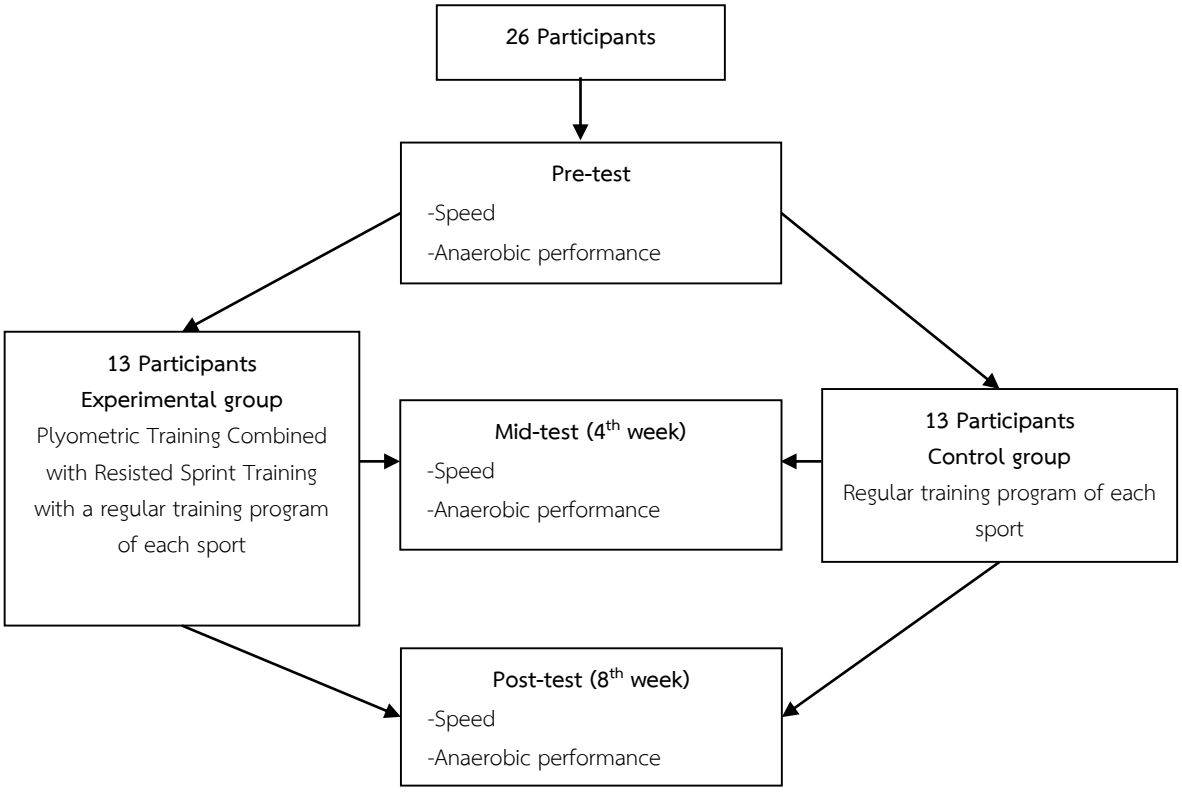

Figure 1: Research Process

Data Collection

According to (Figure 1). The participants' body weight were measured and recorded. The 40 - yard Sprint Test and the Running - Based Anaerobic Sprint Test (RAST) were used to measure the participants' performance. The pre - test was held before training. After the training, Mid - test and Post - test were held in the 4th and the 8th week accordingly. Prior to each test, the participants were required to warm up for approximately 25 minutes: Jogging 5 minutes, stretching 5 minutes, practicing the test 10 minutes, and resting 5 minutes.

Data Analysis

1. The data were analyzed by using a computer program for basic statistics with Mean and Standard deviation.
2. Compare the difference of average speed, anaerobic power and anaerobic capacity between the experimental group and the control group using Independent sample t - test.
3. Statistically significant difference at .05 level ($p<.05$).

Results

Table 2 Average speed (seconds), Anaerobic Power (watts) and Anaerobic Capacity (watts) Pre-test, Mid - test (Week 4) and Post - test (Week 8).

Test		Exp		Cont		Mean diff	SE	t	*p*
		$\bar{x}$	S.D.	$\bar{x}$	S.D.				
Pre-test	SP	5.14	0.364	5.25	0.220	-0.113	0.118	0.958	0.348
	AP	467.24	81.967	471.74	84.609	-4.495	32.672	0.134	0.894
	AC	376.05	63.069	366.32	61.447	9.728	24.422	-0.397	0.695
Mid-test at Week 4	SP	5.05	0.323	5.20	0.217	-0.152	0.108	1.411	0.171
	AP	455.50	99.277	420.42	100.370	35.080	39.155	-0.898	0.378
	AC	351.68	61.121	339.99	58.363	11.683	23.439	-0.492	0.627
Post-test at Week 8	SP	4.92	0.293	5.11	0.164	-0.195	0.093	2.098	0.047*
	AP	483.34	91.882	419.31	60.233	64.030	30.471	-2.100	0.048*
	AC	407.81	59.303	362.03	49.299	45.774	21.389	-2.133	0.044*

* $p < .05$

SP = Speed. AP = Anaerobic Power. AC = Anaerobic Capacity.

Exp = Experimental group. Cont = Control group.

According to Table 2, the mean scores of speed, anaerobic power and anaerobic capacity on the Pre - test and the Mid - test (Week 4) of both the experimental group and the control group had no statistically significant difference. However, the Post - test (Week 8) showed the results that the mean scores of speed, anaerobic power and anaerobic capacity of the experimental group were 4.92 seconds, 483.34 watts, 407.81 watts respectively while the means of speed, anaerobic power and anaerobic capacity of the control group were 5.11 seconds, 419.31 watts, 362.03 watts respectively which had statistically significant differences ($p < .05$).

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Discussion

Speed

According to Sittisak Boonhan (2011) revealed that the main factor of speed was the maximum muscular strength in a suitable level; therefore, it was important for the athletes to practice their muscles resisting with heavier weights. In this study, the plyometric trainings were applied to strengthen the athletes' lower bodies by depth jump continuously on 3 boxes, speed bounding and Pogo jump continuing to hurdle jump. The findings revealed that the speed of the experimental group was enhanced in the 8th week after practicing on the program of plyometric combined with resisted sprint training comparing to the control group who only practiced only a regular each sport training program. Kenney, Wilmore, & Costill (2015) mentioned that plyometrics or stretch - shortening cycle exercise was primarily designed to connect between speed and strength training using the stretch reflex to facilitate the recruitment of motor units. Sedano, Matheu, Redondo, & Cuadrado (2011) determined the effects of plyometric training on explosive strength, acceleration capacity and kicking speed in youth football players after a 10 - week plyometric training program. The findings showed that the experimental group improved in explosive strength transferring to acceleration capacity and kicking speed.

In addition, this study also combined the resisted sprint training by doing a sprint in place with resistance elastic band and a sprint 50m with weighted sled towing. Referring to Kawamori, Newton, Hori, & Nosaka (2014) whose study used weighted sled towing to improve sprint acceleration ability, similarly to Martinez et al., (2015) conducted the research to investigate the effects of sled towing at 10%, 15% and 20% of body mass (BM) on sprint performance and force production during the acceleration phase showing the result of the increased sprint time. Therefore, it could be concluded that the resisted sprint training in this study improved the speed of the experimental group.

Anaerobic Performance

According to Inbar, Bar - Or, & Skinner (1996, as cited in Draper, & Whyte, 1997) anaerobic performance included anaerobic power and anaerobic capacity, it occurred from highly intensive movements in a short period of time. The energy was produced through the combustion of carbohydrates without oxygen. The athletes could use it to build strength, endurance, speed and power. However, it generally was used only for a short burst of activities, otherwise, Lactic acid was produced to degrade muscle functions. Sonthaya Sriramatr (2012) mentioned that athletes could improve their anaerobic performances not to have Lactic acid by increasing CP and ATP into the muscles through training with high intensive activities in a short training period. Karadenizli (2013) conducted the study to determine the effects of plyometric trainings on selected anthropometric characteristics, speed, anaerobic power and flexibility of handball players. In conclusion the plyometric trainings provided significant effects to develop the characteristics of flexibility and anaerobic power on the tested handball players.

This study designed the programs of plyometric training combined with resisted sprint training to practice approximately 25 - 35 minutes consisting of training types, rest interval per training type, rest interval per set and number of training set. The training activities which were high intensity enhanced the anaerobic performance of the experimental group.

Conclusion

The findings of this study showed the significant differences between the experimental group and the control group on the speed and anaerobic performance after using plyometric training combined with resisted sprint training for 8 weeks. It revealed from the existing data that there were positive effects on improving athletes' speed and anaerobic performance.

Recommendations for Further Research

1. Since the samples in this study were limited to particular groups (male students of Sport talented school), therefore, in further studies, it was recommended to determine the effects of plyometric training combined with resisted sprint training to other participants such as sport schools in other countries, sport associations both locally and internationally. So that the result can be generalized.

2. In further studies, it was recommended to apply the plyometric training combined with resisted sprint training program to sports required fast-moving with extreme physical strength in a short time, repeatedly and continuously such as basketball, futsal, sprint running and jumping events, etc.

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