



The Effect of Combined Exercise (Interval and Polymetric) on Some Physical Fitness Parameters in Middle-Age Men

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Original Article

Received: 03.06.2018

Accepted: 06.01.2019

DOI: 10.25307/jssr.430084

Online Publishing: 30.06.2019

Abstract

The purpose of this study was to determine the effect of a combination of interval and polymetric training on some physical fitness parameters in Imam Reza international university employees.

In this semi-experimental study, 24 men age between 30 and 35 years and a body mass index of 25 to 27 kg/m² were assigned into experimental (n=12) and control (n=12) groups. Subjects in experimental group (interval and polymetric training) under went six weeks, 3 sessions per week and each session 60-90 minutes polymetric training at an intensity of 80-85% maximal heart rate. The parameters of the test included: cardio respiratory endurance, anaerobic power, speed, agility, muscular endurance and power were collected before and after six weeks of training. While the control group was prevented from any sport activity and just participated in pre and post-testing. Six weeks of combined training program resulted in a significant difference in cardiovascular endurance records, muscular endurance, speed and agility between experimental and control groups. But a significant difference between anaerobic and power can be found at the end of the period. The combination of interval and polymetric training is affective in improving physical fitness parameters among staffs of Imam Reza international university.

Keywords: Interval training, Polymetric exercises, Physical fitness

INTRODUCTION

One of the consequences of mechanical life and technological progress in this century is movement poverty and reducing physical activity in individuals. On the otherhand sedentary life style increases the risk of mortality and doubles cardiovascular diseases. Regular physical activity as an important behavior for enhancing health, prevent or delay chronic diseases and early mortality (Sharifirad, Mohebi, & Matlabi, 2007). Increasing evidences suggest that regular physical activity leads to enhance mental health, reduce depressive symptoms, anxiety and increase life satisfaction and quality of life (Aghamollaei, Tvafian, & Hasani, 2008). A physical exercise is one of the ways that lead to improve physical fitness levels. There are

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various reasons for doing exercise like strengthening muscles and cardiovascular system, skills acquisition, maintain or lose weight and also for creation.

There are various methods to strengthen systems of body including variety of exercises such as aerobic exercise to strengthen the cardiovascular system, interval training to power the musculoskeletal system and combination of aerobic, anaerobic, and polymetric exercises (Bompa, 1994). Interval exercises are repetition of exercise phases that interrupt with rest stages alternately. These rest stages involve light exercises (Bompa & Haff, 2009). Every muscle exercises that can be combined with jump and the muscle stretch reflexes are used when tested are called polymetric exercises. Polymetric exercises are a normal part of most movements, including jumping, hopping and jogging (Campo et al., 2009). In this type of motion, fast muscles twitch stimulates the muscle spindlereflex. The results of some studies show that doing polymetric exercises are more effective than pure strength training for athletes (Martel, Harmer, Logan, & Parker, 2005). Since in the polymetric exercises, a lot of stress is applied on the neuromuscular system, achievements of polymetric exercises are rather nervous.

To explain the effect of this kind of exercise on the relationship of muscle force and speed can note to increase fire rate and motor units recruitment (Thomas, French, & Hayes, 2009). These movements are necessary to create initial tensions in the muscle to carry out the main movement. In other words, the key element and important speed factor are explosive movements. Polymetric training is method that creates the most favorable relationship between speed and power and, ultimately, consideras explosive power (Singh, Sakshi, & Singh, 2014). Power and muscle power are also considered as key elements of a successful sports performance, to perform daily activities and job duties. Research literature is involved a wide range of assessments including the effect of polymetric movement on athletes and non-athletes, the implementation of aerobic and size of muscle fiber, as well as its effectiveness as a training program standalone or part of the program, combined with aerobic training, resistance training or electrical stimulation (Luebbbers et al., 2003). Some scholars have suggested that polymetric training requires good technical ability and adequate levels of muscle strength and coordination of joint (De Villarreal, Requena, & Newton, 2010). In this context, Fabricius (2011) investigated the effect of various polymetric exercises on agility, power and speed between 52 rugby players aged 15 to 17 years for 7 weeks. Results show that agility was improved more in training in the water, and power and vertical jump in the land; However, the impact of two type of exercises was the same on speed factor (Fabricius, 2011). Dupont and colleagues (2004) examined the effect of 10 weeks, each week two interval training sessions. They concluded that the practice leads to a significant increase VO2 max and reduce the time of 40 meters sprinting (Dupont, Akakpo, & Berthoin, 2004). In contrast, Sassi et al., (2005) compared performance of football training withinterval training and observed a significant difference in aerobic capacity factors, heart rate and blood lactate (Sassi, Reilly, & Impellizzeri, 2005).

The mentioned results reported indicate that parameters of physical fitness and motor physical activity are dependent on the type of activity, but factors such as the intensity and duration of the activities, environmental conditions and the state of physical fitness of individuals have important role (Ross, 2011). In short, in recent years scientific research have been considered to identify the role of practice pattern on the physical performance of athletes and non-athletes. In this regard, variety of ways and special tools has been introduced to increase strength and endurance. Therefore, it's difficult to select the better method between various practice

patterns. It is necessary to provide a clear picture of the new information and provide a simple, logical and personal approach for interval training and polymetric to increase strength, speed and muscular endurance; according to these mentioned study, the present study investigated whether a combination of interval training and polymetric can be traced to the index of physical and motor fitness in middle-aged men.

METHOD

This study was a semi-experimental design with pre and post-test with two experimental and control groups. The sample of this study consisted of 24 participants who were middle-aged with range of 35-45 years man living in the city of Mashhad in 2017 that was selected through selective and targeted sampling method. First, people were familiar with the nature and affiliation to the study. None had any prior history (6month) of drug, smoking or any exercise and completed health inventory. 60 volunteers of the participants completed physical and health questionnaire. After the analysis of questionnaires, 24 were eligible to participate in the study. Subjects participated in the study voluntarily and signed a consent form. In order to evaluate body composition, we used stadiometer Seca (made in Germany) to measure height of the subjects with a sensitivity of 5 mm, hips and waist circumference with a tape measure (Mabys- Japan) with an accuracy of 5 mm, weight 100 g size sensitivity respectively. Body mass index was calculated in kilograms per square meter. The volunteers were assigned randomly into two groups: 1) polymetric training (n = 12) and 2) control (n = 12). The following equation was used to determine sample size:

$$n = \frac{2\sigma^2(Z_{1-\alpha/2} + Z_{1-\beta})^2}{d^2} = \frac{2(2.5)^2(2 + 1.28)^2}{3.5^2} = 10.97 \cong 11$$

In this equation, the power of the test was 0.8, $\alpha=0.05$ and variation of means was 5 units. Based on the estimated equation, a sample size of 10.97 was obtained. For more caution, 24 men including both experimental and control men were selected as the two groups.

Materials and procedure

After talking to subjects to ensure the lack of the diseases: hypertension, diabetes, obesity, atherosclerosis, they were invited to the experimental setup. Then they were informed orally. Then subjects participated in physical and motor fitness tests based on their special program. To assess cardio respiratory endurance (540 m running test), anaerobic power (vertical jump or Sargent), speed (36 m 40 yards), agility (4 × 9 m test), muscular endurance (sit-up test) and power (length jump) was done.

540 meters running:

The distance of 540 meters is determined on the proper surface and the beginning and the end of this distance are determined as the starting line and the finish line. The volunteer is behind the lane, located on one side and travels at a distance of 540 meters.

Explosive Power of Legs by Vertical Jump Test:

First, the trial weight is measured. The athlete is placed side by side with the lined wall and hands up and we highlight the highest possible spot. Now the athlete makes a full power jump vertically and marks the point that hands could touch. The distance between the two points

indicates the athlete's muscular strength. It means the more distance the athlete's more muscular strength.

36-meter sprint test (40 yard):

Each 36-meter trial starts with the word go and completed at the finish line. The time shown by the chronometer records as the rated speed of the trial.

4×9 meters running:

By specifying 9-meter distance and drawing a two-pronged line at the beginning and at the end of this distance, put two small pieces of wood on one side and the person being tested should stands on the other side. With the start command, the athlete must run 9-meter distance with the maximum speed and, by removing a piece of wood, bring it to the opposite side and move on to carry the second stick. Similarly, the athlete should take the 9-meter distance for 4 times as fast as he can. The time between Start and the end is recorded in seconds.

Sit-ups:

In this test, the athlete lays on the back and starts with the start command which is coincides with the push-button of the timer, while lifting his arms to the back and knee joint at a 90-degree angle, raising the head and move the head as close as possible to legs then change to the initial position. This movement is repeated in one minute and the number of times that it is done is recorded as the scale of the measurements.

Jump lengths in place:

Draw a line on the floor and the person should stand behind it. He should jump forward as much his in a linear pattern. The location of the heels to the drawn line is determined the amount of jump. This move is done in two turns and the maximum jump length is recorded. The set scale is considered as the rate of jump length to the height of the person. While the control group was prevented from any sport activity and just participated in preand post-testing

Training program

In this research training group participated in selected combined interval and polymetric exercise with intensity of 80-85% of maximum heart rate for six weeks (three sessions per week, each session 60 to 90 minutes). In the combined interval and polymetric exercise group, subjects settled warm up (stretching, exercise, jogging) for 10 minutes, interval training (35 minutes), running (2 minutes), active rest (2 minutes) 5 times and 6 sessions and in 6 second sessions running (3 minutes), active rest (1.30 minutes), running (2 minutes), active rest (1 minute), running (1 minute) and active rest (30 seconds). In the second part of training program, light polymetric exercises such as some simple movements mutation was used in the first and second week. From the third week onwards, selected exercises like jump diagonally from the hexagonal cones, vertical jump with a barbell, and jump on the stairs were done. Intensity of polymetric exercises using the height, distance and frequency was controlled. The heart beats were considered between 80 to 85 percent of maximum heart rate during polymetric exercises (Nikroo & Barancheshme, 2014). At the end of each session, subjects participated in activities to cool-down for 10 minutes.

Statistical analysis

The data collected were analyzed using SPSS version 16. Normality was tested using Shappirowilk test and homogeneity of variances with Levene test. For comparison of means within and between means groups Paired-Samples t-test and Independent t-test was used respectively. To test the significance level of $P < 0.05$ was considered.

FINDINGS

Table 1. Descriptive parameters of the participants

Groups	Variations (M±SD)			
	Age (years)	Height (m)	Weight (kg)	Body Mass Index (kg/m ²)
Exercise	33.91±4.16	1.74±5.99	80.18±8.66	26.28±3.43
Control	34.91±5.81	1.76±6.57	81.16±8.95	25.93±2.32

The findings of Table 2 showed significant difference in cardio respiratory endurance ($t=2.42$; $p=0.03$), anaerobic power ($t=-4.05$; $p=0.001$), speed ($t=3.38$; $p=0.001$), agility ($t= 3.12$; $p=0.001$), muscle endurance ($t=-5.98$; $p=0.001$) and power ($t=-21.00$; $p=0.001$), in the experimental group compared to the control group. Also, independent t-test results showed changes in mean between groups in cardio respiratory endurance ($t=3.36$; $p=0.001$), speed ($t=2.83$; $p=0.001$), agility ($t=3.08$; $p=0.001$) and muscle endurance ($t=-5.48$; $p=0.001$) variables, and significant difference was observed between the experimental and control groups.

Table 2. Comparison of the first and final values of the participants

Variables	Group(s)	Pre-test M±SD*	Post-test M±SD*	Variations																																																																	
				Within groups		Between groups																																																															
				t	P-value	t	P-value																																																														
Cardio respiratory endurance (ml/kg/min)	Exercise	2.61±0.41	2.43±0.30	2.42	0.03 [‡]	<u>3.36</u>	0.01 [‡]																																																														
	Control	2.64±0.36	2.70±0.35	-1.73	0.09			Anaerobic power (Cm)	Exercise	1.98±0.28	2.03±0.29	-4.05	0.01 [‡]	<u>-1.81</u>	0.07	Control	1.89±0.20	1.90±0.21	0.80	0.42	Speed (S)	Exercise	7.82±1.01	7.49±1.19	3.38	0.01 [‡]	<u>2.83</u>	0.01 [‡]	Control	8.97±0.74	8.94±0.76	0.63	0.53	Agility (S)	Exercise	11.05±1.25	10.26±1.46	3.12	0.01 [‡]	<u>3.08</u>	0.01 [‡]	Control	11.32±1.28	11.26±1.27	0.47	0.64	Muscle endurance (R)	Exercise	32.75±7.13	35.25±7.03	-5.98	0.01 [‡]	<u>-5.48</u>	0.01 [‡]	Control	26.08±7.85	25.33±6.88	2.06	0.05	Power (Cm)	Exercise	2.65±0.11	2.70±0.11	-21.00	0.01 [‡]	<u>-0.81</u>	0.41	Control	2.53±0.11
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*Data presented as mean ± standard deviation

‡The mean difference is significant at the 0.05 level

DISCUSSION and CONCLUSION

The aim of this study was to examine the effects of selected combined interval and polymetric exercise on physical fitness of middle-aged men. Results suggest that six weeks of combined training (interval and polymetric) resulted in a significant increase in cardiovascular endurance record at the end of the training period. These findings are consistent with Hottenrott, Ludyga, & Schulze, (2012). Hottenrott et al., (2012) investigate the effects of interval training with high intensity and continuous exercise on aerobic capacity and body composition. 34 runner participated 12 weeks and 2 sessions (2 hours and 30 minutes) perweeks in their study. They found that exercise resulted in a significant increase in VO₂max from 6/43 to 8/36 ml/kg/minute (Hottenrott et al., 2012). Aerobic exercises increase the number of muscle fibers and muscle cross-sectional area that lead to better blood –transfusion to the muscle; also increase the number and size of skeletal muscle mitochondria that improves muscle oxidative metabolism therefore these changes lead to an increase in muscle aerobic capacity (Short et al.,

2003). The results showed that after six weeks of interval, polymetric training resulted in a significant reduction in speed and agility records among subjects in the end of the period.

The results of this study are consistent with Buchheit et al., (2010). But are inconsistent with the findings of Polhemus and et al., (1980). Buchheit et al., (2010) compared the effects of sprint training versus agility (7 cases), with interval speed training (number 7) on the acceleration and speed for 4 weeks in 3 to 4 sessions of speed / agility and 4 to 6 practice; For example (agility training, start-standing and very short-term, all lasted less than 5 seconds) and the duration of the utilization of passive recovery was 30 seconds to 3 minutes. they concluded that the speed / agility training was influential much more on the record of 10 meters as well as interval exercises was more effective on subjects acceleration. In the interval training sessions include 3 to 5 reps of 30-second with the speed of 40 m and 2 minutes passive rest (Buchheit et al., 2010). Polhemus et al., (1980) study the effect of weight training including the bench press and semi squat on 40 yards sprinting. Training sessions were conducted in 3 weeks and 6 sessions per weeks. They did not find a significant difference in increasing running speed that is incompatible with the present study (Polhemus, et al., 1980). Duration and intensity of exercise during the investigation may be the cause of this contradiction. Most researches include 6 to 8 weeks with rest intervals of 2 to 3 days a week, but this survey was held for 3 weeks and 6 sessions per weeks (Polhemus et al., 1980). Bompa says that every practice should be 48 to 72 hours so that people have enough time to recovery. The reason of contradiction between this study and those of Bompa and colleagues may be subject to intensity and type of exercises than age. Finally, as Bompa and colleagues suggested that adding polymetric exercises to strength training (combined exercises), may be more useful for both upper and lower body than the resistance and static stretching training (Bompa & Haff, 2009).

The results of this research and similar studies show a lot of factors can be effective in polymetric, strength and combined training such as differences in intensity, duration, training protocol and fitness level of individuals. Although there is consensus about polymetric exercises influence, many questions remain unanswered about the effect of this kind of training, especially in terms of neural mechanisms. Neurological measurable parameters such as muscle conduction velocity , electromyography, motor unit recalling and Hafman reflex may change in response to physical activity and the possibility of improving performance as a result of polymetric exercises, including the better use of muscle elastic energy , reducing the sensitivity of the Golgi tendon organ, changes in temporary displacement of muscle activation to move more efficiency, preferred fast motor units recalling, faster nervous shooting and excitability of the motor neuron (Chelly et al., 2010; Chimera, Swanik, Swanik, & Straub, 2004; Cormie, McGuigan, & Newton, 2011) .

Diallo et al., (2001) showed that short-term polymetric exercises among twelve years old boys increases significantly jump performance that occur because of lack of muscle hypertrophy at this age, it was assumed that boost performance is created due to neural factors. Lack of inconsistency may be related to the type of sport, physical fitness level and age. Research has shown that polymetric exercises increase three important features like power, speed and endurance at the same time , as well as strengthen neuromuscular coordination and increases Important physical features such as balance, agility and coordination that have a significant impact on execution speed of sport skills (Bompa, 1994; Bompa & Haff, 2009). The results showed significant increase in the muscular endurance record (sit-up test) and non-significant

increase on the legs muscle power of subjects at the end of the period after six weeks of interval and polymetric training which is consistent to the results of the study of Hosiso et al., (2013).

Hosiso et al., (2013) investigated the effect of 12 weeks of aerobic training on physical fitness in 60 non-active women. The training was consisted of 3 sessions per week for 40 to 60 minutes at an intensity of 55 to 69 percent of reserve heart rate in the morning. They concluded that the running speed record has been significantly reduced as well sit-up records increased at the end of 12 weeks (Hosiso, 2013). Polymetric exercises are defined as eccentric loading immediately followed by a concentric contraction. These exercises have been credited with including neuromuscular adaptations to the stretch reflex, elasticity of muscle. In addition, the external force applied by the water resistance, body weight and gravity activates stretch-shortening cycle and thus strengthen concentric contractions. Typically an increase in power output polymetric exercises can be done in two ways; fast muscle stretch leads to activate stretch reflex and afterward increasing muscle tension and releasing saved energy in elastic elements of muscle which add concentric contraction. Polymetric exercises improved subjects performance by shortening the amortization phase and reduce the electromechanical time between eccentric and concentric phases with increasing force production (Masamoto, Larson, Gates, & Faigenbaum, 2003). The findings showed that 6 weeks of selected combined training (polymetric interval), (3 days per week, for 60 to 90 minutes) has a significant effect on physical fitness factors such as cardio-respiratory endurance, agility, speed and muscle endurance. In this context, if combined training carried out under standard condition, it may have a positive effect on running speed, agility, muscular endurance, and improves subject record. The opposite results are probably due to differences in the physiological conditions of the participants, the health, duration, type and intensity of exercise, and nutritional status. Limitations of this study include lack of lifestyle control (sleep, rest and extracurricular activities), genetic and physiological features, and adaptive responses to physical activity, low number of trials due to the withdrawal of some of them from participating the current trials.

Inferential Findings

Therefore, it is expected that doing selected combined exercises six weeks and 3 sessions per week (with suitable intensity and duration) lead to improve individual's performance interestingly.

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