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Acute effects of one session of combined poloyometric and special karate fitness test on physical performance in male karate athletes

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ABSTRACT

Karate is one of the most popular sport in the world which has a lot of fans, to achieve its training goals karate require special physical features such as flexibility, strength, power, agility and Explosive power of arms and legs. This study attempts to investigate the impact of polyometric exercise in helping the athletic performance of karate players. The investigations suggest that the polyometric exercises cause the improvement of sports performance and it recently has been used widely for the rehabilitation of injured athletes [13]. Polyometric exercise is one of the latest methods of training used to increase explosive power, speed and vertical jump in sports. Polyometric exercises are in fact related to the process of stretching and shortening of the muscle [22]. A muscle that is pulled can exert more power than the muscle which is not pulled. Short-binding contraction that takes place immediately after a lengthening contraction utilizes the energy of flexibility that is stored during pulling. The use of this flexibility energy, in turn, generates more power within a shorter time period which causes an increase in explosive power of the muscle [24]. Polyometric exercises is a proper method, on the one hand, that can enable educators to increase the players' explosive power of the muscles in situ vertical jumping, reaction and agility and so on, and on the other hand they can decrease players damages that may happen during practice or competition. Research shows that the domain of joint reaction increases with depth jump [6]. Meyer et.al have shown that in addition to increasing vertical jump performance and aerobic feet performance, polyometric exercises can also prevent knee injury while landing [18]. Blank states that although players can increase their muscular strength and endurance through bodybuilding and fitness exercise, educators need more specific exercises to increase explosive strength of leg muscles and coordination between nerves and muscles [2]. These exercises include standing up and starting that can help individuals' agility. Several studies have been conducted on polyometric exercises. Conroy (2005) and Wilson (2004) listed exercise press, basic strength, explosive power of the muscles and the expansion of motion domain as the effective factors in polyometric exercises [7, 29]. In a study Massamoto et.al compared the effect of a session of Polyometric exercise on the maximum performance of leg squat (1RM) in male athletes they performed Lanzhe movements and deep jumping in 2 separate sessions in 3 sets, 30 seconds before attempting 1RM. The results showed that doing polyometric exercises (deep jumping) rather than Lanzhe movements before attempting 1RM can improve squat performance in male athletes [19]. Studies that investigate the impact of polyometric exercises are not so vast in the country. Shahdadi (1378) investigated the impact of these exercises on the explosive power and acceleration changes of the handball players (3) and Adibpur (1381) studied the effect polyometric exercises on anaerobic power, vertical jump, and some structural characteristics of girl basketball players and they have shown a positive impact of these exercises. Polyometric exercises do not require the use of certain facilities and this can clarify the importance and necessity of this type of exercises for sports coaches [1]. Polyometric exercises can be practiced in various methods, including: Jumping on or jumping over the bench down and vertical jump, triple jump, pair jumps and Madison Ball throwing in any direction (Blair 1990). Polyometric movements should be started with light strikes in ages between 14 to 16 years and gradually by getting stronger and dominant, hard and intensive Polyometric movements can also be prescribed. From a practical point of view, the intensity of

the Polyometric movements is divided into 5 categories. Iterations and offered courses are special for and advanced athletes and cannot be prescribed for beginners. Post-activated potential (PAP) is a common technique which is used to increase the power and efficiency after practice and competition [23, 15]. PAP is a phenomenon that previous contractions cause an increase in power generation and secondary power efficiency beyond the basic level [25]. Isometric, dynamic and throwing or polyometric contractions in maximal and submaximal levels that are used to make PAP, all cause an improvement in the athletic performance of the upper and lower part of the body. An acute increase has been observed in dynamic activities of some athletes after resistance exercises; however, there is little information about the effect of polyometric exercises as an exercise stimulating factor. In addition, fewer studies have examined the effects of PAP on athletes' exercise performance and fewer studies have compared the impact of different exercise methods, especially polyometric exercises along with specific exercises on athletes performance after such exercises, also because in karate the person needs to produce more power and fast movements of the body parts to perform acrobatic techniques and continuous jumps to succeed in the competition and exercises. Therefore, considering the points mentioned by the authors, this question comes up that whether the inclusion of polyometric exercises in the athletes' karate exercising program is going to be followed by an increase in physical potential or not? In this study it is assumed that doing polyometric workouts along with specific exercises of karate rather than doing specific exercises alone, causes some changes in some physical performances (vertical jump, aerobic power of the legs, explosive power of hands and agility). Therefore, this study investigates the effect of polyometric exercises along with specific karate exercises on physical performance after the exercise.

Table (1): The strength level of Plyometric movement

Intensity level	Type of movement	Intensity amount	Number of repetition and courses	Number of repetitions per session	Breaks between courses
1	Jumps with sudden jerks from height of more than 60 cm	maximum	5-15#3-25	50-250	3-5 min
2	Falling- jumps from height of 80 - 120 cm	very high	5-15#5-15	75-150	5-7 min
3	Hopping exercises -Pairs of legs - Single leg	sub- maximum	5-15# 3-25	50-250	3-5 min
4	Light reaction -jumps from height of 20 - 50 cm	medium	10-25#10-25	150-250	3-5 min
5	low-impact throw or Jumps – done persistently – by using Tools	light	10-15#10-30	50-300	2-3 min

MATERIALS AND METHODS

The study population, consisted of 22 male karate experts from Jolfa city/ Iran, with an experience of at least 2 years applicable practices. Out of the 22 people, 9 individuals (average Age of (Yrs.) : 15.57± 1.9 ,Weight (kg): 57.9± 11.1, Height (cm): 165 ± 9.02, Fat percentage: 8.32 ± 2.4) were randomly selected.

Participants (subjects) after having completed a testimonial, participated in this study, while being justified about the process to be done in three sessions , with interval of 2 days . In the first session, height and weight and fat percentage of the subjects were measured, as having them & their parents to complete a letter of consent and get them all to know about research plan. All the subjects, in the second session, after 5 minutes warming up and stretching movements took some of the functional tests , such as Madison balls throw of a 3 Kg ball to measure the power of hands , calculation test of number of the vertical jumps done within 60 seconds to measure anaerobic power of feet, calculation test of the vertical Jump length to measure explosive strength of legs and agility test of 4 x 9 with a break of 2-3 minutes between tests.

The Subjects after 1-2 minutes of rest, performed some specific karate practice (SP) for about 45 minutes . Immediately after the above exercise, all the subjects took the above tests within 5 minutes. Also In the second session, after combining exercises (PL + SP) (Plyometric + specific) , some functional tests were taken by all the subjects before and after the exercises.

Plyometric exercise, consisted of reaction jumping out of a box with height of 80 cm, rating jump over obstacles with pair of legs, peripheral jumps over a cone and Madison Ball standing throw off the chest from the foot and sides to the opposite direction. After performing plyometric exercises, the subjects did specific karate practice and finally in 5 minutes for all participants the tests were listed. In order to compare the subjects' mean test results from two sessions, there was used a T dependent test (Paired T - test) .The selected level was to show a statistically significant difference of ($p \leq 0.05$). For statistical computing, they used statistical software SPSS 16, however; EXCEL / Microsoft office software was used to draw charts.

RESULTS

Before statistical calculations and difference determination between two sessions, an exercise has shown that no significant difference has been observed before practical sessions. The results of dependent t test show that the average of vertical jump and the length of ball trajectory were almost constant in two kind of exercises (tables 2 and 3, diagrams 1 and 3). Also this test shows that time average of 4*9 meter running has non-significant decreasing after doing exercise in methods SP and PL+SP than before it and we see this decreasing more in doing exercise PL+SP (tables 2 and 3, diagram 4). But the number of vertical jumps in exercises PL+SP and SP has increased than before it and this increasing was significant statistically in exercise PL+SP ($p \leq 0/05$) (tables 2 and 3, diagram 2). Also the results of dependent t test show that average difference has non-significant in two kind of exercises before test and after it in variables vertical jump, length of ball trajectory and 4*9 meter ($p > 0/05$). But average difference has increased significantly before test and after it in variable number of jumps in doing exercise PL+SP in comparison to SP ($p > 0/05$) (table 4).

Table 2: Results of correlated t-test for comparison of functional changes mean before and after practice in PL + SP method

Functional variables / Practicing phase		Vertical jump (cm)	Number of Vertical Jump in 60 seconds	Length of throw trajectory (m)	4*9 m (S)
Before practicing	Mean	40	32	5.79	9.93
	Standard deviation	4.8	1.73	0.93	0.5
After practicing	Mean	39.78	*45.42	6.008	9.88
	Standard deviation	4.47	4.68	0.99	0.6

Table 3: Results of correlated t-test for comparison of functional changes mean before and after practice in SP method

Functional variables / Practicing phase		Vertical jumping (cm)	Number of Vertical Jumping in 60 seconds	Length of throw trajectory (m)	4*9 m (S)
Before practicing	Mean	40	33	5.84	10.05
	Standard deviation	7.48	1.29	1.01	0.41
After practicing	Mean	39.87	34.71	5.9	10.03
	Standard deviation	8.09	4.3	0.84	0.68

Table 4: Results of independent t-test to comparing post-test - pre-test mean difference in two practicing methods

variable	Statistical index / Practicing method	Mean and standard deviation	Amount of independent t	P value
Number of vertical jumping in 60 seconds	PL+SP	5.8±13.42	3.65	0.01*
	SP	4.27±1.71		
4*9 m test	PL+SP	0.38±-0.05	-0.125	0.9
	SP	0.43±-0.025		
Trajectory length of the ball	PL+SP	0.73±0.21	1.17	0.28
	SP	0.44±-0.061		
In situ vertical jumping	PL+SP	3.16±1	0.77	0.46
	SP	3.45±0.28		

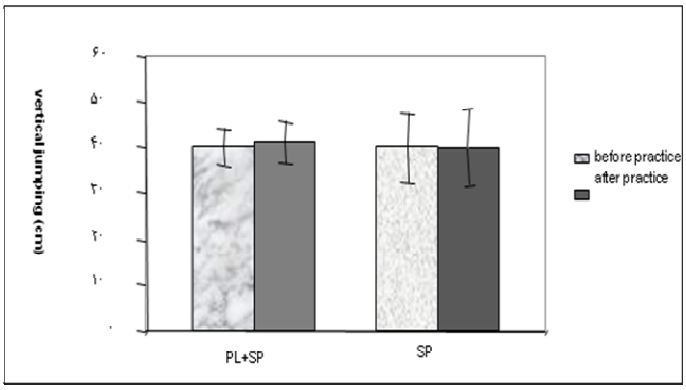

Figure 1. Average of vertical jumping before and after practicing

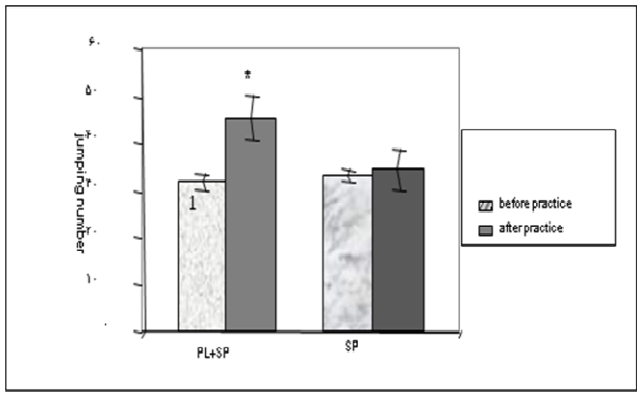

Figure 2. Average of jumping number before and after practicing

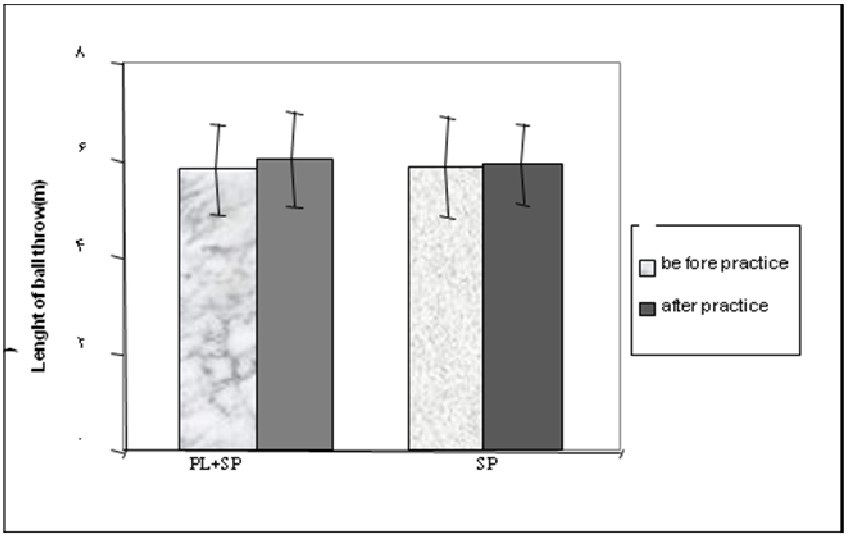

Figure 3. Average of length of the ball throw before and after practicing

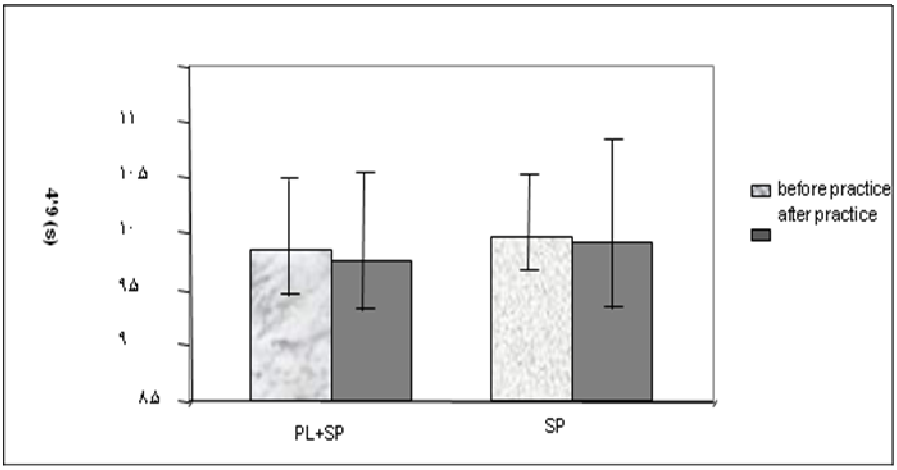

Figure 4. Average 9 * 4 meter before and after practicing

The results of the study showed that polyometric exercises along with specific exercises is an effective way that karate players can increase their anaerobic power of the legs after the exercise. In this study, the polyometric exercises along with the specific exercise has caused a significant change in the number of the jumps than the specific exercise, but in the variables of the vertical jumping, the distance of the ball throw and 4*9 meter had no significant change. The content of the exercise used in these exercises was performed at an average level to avoid neuromuscular fatigue [7]. It is recently reported that the potential created after the activity related to the sudden

increase of muscle torque generated by the muscle contractions after the exercise. Tetanic contractions and voluntary isometric contractions are the cause of increase in muscle torque [5]. Studies have also shown that the burst of PAP after the exercise is due to the increased phosphorylation of the light Myosin arms of the contraction chords [9]. An increase in violent muscle contractions during warming up or during the exercise may have a positive effect on neuromuscular performance after the exercise [16]. Boudray and Douchatief (2004) reported that the maximum potential produced after the activity which included the introverted and extroverted contractions had returned to its original state after periods of 7-10 minutes [4]. Teal et al showed that the running speed of 10 meter and 20 meter in 4, 5 and 6 min after the exercise were equal as well as the vertical jump height at 7, 8 and 9 minutes after the exercise, followed by a dead lift movement (maximum 5 repetitions) Lanzhe (5 repetitions) and isometric contraction of the knee (3 repetitions in 3 seconds) were the same at any given minute [27]. Miyamoto et al reported on a study that the power torque was increased until 5 minutes after the activity [17]. Therefore in this study all the tests were done within 5 to 6 minutes after the exercise. The results of the recent researches conducted by Yang et al [28]showed that doing a set of squat with five repetitions has shown a significant increase in the number of vertical jumps. It is believed that the increase in the number of jumps caused by the polyometric exercises may be caused by the stimulation of the central nervous system so that the athlete can do many explosive movements [21]. Despite the possible similar mechanisms such as: increased motor neuron stimulation, the way of using motor units, or the increase of synergistic activity (or a combination of the above items) induced by exercises [16, 10] in this study, no significant difference in the vertical jump, 4*9 meter and the distance of ball throw was observed so that this finding is consistent with the findings of Teal e. al. and Cooke et. al. In their studies they showed that the polyometric exercises and the dynamic and static contractions for the knees did not have any effect on the vertical jumping and the agility of the subjects. A number of studies have investigated different methods to increase power after the activity [25, 15] and few studies have investigated the impact of polyometric exercises along with the specific exercises related to a specific sports so that only Mireka et al (2011) have investigated the effect of an exercise session which was a combination of (polyometric + specific) exercise and the specific exercise on the number of Madison ball throw and the distance of ball throw in 8 male Judo players. They showed that the total number of Madison ball throw in the combined exercise had a significant increase than the specific exercise immediately after the exercise but no change was observed along the throwing distance. The results of this study offer that polyometric exercise before specific exercises could improve anaerobic power of the hands [20]. Although studies have shown that the increased power production after the activity improves athletic performance (Baker, 2003; Chatsopolos et al, 2007; Georgeolis et al, 2003) several researches have shown that the explosive power followed by the application of various exercises with different rest times after the exercise had no significant effect on the subjects who were on different ability levels and even have caused a slight decrease in the performance [26]. Conflicting results have been observed by Esform et al in the total number of jumps followed by polyometric exercises in subjects who had an experience of anaerobic exercise, the participants' fitness, experience and sport subject, age and the method of exercising could be the reason for this discrepancy [12]. In the research conducted by Charylos et al (2011) they investigated the impact of isometric contraction (3 sets of 3 seconds) and polyometric exercises (3 sets with 5 repetitions) in the bench press and leg press exercises on upper and lower part of the fencers' body. They showed that polyometric exercises had no effect on the lower part of the body's power (number of jumps) and the power of the upper part of the body (the number of throws in the bench press), immediately after the exercise but the isometric contraction has caused a reduction in the power of the upper part of the body but the power of the lower part hasn't changed, which was due to neuromuscular fatigue. The results of this research suggest that if the goal is to increase anaerobic power of the lower part of the fencer's body they should avoid isometric contraction activities [8]. Khamuyi et al have shown that variables of vertical jump, reaction speed, speed of the strike and the jumping speed had no significant change after performing the squat movement with the repetitions of 2, 3, 4 and 5 at 85% 1RM [8] also Scott and Docherty didn't observe any significant change in the vertical jump and long jump after a squat movement with the intensity of 5RM [11]. Unfortunately, in this study, as in other studies [12], the EMG activity of the muscle was immeasurable because of the polyometric exercise for the mechanic of optimal performance to be detected in the pulling cycle and muscle contraction [19]. However, the present research suggests that probably doing polyometric exercises before the specific exercises improves anaerobic power of the legs in male karate players.

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