Comparison of the Pattern of Weight Training on Muscle Strength and Endurance in Karate Men

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Abstract: Some studies performed weight training for improvement physical fitness in martial arts. The purpose of this study was to compare weight training with two loading patterns (double pyramid and reverse step) on muscular strength and muscular endurance in karate men. The subjects who have experienced six years in karate are participated voluntarily. These subjects have been divided randomly into three groups: double pyramid group, reverse step group and control group. Characteristics of subject: double pyramid group (age: 20.55 ± 2.62 years, weight: 73.45 ± 11.17 kg and height: 176.86 ± 5.04 cm), reverse step group (age: 20.50 ± 3.92 years, weight: 75.35 ± 11.24 kg and height: 178.90 ± 9.24 cm) and control group (age: 21.36 ±4.65 year ,weight: 75.77 ± 6.07 kg and height: 178.64 ± 4.67 cm). All subjects performed weight training during eight weeks. Data were statistically analyzed by text dependent, analysis of variance and tukey test with a 0.05 significant level. The result shows that a program of weight training double-pyramid method significantly increases muscular strength and muscular endurance, while a period of weight training reverses step method only significantly increase muscle endurance but no change in muscular strength is observed. The coaches are recommended to use a double pyramid method to improve muscular strength and muscular endurance training with regard to training load for preparing their athletes.

Key words: Weight training, double pyramid, reverse step.

1. Introduction

Karate means empty-handed consisting of two words: “Kara” means empty and “Te” means hand and is basically establishing on two-way hooks of hand and foot using the direct movements. The number of participants at martial fields has rapidly been increasing during the last 10-15 years. It has been estimated that currently 8 million Americans have activity in one of the martial sports styles every day and the tendency of people to this field is increasing [1]. Physiological advantages of martial sports have been reported, and these advantages are as follows: increase in strength, power, balance, flexibility, improvement in cardiovascular readiness and also internal and social positive effects such as reciprocal coordination and respect [2, 3]. A lot of topics are related to resistance training for improvement of body operation [4], which are pointed to lateral effects of resistance trainings and have reported that resistance training play a key role on improvement of athletic operation through increasing the muscles strength, power, speed, hypertrophy, muscular strength, motive performance, balance and coordination [5, 6]

The most important factor in designing of training by weight is consideration to the primary variables such as intensity and volume of training [7]. Through suitable changes of the variables of a training plan by weight such as type of training, numbers of sets, selection of strength, number of repetitions and relaxation between training courses, we may plan various programs for people with different fitness level [8, 9]. Fish et al. [10] compared two methods training pyramidalical and reverse pyramid. It was
reported similar increment in 1 RM (repetition maximum) and 10 RM strength, while some of the trainers support the simultaneous use of different loads instead of using fix loads [11]. Although using the constant load in each turn will cause favorite load and tension on muscle, but this method with constant load and low repeats in each turn, may prevent the stimulation of effective practice [2]. On the other hand, using the fruiting pattern with a gradual increase of load from one turn to the next turn and increment of the number of repetition in turns with less loads that will be accomplished with increasing in TUT (time under tension) of an active muscle, through high tiredness may increase the effectiveness of training [13]. Additionally, applying the various loading in each time is in the same direction of strength training with the principle of “Training Variety” and will preserve the training motivators [14].

Some researches and studies have indicated that similar weight of 80% to 85% for 1 RM and more will have more effect in increment of maximum dynamic strength [15, 16]. Training at this limitation of weight load causes to apply maximum muscular fibers and specially increases 1 RM strength [17]. The amount of training’s effect for increment of muscular strength depends on the type of training system applied in training by weights [5]. Faigenbaum et al. [18] compared two training groups: one of them fulfilled with high intensity, 6-8 repetitions with heavy weights and the middle group with one step 13-15 repetitions. Finally, 1 RM strength in both training groups indicated significant increment with control group, but the difference between two training groups was not significant.

Therefore, the main factor of success in strength trainings in any level of fitness or age is design of a suitable plan. Success in every program depends on some factors such as individual efforts, principal and planned structures, and suitable training motivators. There are numerous ways to fulfill the strength trainings, establishment and increment of training motivators for sportsmen. Therefore, we can plan a suitable program through fulfillment of some changes in each training variables with consideration to its special objectives [19]. One of the best methods for increment of muscular strength is increasing resistance trainings [9]. Progress in this type of training is a dynamic phenomenon that needs to submit a suitable sport plan, evaluation of training progress and intelligent development of training in order to gain objectives [19]. Nowadays, there is deeper understanding on strength training through numerous studies. Strength training is an effective method in increasing of muscular readiness, too. Strength trainings is a type of public sport that has been developed by national organizations of health such as ACSM (American College of Sport Medicine) and AHA (American Heart Association) for many people consisting of adolescences, health adults, old men and patients (with cardio-neurological and muscular diseases).

In recent decades, the researchers have been trying to find an optimal load for effective on strength, endurance and hypertrophy in weight training [20, 21]. The researchers have gained incoherent results, too. Most of the studies have reported that gain of strength will decrease the amount of risk-acceptance in sportsmen [21, 26, 27]. However, less study have examined the effects of different load on increases strength. Therefore, the objective of the present research is to compare two training templates by weight (double pyramidal and reverse step) on muscular strength and endurance among sportsmen in karateka.

2. Research Methodology

The present research is semi-experimental that pre-test and post-test research plans with control group have been used therein. The objective of this research is to study the effects of two different templates of training by weight (double pyramidal and reverse step) on some indexes of bodily readiness
among the sportsmen in karate. The testable samples have randomly been divided into three groups: double pyramidal (10 persons), reverse step group (10 persons) control group (10 persons). Specifications of testable samples: double pyramidal (age: 20.55 ± 2.62 years, weight: 73.45 ± 11.17 kg, height: 176.86 ± 5.04 cm); reverse step group (age: 20.50 ± 3.92 years, weight: 75.35 ± 11.24 kg, height: 178.90 ± 4.67 cm) and control group (age: 21.36 ± 4.65 years, weight: 75.77 ± 6.07 kg, height: 178.64 ± 4.67 cm) that have trained by weights for a period of eight weeks. Descriptive statistics (average and standard variance of variable) and perceptive statistics (T-correlation) and variance analysis (ANOVA) and Tokey Pursuing Test ($P < 0.05$) were used. Plan of strength trainings commenced after primary measurements and the testable samples have been training for a period of two months using two selected loading templates. The strength trainings program consist two following training protocols.

The first group has been training using the double pyramidal protocol with consideration to Table 1. In the first time, with 80% of 1 RM, they fulfilled four repetitions and thereafter, weight of training gradually increased. In each step, 5% was increased to the weight of training to reach a movement with 95% weight. In this step, the weights decreased and number repetition increased to reach a gain to the 80% with four repetitions. Totally, each muscle in double pyramidal trained 8 times [15].

The second group trained using the reverse step protocol with consideration to Table 1. The weight of training increased after fulfillment of a set with two repetitions with 90% of 1 RM, in the next two sets, number of repetitions increased and the amount of weight decreased. Then at the beginning of the 4th set, the weight increased two times in such a way that reached its primary amount, means 90% with two repetitions and after fulfillment of each training turn, the testable samples relaxed between 2.5 min and 3 min [15].

<table>
<thead>
<tr>
<th>Load (%)</th>
<th>Repetitions</th>
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<tr>
<td>80</td>
<td>4</td>
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<tr>
<td>85</td>
<td>3</td>
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<tr>
<td>90</td>
<td>2</td>
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<td>95</td>
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<td>90</td>
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<td>85</td>
<td>3</td>
</tr>
<tr>
<td>80</td>
<td>4</td>
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The participants fulfilled six trainings of bench press, leg press, barbell curl, lying leg curls, lying triceps press and leg extensions orderly, for a period of eight weeks, three sessions per week in such a way that all active muscles were under training in every session. In each training session, the researcher supervised on the participants training and once in every three weeks, the maximum repetition test (1 RM) was fulfilled for them and with consideration to the amount of displaced weights, a new program was given to them to observe the loading principle.

2.1 Measurement of Muscular Endurance and Strength

Before measurement, all participants participated in explanation training programs for a period of two sessions are introduced to training tools and training of accurate techniques of movements. Maximum strength of them was measured through 1 RM test. The measurement method was as follows: before test and after general warming, five repetitions with 30% (2 min relaxation), four repetitions with 50% (2 min relaxation), three repetitions with 70% (3 min relaxation) and 1 RM repetition with 90% (3 min relaxation) were fulfilled for warming. After the last turn with 90% of 1 RM weight, in next turns with consideration to feedback of the participants on the
basis of the displaced weights, increased for gaining 1 RM (2.5-10 kg after successful effort) [28]. After determination, the 1 RM of the participants, 60% of their 1 RM was calculated in each movement individually and separately then they fulfilled the maximum repetition with 60% of 1 RM. Finally, the number of fulfilled repetition was considered as muscular local endurance [29].

2.2 Vertical Jumping Test for Evaluation the Muscular Power

Muscular power of the participants was evaluated by vertical jumping test (sergeant jump test). The participants put a sign with their chalky fingers on a gradient wall after the maximum possible point on the wall. Difference between the signed point by jumping and sign on the wall that the participants put on the wall after standing beside the wall and stretching his hand, was measured as vertical jumping. At first, the participants made themselves warm and then they fulfilled three experimental jumping and the 4th jump was registered as height of vertical jump. They were requested to jump as high as possible.

2.3 Measurement the Muscular Volume

In order to measure the muscular volume using anthropometry method for muscles of leg (quads and hamstring muscles) and arm according to Housh et al. method [30], it was calculated according to Roberto’s method [31].

3. Results and Research Findings

The mean & standard deviation were shown in Tables 2-4. Findings showed that after eight weeks weight training, double pyramid method was significant in increasing muscular strength and muscular endurance, muscular power and hypertrophy, that this increase was not significant between double pyramid and reverse step but between double pyramid group and control group was significant in strength and other method (reverse step) shows that was significant in increasing of endurance and power. But this increasing was not more and significant with double pyramid and so control group.

There is a significant different between groups in muscle strength, and Tukey test showed that there is a

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Anthropometric characteristics of subjects in three groups.</th>
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<tr>
<td>Variable</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Age</td>
<td>20.55 ± 2.62</td>
</tr>
<tr>
<td>Height</td>
<td>176.86 ± 5.045</td>
</tr>
<tr>
<td>Weight</td>
<td>73.45 ± 11.17</td>
</tr>
<tr>
<td>Body fat</td>
<td>11.43 ± 5.91</td>
</tr>
<tr>
<td>BMI (body mass index)</td>
<td>23.45 ± 3.24</td>
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<tr>
<th>Table 3</th>
<th>The results of the t-test to compare pre- and post-test.</th>
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<tbody>
<tr>
<td>Variable</td>
<td>Before test</td>
</tr>
<tr>
<td>Muscle strength double pyramid</td>
<td>1.80 ± 0.531</td>
</tr>
<tr>
<td>Muscles strength reverse step</td>
<td>0.198 ± 0.013</td>
</tr>
<tr>
<td>Muscles endurance double pyramid</td>
<td>23.45 ± 7.17</td>
</tr>
<tr>
<td>Muscle endurance reverse step</td>
<td>23.40 ± 10.18</td>
</tr>
<tr>
<td>Muscle power double pyramid</td>
<td>41.91 ± 8.33</td>
</tr>
<tr>
<td>Muscle power reverse step</td>
<td>45.30 ± 6.37</td>
</tr>
<tr>
<td>Muscles hypertrophy double pyramid</td>
<td>2.79 ± 1.413</td>
</tr>
<tr>
<td>Muscles hypertrophy reverse step</td>
<td>3.96 ± 1.49</td>
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*P < 0.05.
Table 4  Result of Tukey test in for cooperation between muscles strength in research groups.

<table>
<thead>
<tr>
<th>Muscle strength</th>
<th>Groups</th>
<th>Different means</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle strength</td>
<td>Double pyramid—reverse step</td>
<td>2.36</td>
<td>0.446</td>
</tr>
<tr>
<td>Muscle strength</td>
<td>Double pyramid—control</td>
<td>5.91</td>
<td>0.010*</td>
</tr>
</tbody>
</table>

* $P < 0.05$.

**Fig. 1**  Result of Tukey test for comparison muscle strength between groups.

significant different between double pyramid and control group, but there is no significant difference between double pyramid and reverse step, reverse step and control group.

**4. Discussion and Conclusion**

The main objective of this study was to evaluate the different effects of two loading models of training with weights (double pyramid and reverse step) on some important indicators of physical fitness of karate-kas. The results of research after eight weeks of weight training showed that muscle strength in the double pyramid group had a significant increase. This increase was not significantly different between double pyramid and reverse step group, and among double pyramid and control groups, the difference was significant ($P < 0.05$). In reverse step group, no significant difference was observed in variables of muscle strength. Our study is consistent with the results from Westcott, who compared two training groups in a study. The first group was exercising with high-intensity, 6-8 repetitions with heavy weight and the other group with average-intensity training of 13-15 repetitions. 1 RM strength showed significant increase in both training groups compared with the control group, but showed no significant difference.
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The exact mechanism of increasing the muscle strength has not yet been determined. But, according to the results of the studies, the force generated per contraction depends on active movement units at that contraction, so more motor unit recruitment will produce more force [15]. Furthermore, Rooney [13] in his study reported that when an athlete is tired, more motor units are employed, therefore, in continuation of efforts for muscle activity, these stimuli cause increase the strength, so the case of double pyramid and reverse step models is true. Several studies that had compared different sets obtained similar results. For example, Starkey et al. [26] compared a 2-set, 6-set and 12-set protocol with each other and found that the three volumes used had positive results in 1 RM strength increase, but difference between different groups after 10 weeks of training was not significant (all three groups had used similar RM weights). Contribution of the nervous system is very important in building muscle strength, because this system determines why some people without bulky muscles could produce maximum contractile force.

Kraemer et al. [32] also reported that the subjects depending on the level of training may show different compatibilities in response to resistance training, while some researchers have reported 40% increase of strength in detraining subjects and 2% increase in expert training subjects.

Among other findings of this study, it was showed that muscle endurance in double pyramid and reverse step groups has been increased significantly, and this increase did not have a significant difference between two training and control groups. Results of the present paper were similar to the results of Gorostiaga et al. [33] found that the group with low intensity and high repetition has produced much muscular endurance, by comparing the three categories of high-intensity and low repetitions, average intensity and repetitions, low intensity and high repetition after nine weeks training. Hosseini [34] found that there is no significant difference between two training groups in muscular strength and endurance, muscle mass and body composition, but there was a significant difference between them and the control group, which is not consistent with results of the present paper. Based on our studies, age, fields of sports and number of subjects are among the factors affecting the results of studies in this field. Probably these factors lead to the difference in the results between our study and Hosseini’s. Improvement in muscular endurance is along with increase in muscular strength and changes in metabolic patterns as well as local blood circulation. In addition, muscular endurance occurs probably due to economic performance and increase in movement efficiency [6, 9, 35]. Also, resistance training, the higher repetition and the lower weights are effective on muscular endurance [19, 22].

Almost similar increase in muscle power in both double pyramid and reverse step groups is among other results of this research. Kraemer et al. [19] reported that in power trainings that do not have lunching repetitions, relatively high weights are required. Jones et al. [36] showed that training with a high speed and an average-to-high weight has a greater effect in power progress than training with low speed.

The results of the present paper in hypertrophy muscular variable also showed that after eight weeks of training with weight of double pyramid group has been increased, but there was not a significant increase among the other groups. Consistent with the present results, Campos et al. [37] showed that after eight weeks of resistance trainings in the group with average and low repetitions, the effects of muscle mass were significant. Benedict [38] showed that programs with low load and high intensity produce a significant increase in muscle mass compared to the protocols with high load and low intensity. According to studies conducted, the use of medium to heavy weights, average to high repetitions, multiple times for each move as well as performing several moves per
session are generally considered as the high-volume programs, and these types of trainings are considered special training programs for muscle mass [39].

Studies and researches conducted indicate that physical exercise improves the quality of skills in various sports such as karate. Therefore, to have a ready team, the elements of fitness, muscular strength and endurance, muscular power and hypertrophy cannot be ignored. Given that the results of this study showed that strength training has an important role in improving the physical fitness of karate athletes, and double pyramid model is effective in muscular strength, muscular endurance, muscular power and hypertrophy, hence, it can be suggested that trainers use this method to prepare their athletes during the preparation period.

References


