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THE EFFECT OF RESISTANCE BAND TRAINING ON THE MAXIMUM FORCE AND ANAEROBIC POWER OF BOXERS

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Abstract:
Study was carried out to examine the effect of application of resistance band in the female boxers on the levels of the anaerobic power and Maximal Bench Press force (MBP). The study was carried out on 12 female subjects, in ages between 19 and 23yo, who are actively engaged in the boxing branch. The subjects were divided into two groups, each consisting of 6 people, as Constant Resistance (CR) and Wavy Resistance (WR). The average age of CR group was 21.33±0.81 years, the average height 169.67±2.06 cm, and the average body weight 65.28±8.95 kg. The average age of WR group was 21.16±0.75 years, the average height 173.50±3.27 cm, and the average body weight 65.56±3.19 kg. In the study, the exercise of resistance band was made by all subjects four days a week for 6 weeks between the hours 9.00-10.00, boxing training for competition period between the hours 18:00–20:00 in evenings. In CR group, the bands in the same color and resistance were used by the method of the black band constant, resistance, in WR group, the bands in different color (red, blue, black) and resistance by the wavy method. Before training, the body weights, and the levels of anaerobic power and MBP levels of both groups were determined. The same measurements were repeated six weeks later. In the statistical analyses of the data obtained, in determining the differences between in-group test and the final test, Paired-sample t-test was used. In determining the difference between two groups, pre-test and final test, independent samples t-test was used. The significance between differences was determined at the level of P<0,05. As a result; as a matter of fact, it can be said that the constant resistance method of CR group is more effective than the wavy resistance method of WR group. Hence, conducting the studies of resistance band that

will be conducted specific to branch, using the method of constant resistance, can be more effective.

Keywords: anaerobic power; boxing; maximal force, resistance bands

1. Introduction

Amateur boxing is a popular sport in Europe countries as well as in the world. The physiolgical profile of elite amateur boxers (Joko 1983, Ghosh et al 2010, Guidetti et al 2002, Smith 2006, Khanna and Manna 2006) and analysis of the techniques and training in amateur boxing (Kravitz et al 2003) have been studied. One sport that may be categorized within the multiple repeated high-intensity exercise domain is that of boxing. Typically, a modern day boxing match will consist of a predetermined number of rounds, each lasting 3 minutes while separated by a 1-minute seated recovery (World Boxing Association 2016). Help support the overall metabolic demands of a boxing match and to accelerate the recovery process between rounds, athletes of both sexes require a high level of cardiorespiratory fitness. International boxers show a high peak and mean anaerobic power output. Muscle strength in both the upper and lower limbs is paramount for a fighter's victory and is one of the keys to success in boxing. As boxing punches are brief actions and very dynamic, high-level boxing performance requires well-developed muscle power in both the upper and lower limbs. Albeit limited, the available studies reveal that isometric strength is linked to high-level boxing performance Chaabene et al 2015). Boxing has the sudden combined strokes; therefore, energy loss is at high level. In this respect, in boxing, it is understood that the importance of maximal force and anaerobic power. Boxing, due to its dynamic and static characteristics at a high level, has a complex structure and is among the fighting sports that require high level of power (Mitchell et al 1994).Therefore, it is important to investigate how resistance tires exercises affect maximal strength and anaerobic strength of athletes. Greater emphasis is now placed on the amateur boxer to perform more frequent repeated bursts of high intensity activity, especially the punch rate and dynamic footwork (Smith 2006). It will be seen Boxing coaches and practitioners, in order to establish the optimal training intensity, should recognize that the heart rate response is disproportionately high to the blood concentration level, during competition (Hanon et al 2015). Amateur boxers have been studied for competitive performance improvements over the past 2 decades, contributing to an increase in knowledge of the sport through the characterization of their physical and physiological profile. The fitness components include cardio-respiratory endurance, muscular

strength, muscular endurance, flexibility, and body composition. Skill-related components include speed, agility, power, balance, coordination, and reaction time. Most combat sports require a mix of technique, strength, aerobic fitness, power, and speed. Usually, no single performance characteristic dominates in combat sports. Indeed, physiological responses, especially heart rates and maximal oxygen uptake (VO_2max), recorded during competitive situations and blood lactate values recorded post contest consistently demonstrate differences between weight categories and combat rounds (Slimani et al 2017). Boxing consists of stand-up fist fighting and should therefore not be confused with other fighting styles such as kickboxing, Savate or French boxing, Muay-Thai or any other combat sport that allows the use of feet, elbows or knees to strike (El-Ashker and Nasr 2012, Chaabène ve ark 2015). To succeed in delivering a scoring blow and in return to avoid getting blows, boxers require well-developed technical-tactical skills and a high level of physical and physiological fitness.

It has been reported that a high anaerobic threshold and aerobic power level are necessary to succeed in boxing. Amateur boxing is characterized by high-intensity movements during rounds, with short breaks that are not enough to provide a full recovery [14]. In this context, to properly train a boxer, knowledge of the metabolic requirements of a boxing match from the scientific literature seems to be extremely necessary (Chaabène ve ark 2015).It is known that up to 70% of a person's maximum power or capacity is due to genetic factors. It is generally accepted that with a good aerobic training program, aerobic power can easily be increased by 10-20% and it is suggested that at least some persons may be able to exercise maximum aerobic power (Astrand and Rodahl, 1986).

2. Materials and Methods

2.1 Subject

In this research, the average age of the students attending S.U. Physical Education and Sports College between 19-23 and 12 female boxers participated as elite volunteer subject.

2.2 Groups

Fixed Resistance Group; **FR, n:6**
Wave Resistance Group; **WR, n:6**

2.3 Method

Two groups, the wave resistance group (WR) n:6 and the fixed resistance group (FR) n:6, participated in the study. Resistance tires practice were given to the subjects between 9-10 a.m. for 5 days a week throughout 6 weeks and boxing training was done at 6 p.m. directed for the competition. Along with the 6-week competition period training, measurements which are indicative of before and after the application of the resistance rubber, were made.

A. Tall Stature and Body Weight: Height lengths of the athletes; with a stadiometer (Holtain Ltd., UK) which measuring ±1 mm, it was taken in cm-denominated. Body weight; was taken in 'kg' with a scale (Tanita 401 A, Japan) measuring ±100 g precision.

B. Wingate Arm Anaerobic Power and Capacity Test

For the Wingate test Monark 824 model (made in Sweden) hand bike ergometer was used. With the 20% of the test loads calculated on the bicycle ergometer for the athletes, at a speed of 60-70 rpm, 4-8 seconds duration containing two or three sprint, a 5 minute warm-up protocol was applied. After warm up passive resting was provided for 3-5 minutes. Test was performed as specified in the protocol (Özkan et al 2010).Hand anaerobic power measurement is used as a load resistance of 50 gr / kg per kilogram of body weight for Monark ergometer (Özkan et al. 2010).

Figure 1: Monark 824 Model Arm Bicycle Ergometer

C. Maximal Force Measurement (Bench Press) Warm-up Protocol

Before the test, the bench press movement is repeated eight times in a set with the weight (kg) corresponding to 50% of the body weights for all subjects (Benpen and McCalip 1999).

D. Maximal Force Measurement (Bench Press)

For bench press measurements, standard weights were used like 1-1,5-2-2,5-3-5-10-15-20 kg. The maximal strength of each structure was determined by the single repeat method. One maximum repeat (1 MR) method was used. This standard weight lifting during exercise is the maximum one-time lifting weight performance (Tamer 2000).

2.4 Training Program

Boxing trainings during the competition were held for the first 4 weeks, 6 days a week for the last two weeks and 5 days a week.

Table 1: The distribution of the training program of the competition period

Competition Training Program (6 Week)		
20% Special Condition	40% Technical Works	40% Tactics and Matches(Sparing)

Sparing: The closest fighting training to the competition;
Condition: Bag, sparing, weight and running;
Technical Study: Mutual glove studies.

2.5 Resistance Band Training

Both groups between 9:00 - 10:00 a.m. 4 days a week, in the El Wingate test the bands were adjusted according to the percent elongation of the weight of the resistance bands given in the table of the weight corresponding to the weight of 50 g / kg given per kg of body weight.

The fixed resistance group (FR) stretching the band by using black band with box striking technique at maximal and submaximal level applying 30 sec. working 60 sec. resting (1/2) made 15 sets. (Page and Ellenbecker 2005)

The wave resistance group (WR) made 30 sec. working out and 60 sec. resting at maximal and submaximal levels with a red colored resistance band at first week and at week 2 with a blue colored resistance band whose weight value increased, made 30 sec. working out and 60 sec. resting (1/2) at maximal and submaximal level and at week 3 and 4, resistance band working out made with black bands at maximal and submaximal level for 30 sec. and 60 sec resting (1/2) with 15 reps.

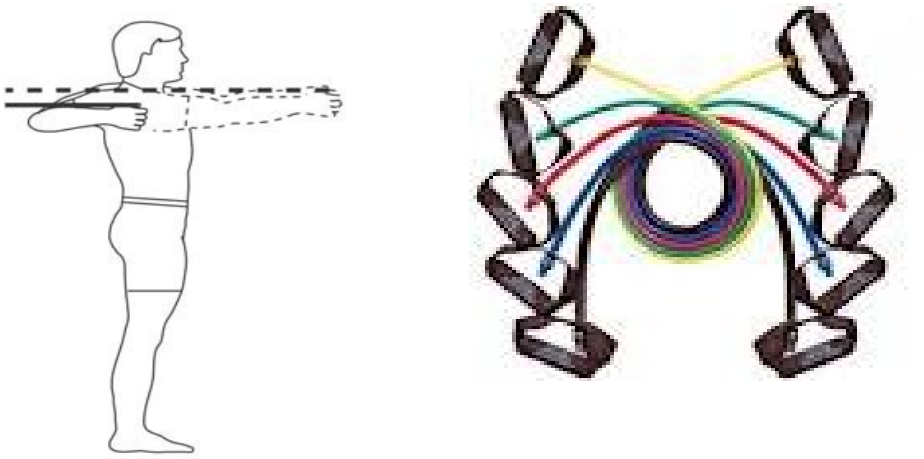

Figure 2: Resistance Band Features

Table 2: Resistance band implementation chart

	Resistance-Kg		
	Red	**Blue**	**Black**
Percentage of elongation (%)			
25%	1.5	2.8	3.6
50%	2.6	4.6	6.3
75%	3.3	5.9	8.1
100%	3.9	7.1	9.7
125%	4.4	8.1	11
150%	4.9	9.1	12.3
175%	5.4	10.1	13.5
200%	5.9	11.1	14.8
225%	6.4	12.1	16.2
250%	7	13.3	17.6

2.6 Statistical Analyses

With the aim of determining the homogeneity of the data the "single sample Kolmogorov-Smirnov" test was performed. It is determined that the data showed normal distribution. Paired-sample test was used to specify differences between intra-group pre-test and post-test. To determine the difference between the two groups the "Independent samples" test was used also. Significance between the differences was determined at $P < 0,05$.

3. Results

Table 3: Age and height averages of groups (FR,WR) and its difference

	N	Groups	Mean±FR	t	p
Age(year)	6	FR WR	21,33±0,81 21,16±0,75	0,368	0,72
Height (cm)	6	FR WR	169,67±2,06 173,50±3,27	-2,427	**0,03***

FR: Fixed resistance group
WR: Wave resistance group
*P<0,05

The height of the WR group is significantly (P<0,05) higher than the FR group.

Table 4: Comparison of pre-test and post-test values of fixed resistance group (FR)

Parameters	N	Pre-test Mean±FR	Post-test Mean±FR	t	p
Body Weight (kg)	6	65,28±8,95	65,50±8,82	0,399	0,70
Wingate (kgm/sn)	6	148,85±28,97	185,98±31,60	-25,39	**0,00***
Max Bench Press (kg)	6	34,83±6,01	35,33±4,46	-2,236	0,76

FR: Fixed resistance group
WR: Wave resistance group
*P<0,05

There was a significant (P<0,05) increase in anaerobic power between pre-test and post-test.

Table 5: Comparison of pre-test and post-test values of wave resistance group (WR)

Parameters	N	On test Mean±FD	Son test Mean±FD	t	p
Body Weight (kg)	6	65,56±3,19	64,38±3,45	2,47	0,06
Wingate (kgm/sn)	6	142,46±27,78	151,94±19,45	-4,161	**0,00***
Max Bench Press (kg)	6	37,17±2,04	37,50±1,97	-1,58	0,17

FR: Fixed resistance group
WR: Wave resistance group
*P<0,05

There was a significant (P<0,05) increase in anaerobic power between pre-test and post-test.

Table 6: Comparison of body weight, wingate hand anaerobic power and maximal bench press parameters between groups of fixed resistance (FR) and wave resistance groups (WR)

Parameters	N	Groups	Mean±FR	t	p
Body Weight Pre-Test(kg)	6	FR	65,28±8,95	0,73	0,94
	6	WR	65,56±3,19		
Body Weight Post-Test(kg)	6	FR	64,85±8,82	0,121	0,90
	6	WR	64,38±3,45		
Wingate Pre-Test(kgm/sn)	6	FR	148,85±28,97	0,424	0,68
	6	WR	142,46±22,78		
Wingate Post-Test(kgm/sn)	6	FR	185,98±31,60	-2,247	**0,04***
	6	WR	151,94±19,45		
Max Bench Press Pre-Test(kg)	6	FR	33,17±6,01	-1,543	0,15
	6	WR	37,17±2,04		
Max Bench Press Post-Test(kg)	6	FR	35,50±4,46	-1,004	0,33
	6	WR	32,50±1,97		

FR: Fixed resistance group
WR: Wave resistance group
*P<0,05

Anaerobic power; the increase in the FR group is significantly (P <0.05) higher than the WR group.

4. Discussion

In the study, the pre-test Wingate anaerobic power level of the FR group was measured as 148,85 ± 28,97 kg/s and the WR group was measured as 142,46 ± 22,78 kg/s and the difference between the two groups was not significant. After the 6-week resistance training program with both boxing training sessions, the anaerobic power of the FR group increased from 148,85 ± 28,97 kgm/s to 185,98 ± 31,60 kgm/s after 6 weeks and that increase (P <0.05) was found significant. The Wingate pretest of the WR group was measured as 142,46 ± 27,78kgm/s and the final test was measured as 151,94 ± 19,45kgm/s. It was determined that the increase (P <0,05) in this group was significant. Therefore, the anaerobic power and capacity measurement which is result of Wingate test, has increased in both groups in 6 week training session. Interesting anticipation of the study is which group is the source of this increase or whether it was the result of boxing workouts or resistance work. Boxing is considered to be a branch of high-intensity, large scale anaerobic environment. Therefore, even for boxing training, the increase in arm Wingate level is an expected fact for a boxer. As a matter of fact, a significant increase is expected in both groups after the workout. But has this increase

in both groups led to difference in the level of anaerobic power applied by different methods of resistance band exercises?

When the difference between the two groups was examined after 6 weeks, the Wingate anaerobic power level of the FR group was 185,98 ± 31,60 kg/s and the WR group was 151,94 ± 19,45 kg/s. It was determined that the difference between the two groups was important (P<0,05). It is thought that this increase in the FR group was significant (P <0.05) than the WR group, and the competition period of both groups that were doing the same boxing training was not due to 6-week boxing training but by resistance band exercises that using different methods. Thus; it is seen that when the resistance band studies in the study were considered to be 30 second maximal operations, the FR group's work with the tire with the greatest resistance using the constant resistance method shows that the WR group has a more significant effect on the anaerobic power than the bands with different colors and resistances using the wave method. Therefore, it can be said that the difference between the two groups is due to the studies of resistance band workouts that made with different methods from boxing training.

In the study; MBP (Maximal Bench Press) pre-test of the FR group as a 34,83 ± 6,01 kg final test identified as a 35,33 ± 4,46 kg and the difference between pre-test and post-test was not significant. The difference between pre-test and post-test, which was measured as the MBP pre-test level of the WR group was 37,17 ± 2,04 kg and the final test was 37,50 ± 1,97 kg, was not significant. When the difference between the two groups in the study was examined, it was noted that there was no difference between the pre and post-test MBP levels of the FR and WR groups in terms of statistical significance. It has been observed that the technical strength study applied by using a double layer resistance band or by using a single layer resistance band has increased the technical strength of the athletes in studying the effects of the resistance band (pulling band) in different resistances and the technical strength of the high school students working with taekwondo. (Resistance bands are used with 1 to 2 pull) (Topal 2007). Ghigiarelli et al (2009) investigated the effect to the maximal strength and quick strength with the exercise of bench-press which is for 7 week for the football players for upper extremity muscles with resistance band and weight-chain. They were divided into three groups of resistance band group, chain weight group and free weight group, and training was given for 7 weeks and 4 days a week. It was observed that the maximal strength increased significantly in all three groups, whereas the rapid strength was found to be more improved in the resistance group and the exercise group. Indeed, as noted in our study, the increase in the anaerobic capacity, which is a result of the resistance force's rapid-strength indicators, is similar to the above study. Colado and

Triplett (2008) studied the effects of resistance tires and weight machines on functional capacity and body composition with similar resistance training programs in sedentary women. A periodic training program was applied for 10 weeks and 2 times a week and 6 exercises were used for each of the basic muscle groups in each workout. As a result of the study, resistance tires showed similar physiological benefits when compared with weight machines.

As a result; resistance band exercises show not an important effect at MBP (Maximal Bench Press) level, but in anaerobic power both group (FR, WR) has important increase (P <0,05) and that increase is more significant in FR group (P <0,05) than WR group. Therefore, it can be said that it would be more effective to use the resistance method of resistance bands to be made specific to the boxers.

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