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Chronic Effect of Jump Rope Exercises on Inspiratory and Expiratory Muscle Strength

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Abstract

The aim of this study was to observe the chronic effect of rope jumping exercise on the respiratory muscles of individuals who were given rope jumping exercise for eight weeks. Twenty-six sedentary young men aged 18-20 years participated in this study in which we examined the chronic effect of rope jumping exercises on inspiratory and expiratory respiratory muscle strength. The subjects were divided into 2 groups as control and experimental group. The control group consisted of 13 people and the experimental group consisted of 13 people. The experimental group participating in the study was selected from those who had a history of jumping rope before. A 30-minute exercise program with jump ropes was applied to the group 4 days a week for 8 weeks. The program was planned as 5 minutes warm-up, 20 minutes jumping rope exercise, 5 minutes cooling down. After the 8-week exercise program, respiratory muscle strength was measured with a spiro-meter. The data obtained were analyzed in SPSS 22.0 program. Pre-post test comparison of the respiratory muscle strength values of the experimental and control groups was made. At the end of the respiratory muscle strength study, MIP-MEP-PIP values of the experimental group showed a significant difference ($p<0.05$). As a result of the study, it is thought that rope jumping exercises influence respiratory muscle strength and individuals can have stronger respiratory muscle strength by continuing these exercises for a long time.

Keywords: Respiration, Jumping rope, Muscle

İp Atlama Egzersizlerinin İnspiratuar ve Ekspiratuar Solunum Kas Kuvvetine Kronik Etkisi

Öz

Bu çalışmanın amacı sekiz hafta boyunca ip atlama egzersizi verilen bireylerin ip atlama egzersizinin solunum kasları üzerindeki kronik etkisini gözlemlemektir. İp atlama egzersizlerinin inspiratuar ve ekspiratuar solunum kas kuvveti üzerindeki kronik etkisini incelediğimiz bu çalışmaya 18-20 yaşlarında 26 sedanter genç erkek katılmıştır. Denekler kontrol ve deney grubu olarak 2 gruba ayrılmıştır. Kontrol grubu 13 kişiden, deney grubu ise 13 kişiden oluşmuştur. Araştırmaya katılan deney grubu daha önce ip atlama geçmişi olan kişilerden seçilmiştir. Gruba 8 hafta boyunca haftanın 4 günü 30 dakikalık ip atlama egzersiz programı uygulanmıştır. Program 5 dakika ısınma, 20 dakika ip atlama egzersizi, 5 dakika soğuma olarak planlanmıştır. 8 haftalık egzersiz programının ardından solunum kas kuvveti spirometre ile ölçüldü. Elde edilen veriler SPSS 22.0 programında analiz edildi. Deney ve kontrol gruplarının solunum kas kuvveti değerlerinin ön-son test karşılaştırması yapıldı. Solunum kas kuvveti çalışması sonunda deney grubunun MIP-MEP-PIP değerleri anlamlı farklılık gösterdi ($p<0,05$). Çalışma sonucunda ip atlama egzersizlerinin solunum kas kuvvetine etki ettiği ve bireylerin bu egzersizleri uzun süre devam ettirerek daha güçlü solunum kas kuvvetine sahip olabileceği düşünülmektedir.

Anahtar Kelimeler: Solunum, İp atlama, Kas

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Introduction

Muscles are a structure made up of cells that surround our body, giving it shape and movement. They also provide strength to the body and develop various physiologic, morphologic and psychological aspects as we exercise. Physiologically defined muscle strength is the ability of any muscle or muscle group in the body to resist external resistance, and muscular endurance is defined as the ability of a muscle or a muscle group to maintain its ability to resist the resistance applied to it (Günay & Yüce, 2001; Fauroux, 2003). Muscle structures in our body vary among themselves and are named according to different parts of the body. One of the important muscle groups in the human body is the core muscles. During training in athletes, movement primarily starts from the core and passes from this region to the extremities (Bliss & Teeple, 2005). At the same time, the core muscles act as a pivot point for the limbs, transferring force and load throughout the body (Barati, 2013). In addition to the core muscles, inspiratory and expiratory muscles also play a role in core stability during training (Al-Bilbeisi and Dennis, 2000). Respiratory muscles are specialized muscles due to their high fatigue tolerance, oxidative capacity, capillary network and maximum blood flow (Decramer, 1999). Respiratory muscles are of great importance for the respiratory and circulatory systems. The structure of these two systems constitutes the cardiorespiratory system and respiratory muscles developed with exercise are known to improve the cardiorespiratory system. Studies have shown that jumping rope exercise has a positive effect on this system and it has been observed that this exercise model used in training improves respiratory endurance in athletes (Orhan, Yücel and Orhan, 2019). At the same time, many studies are showing that jumping rope has positive effects on physical qualities (Miyaguchi et al., 2014; Ozer et al., 2011). For example, in a study conducted with elite adult athletes, it was observed that using jumping rope as a warm-up protocol instead of traditional warm-up resulted in better horizontal jumping movements (Makaruk, 2013). In the light of all this information, the aim of this study was to observe the chronic effects on the respiratory muscles of individuals who performed rope jumping exercise for eight weeks.

Methods

Experiment Design and Participants

Our study was designed according to a controlled pre-test post-test design from quantitative research methods. Groups are rich in randomness. In this study, 26 sedentary young men between the ages of 18-20 participated. The subjects were

divided into 2 groups as control and experimental group. The control group consisted of 13 people and the experimental group consisted of 13 people.

Data Collection Tools

An electronic respiratory pressure gauge (Pocket Spiro MPM-100, Medical Electronic Construction R&D, Brussels, Belgium) was used for the pretest and posttest measurements of the volunteers.

Before enrolling the volunteers in the exercise study (1 day before), the force that the respiratory muscles could produce was measured with a spirometer. After the end of our exercise study (1 day later), it was measured again with a spirometer. The data were recorded in the Excel computer program. The last measurements were taken 8 weeks later.

Experiment Content

Our study was carried out on a parquet floor with the help of flat plastic ropes, and the individuals were asked to be ready for the exercise and the day, and suggestions were made for the continuity of the study. Care was taken for the whole group to complete their exercises in the same time frame. For the application group, 30 minutes of exercise time was created with jumping ropes 4 days a week for 8 weeks, this period; 5 minutes warm-up, 20 minutes work, 5 minutes cool down) jump rope exercise program was applied.

Table.1 Jump Rope Exercise Program

	1.Week				2. Week				3. Week				4. Week				5. Week				6. Week				7. Week				8. Week			
Days	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
	5 minutes warm-up + 20 minutes jump rope exercise + 5 minutes cool down																															

After warming up for 5 minutes, the participants jumped rope for 4 minutes and rested for 1 minute during the 20 minutes of exercise. The difficulty level (frequency-scope) of the exercise remained the same every week without changing. "Straight jumping style" was chosen as the rope jumping technique. The straight jumping style was chosen because it does not require any technique and to facilitate the subjects' participation in the study. The environment where we will do the exercise was carried out in an indoor gym. After the pre-test measurement was taken, the subjects performed 32 training sessions in total and completed the study with the post-test measurement at the end of the 32nd day. The result record of the measurements was recorded right next to the first test and the participants were also informed. The

measurements were recorded on the computer through the "Excel" program.

Statistical Analysis

Excel 2007 office program was used to explain the data obtained at the end of the research and to calculate the values, and SPSS 21.0 package program was used for statistical analysis. Shapiro-Wilk test was used for normality test, paired sample t testi was used for the comparison of pre and post tests of the groups and independent t-test was used for the comparison of paired groups. Statistical results were evaluated at $p<0.05$ significance level.

Results

In order to determine the chronic effects of rope jumping exercises on respiratory muscles, the chronic effects of rope jumping exercises on inspiratory and expiratory respiratory muscle strength were examined and interpreted with tables.

Table 2. Descriptive Statistics of Respiratory Muscle Strength of the Groups

		N	Min.	Max.	Avr.	SS.
Experimental Group	MIP1	13	61.00	116.00	85.77	18.46
	MEP1	13	68.00	141.00	96.46	19.18
	PIP1	13	60.00	119.00	90.31	19.21
	PEP1	13	70.00	145.00	99.85	21.79
	MIP2	13	71.00	126.00	94.08	17.41
	MEP2	13	68.00	151.00	104.15	21.19
	PIP2	13	75.00	130.00	98.85	18.47
	PEP2	13	70.00	150.00	109.46	24.09
	MIPdifference	13	-1.00	28.00	8.31	6.77
	MEPdifference	13	.00	20.00	7.69	6.96
	PIPdifference	13	-5.00	22.00	8.54	8.09
	PEPdifference	13	-5.00	22.00	9.62	8.60
Control Group	MIP1	13	68.00	133.00	85.08	17.70
	MEP1	13	79.00	208.00	110.31	43.80
	PIP1	13	71.00	145.00	90.08	21.91
	PEP1	13	74.00	221.00	113.69	47.16
	MIP2	13	49.00	143.00	78.69	26.21
	MEP2	13	54.00	218.00	98.62	55.40
	PIP2	13	46.00	155.00	78.54	32.85
	PEP2	13	57.00	224.00	102.85	56.09
	MIPdifference	13	-30.00	19.00	-6.38	15.84
	MEPdifference	13	-50.00	10.00	-11.69	19.30
	PIPdifference	13	-40.00	10.00	-11.54	16.17
	PEPdifference	13	-53.00	10.00	-10.85	17.38

According to Table 2, the mean PEP2 of the experimental group participants was 109.4±24.09 cmH2O, MEP2 mean was 104.1±21.19 cmH2O, and PEP1 mean was 99.85±21.79 cmH2O. The mean PEP2, MEP1, and PEP1 of the control group

participants were 102.8±56.09 cmH2O, 110.3±43.80 cmH2O, and 113.6±47.16 cmH2O, respectively.

Table 3. Pre-post test comparison of respiratory muscle-strength values of the experimental and control groups

Group			Avr.	SS.	Std. H.	t	p
Experimental Group	MIP	Pre-test	85.77	18.46	5.12	-4.421	0.001
		Post-test	94.08	17.41	4.83		
	MEP	Pre-test	96.46	19.18	5.32	-3.987	0.002
		Post-test	104.15	21.19	5.88		
	PIP	Pre-test	90.31	19.21	5.33	-3.806	0.003
		Post-test	98.85	18.47	5.12		
	PEP	Pre-test	99.85	21.79	6.04	-4.032	0.002
		Post-test	109.46	24.09	6.68		
Control Group	MIP	Pre-test	85.08	17.70	4.91	1.454	0.172
		Post-test	78.69	26.21	7.27		
	MEP	Pre-test	110.31	43.80	12.15	2.185	0.049
		Post-test	98.62	55.40	15.37		
	PIP	Pre-test	90.08	21.91	6.08	2.573	0.024
		Post-test	78.54	32.85	9.11		
	PEP	Pre-test	113.69	47.16	13.08	2.250	0.044
		Post-test	102.85	56.09	15.56		

According to Table 3, as a result of the exercise, a significant difference was found between the pre-test and post-test values of the mean values of respiratory muscle strength MIP, MEP, PEP and PIP of the experimental group ($p<0.05$). There was no significant difference between the pre-test and post-test mean values of respiratory muscle strength MIP, MEP, PEP and PEP of the control group ($p>0.05$).

Table 4. Intergroup comparison of the difference between pre-test and post-test of parameters related to respiratory muscle strength

	Group	Avr.	SS.	Std. H.	t	p
MIP	Experimental Group	8.31	6.77	1.88	3.076	0.007
	Control Group	-6.38	15.84	4.39		
MEP	Experimental Group	7.69	6.96	1.93	3.407	0.004
	Control Group	-11.69	19.30	5.35		
PIP	Experimental Group	8.54	8.09	2.24	4.004	0.001
	Control Group	-11.54	16.17	4.48		
PEP	Experimental Group	9.62	8.60	2.38	3.805	0.001
	Control Group	-10.85	17.38	4.82		

When Table 4 is examined, it is explained that there are significant differences between the experimental group and the control group in terms of MIP, MEP, PEP and PIP results, and this significance is in favor of the experimental group ($p<0.05$).

Discussion

This study was conducted to examine the chronic effect of rope jumping exercises on inspiratory and expiratory respiratory muscle strength. For this purpose, 26 people aged 18-20 13 in the experimental group and 13 in the control group, participated in the study. As a result of the measurements made before and after the eight-week exercise period to determine whether the rope jumping exercises applied in our study had a chronic effect on the respiratory muscles, significant differences were analyzed in the respiratory strength parameters of the experimental group participating in the study. When these respiratory parameters were analyzed separately, significant differences were found in the MEP-MIP-PEP-PIP averages of the exercise performed in the experimental group. In the measurements in the control group, no significant differences were found in respiratory strength parameters.

According to our results, methods that can further improve the functions of core and respiratory muscles will contribute to the development of training programs for healthy people and various disease groups. In addition, those who want to increase their personal fitness during the training period and see increases in their quality of life can benefit more per unit time by including rope jumping exercises in their exercise programs.

As amateur or professional participation in sports increases, the importance of sportive performance and factors affecting this performance also increases. The factors that determine success in sports can be classified under training, genetics, epigenetics, nutrition, motivation, equipment and other environmental factors (Koku, 2015). Jumping rope is one of the most fun and popular games known worldwide and is especially used as an effective method in the fight against overweight and obesity. Jumping rope exercise, which can be planned within the framework of set goals, can be used to achieve aerobic, anaerobic and recreational goals (Şahin, 2017). Research has shown that rope jumping exercise is one of the most effective ways to achieve planned goals (Chen & Lin, 2011; Trecroci, et al., 2015; Eler & Acar, 2018). Jumping rope exercises have positive effects on cardiovascular harmony, muscle strength, endurance, mobility, flexibility, balance, coordination, vertical jumping, timing, rhythm and speed, lean body mass, bone density and skill development (Cahperd, 2005). When these gains are taken into consideration, rope jumping exercises are important in terms of regulating and maintaining motoric characteristics, where respiratory strength is in the foreground, as well as carrying the first information for a scientific

exercise to sports educators, as well as contributing to the studies that have been and will be applied in relation to this subject.

In another study examining the improvements between rope jumping and performance, it was revealed that there were improvements in the speed, directional running and anaerobic endurance performances of handball players as a result of rope jumping training for 6 weeks (Orhan, S., Pulur, A., & Gür, E.). In another study conducted in a different way, it was reported that respiratory muscle strength increased significantly as a result of respiratory muscle training (inspiratory or expiratory). Respiratory muscle training applied in cardiac surgery, neurological diseases and abdominal surgeries has been shown to increase MIP and MEP values (Britto, Rezende, 2011). In a similar study involving 18 soccer players, Özmen et al. reported that 5-week MIP training provided a 3% improvement in the experimental and control groups and a 0.9% improvement in MEP (Özmen, Güneş, Uçar, Doğan, Gafuroğlu, 2017).

As can be understood from the literature and the results of our study, it is understood that core muscles have a close relationship with respiratory muscles, exercises for respiratory muscle strength are important in athletes in terms of athletic performance and rope jumping exercises show an improvement in the respiratory muscle strength of individuals. It is recommended that athletes and coaches in sports branches where respiratory muscles are important add this exercise program to their training for the development of athletic performance and sports performance, to be one step ahead of other competitors in competitions, and to add this exercise program to their training according to their periodization planning in order to do it at the right time. Likewise, individuals who can be characterized as elite athletes who want to improve their athletic performance can do more rope jumping exercises in their special training.

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