The Effects of Rope Training on Heart Rate, Anaerobic Power and Reaction Time of the Basketball Players

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Abstract: A total of 40 men's basketball players, ranging from ages between 16-19, who played basketball at least for 3 years and struggling in young teams level, participated in this study in order to investigate the effects of rope training on the heart rate, anaerobic power, and reaction time. The basketball players were divided into two groups of experimental (n = 20) and control (n = 20) groups by a random method. Along with the training program, a technical training was also applied during a period of 8 weeks to the experimental group after 1 week preparatory rope training, consisting of weekly 3 days rope jumping. And to the control group was applied only a technical training of weekly 3 days during 8 weeks. Age, basketball age, height, body weight, the number of resting heart rate and immediately after the rope training number of heart rate, anaerobic peak and average power and right and left hand auditory and visual reaction times were measured in experimental and control groups. The statistical analysis of the data obtained was made in the package program, normally distributed data in the Simple Paired T-test, and for the data with abnormal distribution Wilcoxon and Mann-Whitney U tests were performed with a significance level of 0.05 in the dependent and the independent groups. As a result, it can be said that the rope trainings applied to the basketball players with explosive pace and re-applied method are effective on the heart rate and the anaerobic characteristics, whereas they do not effect the visual and the auditory reaction time

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Introduction

Many of our sports activities in our daily lives are carried out through our hands. In basketball game, which is one of them, the technical movements like rebounding, shot, block, ball handling, dribbling, and passing to a large extent depond on the strength of the fingers, wrists, and particularly on the strength f the arms (Sevim, 2006). This importance of our hands is due to the movements that our hand muscles give to our hands. The ability of hand skill is the ability hand-eye coordination which is important for works especially requiring fine and rough muscle control. Hand eye coordination especially comes to the fore in the individual sports games, particularly in handball, basketball, volleyball, racquet sports, which require especially a motor hand skill (Menevşe, 2011). Measurement of the reaction time in determining the hand-eye co-ordination plays an important role. The period passing between the beginning time of the action and the time when reaction starts, is being defined as the reaction time (Tamer, 2000). The reaction time is an inherited characteristic of a person that determines the time between the realization of the first muscular reaction or action (Bompa, 1998).

Trainings with rope jumping used as a warm-up or the method of co-ordination in the exercises, has an important role in the development of body coordination and strengthen the general athletic position. Rope jumping which can be done everywhere and which is an activity, the severity of which can be changed with the number and the type of skipping, it looks as a remarkable application in the development and the maintaining of the muscle strength and cardiovascular system and it helps in preparation for the sports disciplines and develops the feet movements. Rope skipping trainings have a positive effect on heart-circulation alignment, muscle strength, endurance, mobility, flexibility, balance, coordination, vertical jumping, timing, rhythm, speed, lean body mass, bone density and the development of skills (Orhan et all, 2008). In the rope trainings applied by the repeat method in the literature, it was observed that the repeat numbers vary between 25-150 for each exercise, and it was reported that it varied between the total of 500-2000 repeated numbers in a daily training. (Kim et all, 2001; Lee, 2006; Sigmon, 2003; Town et all , 1980).

Research Signification

Given above these benefits, the rope jumping trainings, beside giving preliminary information to the trainers for a scientific training with respect to developing and protecting the motoric features in the basketball discipline where the anaerobic characteristics are at the forefront, at the same time they are also important in order to contribute to research made or to be made with regard to this matter. The purpose of this study is to investigate the effects of rope trainings on the heart rate, the anaerobic power and the reaction time of the basketball players.

Materials And Methods

The research was carried out with the voluntary participation of a total of 40 male basketball players, the ages of whom varied between 16-19 and played basketball at least for 3 years. The basketball players were divided into two groups of experimental (n = 20) and control (n = 20) groups by a random method. Experimental group were trained (within rope training programme) three times (days) a week during eight weeks after one week preparatory rope training as well as technical training. Control group were trained only technically three times (days) a week during eight weeks.

In this study for the experimental group were used ropes of Selex (No: 0138) brand, length 270 cm., the rope part weight of 100 gr, total weight 160 gr. and as some sort of cable type having the property (Cable Rope).

An example demonstration was made as a practical application after the volunteers were orally informed in advance about the test application. The measurements were performed by the researcher as the pre-test and post-test in the laboratory in the morning hours of the day at (09:00 to 10:00) and in the same environmental conditions.

Test Protocols

Age and basketball age: The ages of the basketball players have been recorded as a year by subtracting the year of birth from the current year, and for their basketball ages, the year when they started to play licensed was subtracted from the current year.

Height and Body Weight Measurement: Their height was measured with bare feet in cm by using pharmaceutical-type scale tool (sensitivity 0.01 cm., Holtain Ltd., UK), and their body weight was measured in kg by using a pharmaceutical-type scale (sensitivity 0.01 kg., Angel), after they have undressed in a way to remain only with shirts and T-shirts (Tamer, 2000).

Number of Heart Rates: The number of heart rates was measured as beats / min. during resting, after the basketball players remained in supine position during 15 minutes; and the number of heart rates after exercise was measured immediately after the rope training, using a digital heart rate monitor (Polar S720 Heart Rate Monitor, Finland).

Anaerobic Power Measurement: The anaerobic power was measured according to the protocol specified by Wingate test by standard methods set forth in the bicycle ergometer (Monark, 894 E Peak Bike, Sweden) adapted for this test. Before starting the test, detailed information about the test was given, and a standard warm-up at 50 rpm for 5 min. was performed in order to ensure the physiological adaptation of the basketball players to the bicycle ergometer. In order to overcome the fatigue after the warming-up, a rest period of 5-minutes was given before the test. Saddle and handlebar adjustment was made for for every basketball player before the test. The seat level was adjusted in a way that the basketball player was in the sitting position on the saddle, and when the pedal was at the bottom point while turning the pedals, the knee was adjusted in a way to be in full extension and the feet were fixed to the pedal with the help of clips. After the resting period the test began after the weight, corresponding to 7.5% of the body weight of every basketball player, was placed on to the bicycle cradle as a resistance to be applied during the test. They were asked to maintain the highest possible maximal deliberate speed of a pedal for 3-4 seconds at the beginning as unloaded, and later for 30 seconds as loaded in order to reach a determined pedal speed (160-170 rpm). The basketball players were verbally encouraged during the test. After the test, the peak power and the average power of the basketball players was transferred to the computer environment through RS32 application and was recorded in W / kg (Inbar et all, 1996).

Visual and Auditory Reaction Time: In this study, the auditory and the visual reaction times of the basketball players were determined using the Newtest 1000 Tool (precision 1/1000 sec.). Attention was paid that the place where the measurement of reaction times would be measured be a noise free and an euphotic environment. From each experimental subject was taken 1 trial and afterward 3 measurements for both hands against the sound and light stimuli. The best value of the last 3 measurements was recorded in milliseconds as the score of the experimental subjects (Tamer, 2000).

Training Program

Preparatory rope exercises conducted one week before the training and warm-up, flexion and contraction exercises conducted for 5 minutes before each exercise.

Preparatory training program

Aim: rope adaptation, Exercise method: repeat method, Tempo: quick exercise, Duration: 50-60 rp., Break: 1:1, Serial: 2.

Exercises

1.Sidewill left, 2.Side will right 3.Front windmill, 4.Overhead windmill left, 5.Overhead windmill right, 6.Figure eight left, 7.Figure eight right, 8.Sidewill left skipping, 9.Sidewill right skipping, 10.Front windmill skipping.

Rope jumping program for 8 weeks

Duration of application: 8 weeks, Number of training per week: 3, Total training number: 24, Method: repeat method, Exercise tempo: with explosive tempo, of the exercises in the program,

application duration : 50 - 80 rp, Duration of break: 1:1, Number of serial: 1 - 2 set, Break between serials: full break, Tools and materials: jumping rope

Exercises

1.Basic bounce step, 2.bell jump, 3.skier's jump, 4.right foot skipping, 5.left foot skipping, 6.alternate foot step, 7.boxer shuffle, 8.side straddle, 9.scissors, 10.bonus jump.

Statistical Analysis

The analysis of the data obtained, a Two Related Paired T-Test (Simple Paired T-Test) was done for the data showing a normal distribution in the statistical package program of the dependent and independent groups, and Wilcoxon and Mann-Whitney U tests were done for the data not showing a normal distribution in the statistical package program of the dependent and independent groups. P <0.05 value was considered significant.

RESULTS

A significant difference (p <0.05) was found in table 1 in the values of height and body weight of the experimental group and the control group before and after the training; whereas no any significant difference was found between the groups in the comparison before and after training (p> 0.05).

Table 1. Demographic Characteristics of Experimental and Control Groups

Variables		Experimental Group (n=20)	p	Control Group (n=20)	p	Between Groups	
						t	p
Basketball Age (year)	BE	6,50 ± 1,24	1	6,35 ± 1,42	1	,356	,724
	AE	6,50 ± 1,24		6,35 ± 1,42		,356	,724
Age (year)	BE	17,55 ± 1,05	1	17,50 ± 1,05	1	-,168	,886
	AE	17,55 ± 1,05		17,50 ± 1,05		-,168	,886
Height (cm)	BE	186,85 ± 7,32	,000*	187,90 ± 8,02	,002*	-,433	,668
	AE	187,55 ± 6,92		188,45 ± 7,80		-,386	,702
Weight (kg)	BE	79,55 ± 10,08	,012*	81,75 ± 10,25	,209	-,684	,498
	AE	78,75 ± 10,06		81,45 ± 10,17		-,844	,404

* p<0.05 BE: Before Exercise AE: After Exercise

A significant difference (p <0.05) was found in the values in table 2 in the number of resting heart rates of the experimental group before and after the training, the number of heart rates after the exercises, peak power, average power, the sound reaction time of the left hand and the right hand, the light reaction time of the left hand and the right hand; and in the values in the number of resting heart rates of the control group before and after the training, the number of heart rates after the exercises, peak power, average power, the sound reaction time of the left hand and the right hand, the light reaction time of the left hand and the right hand. And while a significant difference (p <0.05) was found in the values of post-exercise number of heart rates, peak power and average power in the comparison of the groups before and after training, no any significant difference was found in the other values (p> 0.05).

Tablo 2. Heart Rate, Anaerobic Power and Reaction Time Values of Experimental and Control Groups

Variables		Experimental Group (n=20)	p	Control Group (n=20)	p	Between Groups	
						t	p
Resting Heart Rate (beats/min)	BE	79,20 ± 6,57	,000*	78,15 ± 5,04	,000*	-1,162	,253
	AE	76,00 ± 7,73		77,75 ± 4,91		-,855	,398
Heart Rate After Exercise (beats/min)	BE	163,20 ± 13,27	,000*	166,85 ± 11,27	,116	-,938	,354
	AE	177,60 ± 9,27		169,65 ± 13,57		2,164	,037*
Peak Power (watt/kg)	BE	14,18 ± 2,12	,000*	13,71 ± 1,78	,008*	,757	,454
	AE	16,95 ± 3,01		14,13 ± 1,74		3,618	,001*
Average Power (watt/kg)	BE	7,12 ± 0,65	,000*	7,23 ± 0,78	,645	-,476	,637
	AE	7,91 ± 0,82		7,29 ± 0,74		2,510	,016*
Left Hand Reaction Time to Sound (sec)	BE	0,203 ± 0,03	,002*	0,196 ± 0,02	,126	,785	,437
	AE	0,188 ± 0,27		0,192 ± 0,02		-,563	,577
Right Hand Reaction Time to Sound (sec)	BE	0,198 ± 0,28	,003*	0,188 ± 0,02	,003*	1,226	,228
	AE	0,186 ± 0,02		0,182 ± 0,02		,682	,500
Left Hand Reaction Time to Light (sec)	BE	0,222 ± 0,21	,057	0,212 ± 0,02	,011*	1,566	,126
	AE	0,213 ± 0,02		0,205 ± 0,02		1,359	,182
Right Hand Reaction Time to Light (sec)	BE	0,212 ± 0,02	,009*	0,206 ± 0,02	,013*	1,008	,320
	AE	0,203 ± 0,02		0,200 ± 0,02		,727	,472

* p<0.05 BE: Before Exercise AE: After Exercise

Discussion

In this study, where the effects of rope training on the heart rates, anaerobic power, and reaction time of the basketball players were investigated, not having found any significant difference between the ages, basketball ages, body weight and height of the sportsmen of the experimental and the control groups, may suggest that the volunteers of the both groups have the similar phenotypes in terms of the physical profile features.

It is stated in the literature that getting taller during the last period of the adolescence between the ages of 18-20, which is the period when the height extension stops, was a natural consequence of the individual differences (Ozer and Ozer, 2000). Having an increase in the height average values of both of the groups, the physical properties of basketball players participated in the study after the training, contrary to the effects of the rope tranings, may be related to the impact of the ongoing puberty. The literature knowledge supports the study. On the other hand, the decrease in the body weight of the rope group being more significant than the decrease of the control group, may be due to the effects of the rope training program applied.

In the literatüre it was reported that while the skipping with rope had positive effects on the cardio-circulatory adaptation (Cahperd, 2005), it was a remarkable application in the muscular endurance and on the construction and maintaining of the cardiovascular system and it developed the feet movements by helping the preparation of the sports discipline (Seabourne, 2006). Irvine, in his study he conducted the college students in order to determine the effects of the exercises on the body scales, personal self and cardiac respiratory compliance; he recorded significant developments in the cardiovascular system at the end of the aerobic training consisted of rope jumping, aerobic dance and walking, applied twice a week for 50 minutes during 14 weeks in total. (Irvine, 1984).

While it was reported that the values of heart rate speed during resting of the well-trained athletes who have been training for a long time, were expected to be lower compared to those of the healthy untrained individuals (Fox et all, 1988), in another study conducted, it was reported that the heart rate speed decreased by 4-9 beats per a minute with an exercise (McElroy and Segel, 1969). It was reported that in the endurance works applied by the common interval method to the the basketball players of 13-14 ages, a significant decrease was shown in the number of the resting heart rate of being 84,67 ± 13,94 beats/min before the training and being 74,33 ± 11,24 beat/min after the training (Erol, 1995). At the end of the quick power and plyometric training applied to the basketball players of 15-16 age group, a significant change has been identified in the values of resting heart rate numbers of the quick power group (Öztin et all, 2003). Though the resting heart rate number in both of the groups showing a significant decrease before the training is a thought-provoking, this situation may be due to the metabolic adaptation of the basketball trainings carried out routinely outside of the rope trainings and which are similar in content. The literature knowledge supports the study.

In the study conducted for the women's and men's aerobic and anaerobic responses to the rope jumping, 6 male and 6 female experimental subjects were put to rope jumping exercise in a way to make 160 skippings in 120, 140 minutes with the maximal bicycle ergometer. Having determined the throp values respectively as 185, 166, 168 and 178 beats / min. in the study, it was reported that both of the aerobic and anaerobic sources in the rope jumping exercises were highly needed (Quirk and Sinning, 1982). In the study, where the effect of rope jumping rate for energy expenditure in women and men was investigated, a rope jumping exercise of 5 min. was exercised by 19 men and 11 woman in a way to make 125, 135 and 145 skippings per a minute. It was reported that the relevant heart rates for the total sample were found to be 176, 177 and 177 beats / min. and that the women had a significantly higher heart rate speed than that of the men's (Town et all, 1980). It was reported that having 30 woman between the ages of 18-31 had a therapy activity consisting of skipping one day with a rope and another day without a rope at a maximum degree of difficulty designed, the heart rate speed after the skipping with rope was significantly higher than that of the skipping without a rope (Bloch et all, 1989). Having the increase of the heart rate numbers after the exercise indicating significance in the experimental group, may suggest that the rope trainings practised with an explosive tempo were effective. These findings obtained are in line with the literature.

In the study investigating the physiological and technical characteristics of the national young basketball team aged 18, the anaerobic peak power was identified as 10.7 ± 1.3 watts / kg. and the anaerobic mean power as 8.0 ± 0.7 watts / kg. (Apostolidis et all, 2004). At the end of the quick power and the plyometric training applied to the basketball players of 15-16 age group; a significant change was found out in the anaerobic power values of the quick power group (Öztin et all, 2003). Having investigated the effect of the weighted rope skipping training in the study as an alternative to the plyometric exercise in the development of anaerobic capacity and explosive reaction power of the college students, statistically significant developments were identified in the anaerobic peak power value after the training program

of weekly 3 days during 10 weeks, and the skipping with a weighted rope was recommended as a viable alternative in the high effective plyometric exercises (Masterson and Brown, 1993). In a doctorate study as well, it was reported that the benefits of the rope jumping were not lasting with regard to the ability to make benefit from the various energy systems only, but they indicated that they were also useful in the development of the explosive reaction power (Masterson, 1991). Given the differences before and after the trainings of the experimental and the control groups, we understood how important was the feature of anaerobic explosive power in terms of the basketball discipline, whereas the feature of having the anaerobic power continued was more significant in the experimental group and it can be said that rope skipping is significantly high effective in developing of this feature. The findings obtained support the literature.

In the study conducted on the biomechanics of the sprint conditions, it was stated that the reaction time of the successfull sportsmen was shorter compared to the others, but this difference was not linked directly to the performance levels (More et all, 1992). In the literatüre it was stated that the reaction time can be improved by trainings up to 0:12 mns (Dundar, 1998), it was emphasized that the reaction time could be improved by regular trainings (Bompa, 1998). In another study it was stated that the reaction time could be shortened by physical trainings done for a long time (Çolakoğlu et all, 1993). In the study where the effect of the exercise and heat load of the university students on the simple reaction time was investigated, it was reported that there was a significant decrease in both of the visual and the auditory reaction periods after the exercise (Chandra et all, 2010). In a study conducted, it was found out that the individiuals who perform the exercise with 115 heart rates in a minute, had a faster reaction time (Lewitt, 1971), in another study conducted, it was reported that the reaction time of the physically healthy individuals was faster (Welford, 1980). Although statistically significant decreases were seen in the visual and the auditory reactions times of the experimental and the control groups compared to the time before training, not having a significant difference between the groups may be an indication that the rope trainings were ineffective on the reaction time. In other words, it can be considered that there was a similarity between the visual and auditory reaction times of the experimental and the control group of the basketball players and this similarity was due to the necessity of creating a fast response to the rapid stimuli, existing in the content of the basketball discipline.

In one study, the reaction time of the trained athletes to visual stimuli is reported to be shorter than that of the untrained athletes (Williams and Walmsley, 2000). Although the findings of the study does not appear similar to the literatüre at first glance, the significant decrease of the visual reaction times was found to be more in the experimental group than that of the control group. The literature knowledge supports the study.

It was indicated that the responses to the auditory stimuli in the literature are shorter than the responses given to the visual stimuli (Williams and Walmsley, 2000). In the study, what the source of the sound was being not important in the occurrence of the faster auditory reaction time values in both of the groups, it can be interpreted that only hearing the sound stimuli was sufficient in the formation of the perception and the visual stimuli needed to be definitely seen and therefore, the reaction period was longer due to that reason.

Conclusion

As a result, it can be said that the rope trainings of the basketball players, applied with the explosive tempo and the repeat method are effective on the heart rate and the anaerobic characteristics and that they do not effect the visual and the auditory reaction time.

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