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# Effect of Weighted Rope Jumping Training Performed by Repetition Method on the Heart Rate, Anaerobic Power, Agility and Reaction Time of Basketball Players

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**ABSTRACT**

Total 40 male basketball players, who are competing in the level of junior teams and playing basketball for at least 3 years and whose ages varied between 16 and 19, have participated in this research that is made to examine effects of weighted rope jumping training performed by repetition method on the heart rate, anaerobic power, agility and reaction time of basketball players. Basketball players were separated into two groups randomly being experimental (n=20) and control (n=20) groups. After preparatory rope training for 1 week, training program including weighted rope jumping training by repetition method for 3 days in a week and for 8 weeks was implemented by the experimental group together with the technical training. For the control group, only technical training was applied for three days in a week over the course of 8 weeks. Age, basketball age, height, body weight, resting heart rate, heart rate immediately after the rope training, anaerobic peak and average power, hexagon agility test and right and left hand visual and auditory reaction times of experimental and control groups were measured. Statistical analyses of data obtained were realized in package program in the significance level of 0.05 by means of Paired Simple T-Test for data having normal distribution, and by Wilcoxon and Mann-Whitney U tests in dependent and independent groups for data that do not have a normal distribution. As a consequence, it can be stated that jumping training performed with weighted rope and by explosive tempo and repetition method has influenced the heart rate and anaerobic characteristics positively, and agility and reaction time negatively.

***Key words:*** Basketball, Rope Training, Weighted Rope, Anaerobic, Reaction.

## Introduction

Rope jumping training practiced as a heating or coordination method have an important place in the development of body coordination, and strengthen the general athletic position. Jumping with rope is an activity that can be done everywhere and its intensity, jumping number and type can be easily changed; and seems as significant implementation to develop and conserve the muscle strength and cardiovascular system, and helps in the preparation to sports branch and improves leg movements. Rope jumping training has positive effects on cardiac-circulation compatibility, muscle strength, endurance, mobility, flexibility, balance, coordination, vertical jumping, timing, rhythm and speed, fat-free body mass, bone density, and skill improvement [21]. In the literature, repetition number varies between 25 and 250 for each practice and between 500 and 2000 repetitions in the daily training for the rope training implemented by repetition method [12,13,27,30].

Weighted ropes are manufactured from rigid plastic or latex ropes in which sand, shot metals, iron filings, etc. are placed and they can be in different weights. Sporters physically in good condition should be selected. When it is combined with a weight training program, it helps to improve the upper body strength, and mainly exercises arm, shoulder and pectoral muscles. Main purpose of the jumping rope is to develop the hand-foot speed, agility, skills, reaction time and cardiovascular system. Weighted rope does not allow movements to be realized at a speed sufficient to provide these improvements since the time to continue jumping is limited [28,13].

Weighted ropes are generally designed in two different ways. In the first one weight is designed to be in the handles and it is efficient on the foot techniques by the basic jumping exercise; in the second one weight is designed to be in the rope section and this design increases the work load by means of the centrifugal force. When the weighted rope is utilized properly, it is efficient on the upper

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body, however if the sporter does not have the required qualifications, centrifugal force may cause disablement [28,13].

Studies reveal that 15% of the basketball game is realized at high intensity and success in basketball is dependent on development of anaerobic powers of sporters instead of their aerobic powers [19,9]. It became obligatory for the basketball players to have better perception, decision-making and implementation skills in today's fast basketball games. For this reason, due importance and place should be given to coordination training that shall increase conditional and technical-tactical skills of the basketball players [26].

Although there are studies on rope jumping exercises in the field of sports sciences, limited number of studies on basketball players and rope training program being different from the other studies in terms of material and method, constitute the basis of this study. Accordingly, the purpose of this study is to examine effects of jumping training with weighted rope on the heart rate, anaerobic power, agility and reaction time of the basketball players.

## Materials and Methods

Study is realized with the voluntary participation of total 40 male basketball players who are playing basketball for at least 3 years and whose ages vary between 16 and 19. Basketball players are randomly separated into two groups being experimental (n=20) and control (n=20) groups. After preparatory rope training for 1 week, training program including weighted rope jumping training by repetition method for 3 days in a week and for 8 weeks was implemented by the experimental group together with the technical training. For the control group, only technical training was applied for three days in a week over the course of 8 weeks.

Weighted rope with trade mark Powerope (V-3067) that has 260 cm length and 600 gr rope weight, and 695 gr. total weight was used for the experimental group in the study.

At first volunteers are informed about the implementation of the test orally, and then demonstrations are made practically. Measurements were taken by the researcher in the morning hours (09:00-10:00) and under the same environmental conditions in the laboratory medium as pretest-posttest.

*Test Protocols:*

*Age and Basketball Age:*

Ages of basketball players were found by subtracting birth year from the current year and their basketball age was found by subtracting the year he started to play as a registered player from the current year.

*Measurement of Height and Body Weight:*

Height measurement was found in cm with barefoot by utilizing medical type of height measuring device (sensitivity 0.01 cm, Holtain Ltd., UK), and body weight was measured by medical type of platform balance (sensitivity 0.01 kg, Angel) after sporters took off their clothes so that they have only shorts and t-shirts [29].

*Heart Rate:*

Resting heart rate was measured in pulse/min. by utilizing a digital heart rate monitor (Polar S720i Heart Rate Monitor, Finland) after basketball players stayed in laying position for 15 minutes, and heart rate after exercises was measured immediately after the rope training.

*Anaerobic Power Measurement:*

Anaerobic power was measured according to the Wingate Test protocol by standard methods suggested in bicycle ergometer adapted for this test (Monark, 894 E, Peak Bike, Sweden). Detailed information was given before starting the test, and a standard heating was applied at 50 rpm for 5 min. in order to provide physiological adaptation of basketball players to the bicycle ergometer. A resting period of 5 minutes was provided with the aim to eliminate fatigue seen after heating. Saddle and handlebar adjustments were made for each basketball player before the test. Sitting level was adjusted so that when basketball player is cycling in the position sitting on the saddle, knee is fully in extension when the pedal is in its lowest level, and his feet were fixed to the pedal by means of clips. After the resting period, test started by placing a weight corresponding to 7.5% of body weight of each basketball player to the pan of the bicycle as a load to be applied during the test. It is requested from them to maintain the highest maximal pedal speed possible for 30 sec. with load after 3-4 sec at the beginning without any load to reach the pedal speed determined (160-170 rpm). Basketball players were orally prompted during the test. At the end of test maximum power and average power of basketball players were transferred to the computer medium by RS32 application, and were recorded in terms of W/kg [11].

*Hexagon Agility Measurement:*

Test measures the ability of the basketball player to move at maximum speed by maintaining his balance. A hexagon with 120º corner angels and 60.5 cm side length was drawn to the ground. Basketball

player took his place exactly in the center of this hexagon, and he went out of the first side by jumping on his both feet and returned to the center. He turned both of his feet and face towards to the next side and jumped to all of the sides. 1st tour was completed when he jumped to all sides and returned back to the center, and test was completed when 3 tours were made. Chronometer was actuated together with the first jumping basketball player made outwards from the center and chronometer was stopped when the last jumping of the 3rd tour is made towards to the center. Result is recorded in terms of seconds [3].

*Visual and Auditory Reaction Time:*

In this study, visual and auditory reaction times of basketball players were determined by means of Newtest 1000 Device (precision 1/1000 sec.). Attention was paid in the measurement of reaction times that the place where the measurements were made was noiseless and receiving light. 1 test for both of the hands against audio and visual stimuli were realized for each experimental subject and then 3 measurements were made. The best value among the last 3 measurements is recorded in terms of milliseconds as the score of the subjects [29].

*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:***

The effects of jumping training with weighted rope and by repetition method on the heart rate, anaerobic power, agility and reaction time are examined in this study, and findings are expressed in the form of tables.

**Table 1:** Demographic Characteristics of Experimental and Control Groups.

| Variables | | Experimental Group (n=20) | P | Control Group (n=20) | p | Between Groups t | Between Groups p |
|---|---|---|---|---|---|---|---|
| Basketball Age (year) | BT | 6,75 ± 1,44 | 1 | 6,35 ± 1,42 | 1 | ,265 | ,657 |
| | AT | 6,75 ± 1,44 | | 6,35 ± 1,42 | | ,265 | ,657 |
| Age (year) | BT | 17,50 ± 1,08 | 1 | 17,50 ± 1,05 | 1 | ,000 | 1 |
| | AT | 17,50 ± 1,08 | | 17,50 ± 1,05 | | ,000 | 1 |
| Height (cm) | BT | 189,65 ± 8,32 | ,000* | 187,90 ± 8,02 | ,002* | ,677 | ,502 |
| | AT | 190,15 ± 8,13 | | 188,45 ± 7,80 | | ,675 | ,504 |
| Weight (kg) | BT | 80,80 ± 9,80 | ,055 | 81,75 ± 10,25 | ,209 | -,300 | ,766 |
| | AT | 80,20 ± 9,70 | | 81,45 ± 10,17 | | -,398 | ,693 |

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

A significant difference is observed in the height values of experimental and control groups before and after the training (p<0.05); however no significant difference is determined before and after the training in the intergroup comparison (p>0.05).

**Tablo 2:** Heart Rate, Anaerobic Power, Hexagon Test 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) | BT | 80,45 ± 5,68 | ,000* | 78,15 ± 5,04 | ,000* | ,530 | ,599 |
| | AT | 74,95 ± 4,73 | | 77,75 ± 4,91 | | -1,837 | ,074 |
| Heart Rate After Exercise (beats/min) | BT | 168,30 ± 13,70 | ,000* | 166,85 ± 11,27 | ,116 | ,366 | ,717 |
| | AT | 181,15 ± 11,50 | | 169,65 ± 13,57 | | 2,891 | ,006* |
| Peak Power (watt/kg) | BT | 14,22 ± 2,35 | ,000* | 13,71 ± 1,78 | ,008* | ,780 | ,440 |
| | AT | 16,28 ± 2,78 | | 14,13 ± 1,74 | | 2,929 | ,006* |
| Average Power (watt/kg) | BT | 7,07 ± 0,79 | ,000* | 7,23 ± 0,78 | ,645 | -,621 | ,538 |
| | AT | 8,08 ± 0,83 | | 7,29 ± 0,74 | | 3,190 | ,003* |
| Hexagon Test (sec) | BT | 14,45 ± 1,15 | ,012 | 14,05 ± 1,52 | ,001* | ,564 | ,143 |
| | AT | 13,73 ± 1,44 | | 13,02 ± 1,27 | | 2,676 | ,034* |
| Left Hand Reaction Time to Sound (sec ) | BT | 0,200 ± 0,03 | ,012* | 0,196 ± 0,02 | ,126 | ,439 | ,663 |
| | AT | 0,193 ± 0,02 | | 0,192 ± 0,02 | | ,088 | ,930 |
| Right Hand Reaction Time to Sound (sec ) | BT | 0,195 ± 0,03 | ,006* | 0,188 ± 0,02 | ,003* | ,829 | ,412 |
| | AT | 0,179 ± 0,02 | | 0,182 ± 0,02 | | -,363 | ,718 |
| Left Hand Reaction Time to Light ( sec ) | BT | 0,221 ± 0,03 | ,420 | 0,212 ± 0,02 | ,011* | 1,138 | ,262 |
| | AT | 0,216 ± 0,01 | | 0,205 ± 0,02 | | 2,192 | ,035* |
| Right Hand Reaction Time to Light (sec) | BT | 0,215 ± 0,02 | ,017* | 0,206 ± 0,02 | ,013* | 1,443 | ,157 |
| | AT | 0,201 ± 0,02 | | 0,200 ± 0,02 | | ,233 | ,817 |

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

Significant difference is detected in the experimental group values of resting heart rate and heart rate after training, peak power, average power, hexagon agility, audio reaction times of right and left hands and light reaction time of the right hand ($p<0.05$). Significant difference is found in the control group values of resting heart rate, peak power, audio reaction time of right hand and light reaction times of right and left hands ($p<0.05$). In the intergroup comparison, significant difference is determined in the values of heart rate after exercising, peak power, average power, hexagon test and light reaction time of left hand before and after the training ($p<0.05$), no important difference is detected in the other values ($p>0.05$).

***Discussion:***

Effects of rope training on the heart rate, anaerobic power, agility and reaction times of basketball players are investigated in this study, and it can be considered that volunteers in the experimental and control groups have similar phenotypes in terms of their physical characteristics since no significant difference between the age, basketball age, body weight and height values of sporters in the experimental and control groups is found.

In the literature, it is indicated that increase in length in the last period of puberty between ages 18 and 20 which is the period increase in length stops, is a natural consequence of individual differences [22]. Increase in the average length values of participant basketball players in both of the groups after the training may be associated with the continuation of puberty on the contrary to the effects of rope training. Literature information supports our study. On the other hand, statistically insignificant decrease in the body weight of the experimental group may arise from the influence of weighted rope training program applied.

It is informed in the literature that jumping with rope has positive effects on cardiovascular system [4]; and it is a significant implementation in developing and maintaining the muscle strength and cardiovascular system, and it improves foot movements as a support for the preparation for sports branch [25]. It is indicated that resting heart rate values are expected to be lower in well-trained sporters in comparison to the healthy but untrained individuals [8], and in another research it is informed that heart rate has decreased 4 to 9 pulses in one minute by means of exercising. In the strength training implemented by extensive interval method in the basketball players between ages 13-14, it is informed that resting heart rate has showed significant difference before and after training being respectively 84.67 ± 13.94 pulse/min. and 74.33 ± 11.24 pulse/min. [7]. At the end of the quick power and plyometric trainings applied to basketball players between ages 15-16, significant difference is determined in the resting heart rate of quick power group [23]. Even though significant decrease in resting heart rate of both groups in comparison to the value before training is thought-provoking, this situation may arise from the metabolic adaptation of basketball training that is applied routinely excluding the rope training and that is similar contextually. Literature supports our study.

In the research on aerobic and anaerobic reactions of male and females to rope jumping, 6 male and 6 female objects were subjected to maximal bicycle ergometer and rope jumping exercise where 120, 140 and 160 jumps were realized in one minute. In the study, heart rates were determined respectively as 185, 166, 168 and 178 pulse/min., and it is indicated that requirement to both aerobic and anaerobic sources during rope jumping exercises is high [24]. In study examining effect of rope jumping rate on the energy consumption in males and females, rope jumping exercise was made by 19 males and 11 females for 5 minutes so that they

would made 125, 135 and 146 jumps per minute. It is informed that heart rates of total sample were determined as 176, 177, and 177 pulse/min. and females have significantly higher heart rate than males [30]. In the therapy activity where 30 females between ages 18 and 31 have done jumping training one day with rope at the maximum difficulty level and other day without rope, it is informed that heart rate after jumping with rope is significantly higher than the rate after jumping without rope [1]. Increase in the heart rate of experimental group after exercising being more significant than the rate of control group may give rise to thought that weighted rope training applied with explosive tempo is efficient. Heart rate of experimental group increasing proportionally to $O_2$ intake and labor done may arise from the effect of weighted rope. Our findings show parallelism with the literature.

In the study where effect of weighted rope jumping training on the development of anaerobic capacity and explosive reaction power of college students is examined as an alternative to plyometric exercising; statistically significant improvement is observed in the value of anaerobic peak power after a training program of 10 weeks and 3 days in a week; and weighted rope jumping is suggested as an alternative that can be applied in highly efficient plyometric exercises [17]. In another doctorate study, it is indicated that benefits of rope jumping is not only limited to skill of utilizing various energy systems, but also it is fairly practical for the development of explosive reaction power [16]. Importance of anaerobic explosive power feature in terms of basketball branch is understood from the differences observed in experimental and control groups before and after training, and it can be stated that characteristic of maintaining anaerobic power is more significant for the experimental group and weighted rope jumping training is highly effective in improving this feature. Our findings support the literature.

In a study realized on college students, hexagon agility values were determined as 12.3 sec. in competitor sporters, 12.3 sec. in recreational sporters and 14.2 sec. in sedentary students [9]. In the literature, the main targets of jumping rope are identified as improving hand-foot speed, agility, ability, reaction time and cardiovascular system; and it is stated that since time to continue jumping with weighted rope is limited, it does not permit movements at a speed sufficient to provide these benefits [14,28]. In the study, statistically significant decreases are observed in the hexagon agility test values of experimental and control groups in comparison to the values before training; statistical difference being more significant for the control group may be indicating that weighted rope jumping training is inefficient on agility and influences it in a negative way.

In the study realized on biomechanics of sprint races, it is stated that reaction of time successful sporters is shorter than others; however difference is not directly connected to their performance levels [20]. It is indicated in the literature that reaction time may be improved via regular training [2]. In another study, it is reported that reaction time may be shortened by physical training performed for a long time [6]. In the study realized to determine the effect of exercising and heat strain on the simple reaction time university students, significant decrease is reported in the both visual and auditory reaction times before exercising [5]. In one study, it is specified that individuals performing exercises at a heart rate of 115 pulse/min. have a faster reaction time [15]; and in another study, it is indicated that reaction times of physically healthy individuals are faster [31]. Even though statistically significant decreases are observed in the visual and auditory reaction times of experimental and control groups in comparison to the values before training, it can be stated that weighted rope jumping training is inefficient on the reaction time, since there is no significant difference between the groups; in fact control group achieved better results. In other words, it can be considered that there is similarity in the visual and auditory reaction times of basketball players in the experimental and control groups, and this similarity arises from the necessity to respond promptly to the rapid stimuli existing in the context of basketball branch.

It is indicated in the literature that reactions given to auditory stimuli are shorter than the reactions given to visual stimuli [32]. It is also specified that source of sound is not important for faster auditory reaction times in both of the groups, and it is sufficient only to hear the sound stimulus for creation of the perception, on the other hand, visual stimuli should be seen and thus reaction time may be longer because of this reason.

*Conclusion:*

As a result, it can be said that weighted rope jumping training done by basketball players with explosive tempo and repetition method has positive effects on heart rate and anaerobic characteristics, and negative effects on reaction time.

## References

1. Bloch, M.W., D.A. Smith, D.L. Nelson, 1989. Heart Rate, Activity, Duration and Added-Purpose Versus Single-Purpose Jumping Activities. American Journal of Occupational Therapy, 43(8): 549-550.
2. Bompa, T.O., 1998. Antrenman Kuramı ve Yöntemi. Bağırgan Yayınevi, Ankara, 443.
3. Brittenham, G., 1996. Complete Conditioning for Basketball, Human Kinetics, New York, 100.

4. Cahperd, 2005. (Canadian Association for Health, Physical Education, Recreation and Dance), ''Rope Skipping Fitness and Activity Program'', http://www.cahperd.ca./(17.04.2005).
5. Chandra, A.M., S. Ghosh, S. Barman, R. Iqbal, N. Sadhu, 2010. Effect of Exercise and Heat-Load on Simple Reaction Time of University Students. International Journal of Occupational Safety and Ergonomics, 16(4): 497- 505.
6. Çolakoğlu, M., S. Selamoğlu, N. Gündüz, Ş. Acarbay, S. Çolakoğlu, 1993. Sprint ve Atlayıcıların Hamstring Quadriceps Kuvvet Oranlarının Düzeltilmesinde İzometrik Egzersizlerin Etkileri. Spor Bilimleri Dergisi, 4: 24-31.
7. Erol, E., 1995. Yaygın interval metot ile uygulanan dayanıklılık çalışmalarının 13-14 yaş grubu erkek basketbolcuların aerobik-anaerobik güç, vücut kompozisyonu ve bazı fizyolojik parametreler üzerine etkilerinin incelenmesi, Ph.D. Thesis. Gazi University Institute of Health Sciences. Department of Physical Education and Sport. Ankara, Turkey.
8. Fox, E.L., R.W. Bowers, L.M. Foss, 1988. (Çev. Mesut CERİT), Beden Eğitimi ve Sporun Fizyolojik Temelleri. 62-82.
9. Harman, E., J. Garhammer, C. Pandorf, 2000. Administration, Scoring, And Interpretation of Selected Tests. Essentials of Strength Training And Conditioning, 2nd Ed., (Edited By T.R. Baechle & R.W. Earle), Champaign, IL: Human Kinetics, 310.
10. Hoffman, J.R., C.M. Maresh, 2000. Physiology of basketball. In: Garrett W.E., Kirkendall D.T. (eds). Exercise and Sport Sciences Reviews. Lippincot Williams & Wilkins Philadelphia, 733: 1999.
11. Inbar, O., O. Bar-Or and J.S. Skinner, 1996. The Wingate Anaerobik Test. Champaign, IL: Human Kinetics, 2540.
12. Kim, S.H., H.Y. Kang, H.W. Chae, S.L. Jung, J.S. Lee, B.S. Kim, C.D. Lee, H.K. Byrne, 2001. Effects of 12-Weeks of Rope Skipping Exercise Training on Body Composition and Plasma Leptin of Obese Adolescent Boys. Medicine and Science in Sports and Exercise, 33(5): 228.
13. Lee, B., 2006a. Hyperformance Warm Up, Sprint and Power Program, http://www.jumpropeinstitute.com /training_programs.htm.(12.04.2006).
14. Lee, B., 2006b. Jump Rope Comparision, http://www.jumpropeinstitute.com/(05.03.2006).
15. Levitt Gutin, S., 1971. Multiple Choice Reaction Time and Movement Time During Physical Exertion. Research Quarterly, 42: 405-410.
16. Masterson, G.L., 1991. The effect of weighted rope jump training on selected power performance tests in collegians. PhD. thesis, The University of Mississippi, Mississippi.
17. Masterson, G.L., S.P. Brown, 1993. Effects of Weighted Rope Jump Training on Power Performance Tests in Collegians. The Journal of Strength and Conditioning Research, 7(2): 108-114.
18. Mc Elroy, M.B., N.S. Segel, 1969. Normal Şahıslarda Antrenman Süresince İstirahatte ve Egzersiz Esnasında Seri Halinde Yapılan Çalışmalar. Spor Hekimliği Dergisi, 4: 11.
19. McInnes, S.E., J.S. Carlson, C.J. Jones, M.J. McKenna, 1995. The physiological load imposed on basketball players during competition. J.Sports Sci., 13: 387-97.
20. More, A., P.V. Komi, R.J. Gregor, 1992. Biomechancis of Sprint Running. Department of Biology of Physical Activity. University of Jyvaskyla, Finland, 32.
21. Orhan, S., A. Pulur, A.E. Erol, 2008. The Effects of The Rope and Weigthed Rope Trainings on The Physical and Physiological Parameters of The Basketball Players. Firat University Journal of Health Sciences (Medicine), 22(4): 205-210.
22. Özer, D.S., M.K. Özer, 2000. Çocuklarda Motor Gelişim. Kazancı Matbaacılık A.Ş., İstanbul, 106.
23. Öztin, S., E. Erol, A. Pulur, 2003. 15-16 Yaş Grubu Basketbolculara Uygulanan Çabuk Kuvvet ve Plometri Çalışmalarının Fiziksel ve Fizyolojik Özelliklere Etkisi. Gazi of Physical Education and Sport Science, 8(1): 41-52.
24. Quirk, J.E., W.E. Sinning, 1982. Anaerobic and Aerobic Responses of Males and Females to Rope Skipping. Medicine and Science in Sports and Exercise, 14(1): 26-29.
25. Seabourne, T., 2006. "Lead Story: Breathing Exercises Can Increase Lung Capacity, Areas of Interest: Breathing, Jumping Rope, Diaphragmatic Breathing, Footwork, Relaxation". http://www.betterbodz.com/ Tom/jump_rope_training.html./16.04.2006.
26. Sevim, Y., 2006. Basketbol Teknik – Taktik Antrenman. 6. Baskı, Nobel Yayınevi, Ankara.
27. Sigmon, C., 2003. 52-Week Basketball Training. Human Kinetics, USA, 287.
28. Solis, K.M., 1992. Ropics: The Next Jump Forward in Fitness, Leisure Press Champaign, Illionis.
29. Tamer, K., 2000. Sporda Fiziksel-Fizyolojik Performansın Ölçülmesi ve Değerlendirilmesi. Bağırgan Yayınevi, ss 52-57. Ankara.
30. Town, G.P., N. Sol, W.E. Sinning, 1980. The Effect of Rope Skipping Rate on Energy Expendeture of Males and Females. Medicine and Science in Sports and Exercise, 12(4): 295-298.
31. Welford, A.T., 1980. Choice Reaction Time: Basic Concepts. In A.T. Weiford (Ed.), Reaction Times. Academiv Press, NewYork, 73: 128.

32. Williams, L.R. and A. Walmsley, 2000. Response Timing and Muscular Coordination in Fencing: A Comparison of Elite and Novice Fencers. The Journal of Science and Medicine in Sport, 3(4): 460-475.