Macrothink Institute™

Journal of Educational Issues
ISSN 2377-2263
2022, Vol. 8, No. 3, Special Issue

Investigation of the Effect of Resistance Training Applied Using Functional Exercise Band (TRX) and Body Weight Applied to Male Basketball Players Aged 15-17 on Selected Physical Characteristics

Sadettin Erol (Corresponding author)

Faculty of Sports Sciences, Uludag University, Bursa, Turkey

Tel: 053-2765-5425 E-mail: serol@uludag.edu.tr

Received: June 13, 2022 Accepted: August 1, 2022 Published: October 15, 2022

doi:10.5296/jei.v8i3.19972 URL: https://doi.org/10.5296/jei.v8i3.19972

Abstract

This study was planned to investigate the effect of resistance training applied using functional exercise band (TRX) and body weight applied to male basketball players aged 15-17 on selected physical characteristics. 30 elite basketball players in the youth category of Turkey were included in the study. Athletes; 13 athletes with a mean age of 16.00±0.707 years in the control group (CG) and 17 athletes with a mean age of 16.05±0.747 years in the experimental group (EG) were randomly divided into two groups. The experimental group was given TRX suspension training for 8 weeks with routine basketball training (3 days/week), a total training time of 45 minutes. The control group only did routine basketball training. Pre-tests of 2 groups of 30 athletes (leg extension leg curl, push-ups, sit-ups, (20 m) sprint, vertical jump and agility were taken at the end of 8 weeks before the exercises. Fully repeated measures ANOVA were used to make separate comparisons for the pre and post-measurements in the 8-week training sessions for the experimental and control training groups.

Pre- and post-measurements of the groups were compared.; According to the analysis of the data, a significant difference was observed in the values of leg extension, leg curl, push-ups, sit-ups and vertical jump tests ($p < 0.05$). In the comparison between the groups (20m), significant difference was observed between sprint and agilityt test values ($p > 0.05$).

However, TRX suspension training has shown that it can better improve leg curl, push-ups, sit-ups, and vertical jump performances in basketball players' objects.

Keywords: TRX suspension training, Physical fitness, Basketball, Performance

1. Introduction

Movement is expressed in a change of position any piece of the body or as a change of complete body position. Astrand indicates that the human organism is created to movement (Bastik et al., 2011). Strength can be defined as the ability to develop force against a resistance in a single contraction of restricted duration. Power is the result of applied strength, and it is also defined as the ability to move a resistance at speed. There is no doubt that most of soccer techniques and movements require a high level of strength. Strength training makes a soccer player more powerful in the aspect of performance which require power (Gümüşdağ, 1994).

Basketball is a dynamic team sport where aerobic and anaerobic enzyme activities are used together and requires a wide variety of sportive abilities. Actions with a high level of violence that require sudden acceleration and acceleration occur during offensive and defensive blocks in a basketball match (Obour et al., 2017). Basketball players during a match for 40 minutes; It performs many different activities such as dribbling, jumping, running at different intensities and covers a distance of approximately 4500-5000 meters. While 600 meters of this distance are running with fast acceleration at an average distance of 7 meters, the athletes change tempo 350 times, dribble 250 meters collectively and do short sprints 80 times, 50 stops, 500 times lower extremity activities in the defense block, 90 times jumping, arm movements on the defensive block 150 times, It was determined that he performed arm movements once, hip flexion 250 times and trunk rotation 360 times in the defense block (Narazaki et al., 2009). It contains all the features such as strength, speed, mobility, endurance, flexibility, agility, intelligence, technique and tactics in basketball games at different levels in many parts of the World (Vanmeerhaeghe et al., 2016). Due to the intense contacts in the basketball match, the lower extremity joints of the athletes are under high physical stress due to technical movements and intense physical activity (Mclmes et al., 1995). In order to perform such activities during the sportive performance during the basketball match, the neuron control and the central nervous system must be at an optimal level (Narazaki et al., 2009). Therefore, the key to success in sports branches is the acquisition of a good level of physical fitness. Athletes have an obligation to maximize their sports performance. For this reason, it can increase sports efficiency as a result of arranging training programs according to the needs and characteristics of the athletes by the coaches (Bompa & Haff, 2015). Many sports branches trying to achieve success have recently changed the training meteorites they use, and they give up the traditional training methods that they continue routinely during the season. Negative situations such as natural weights used in traditional strength and power exercises, physiological effects caused by exercise equipment, problems during activity, biomechanical problems have been the subject of research, and as a result, new approaches and trials have begun to be seen today (Anderson, Sforso, & Sigg, 2008; Dishman, Washburn, & Heath, 2004). Because of the importance of strength generation on the motoric characteristics of athletes, its development is the primary emphasis in many training program (Sale, 2002). For this reason, coaches are looking for new ways to increase the strength performance of athletes. Achieving this goal can be accomplished through both traditional and non-traditional training paths. In this context,

recently, different modified and new approaches have come to the fore especially in the training programs created with the athletes' own body weights. According to the American Council on Exercise and the American College of Sport of Sport Medicine (2013), TRX suspension training is a form of suspension training that uses bodyweight exercises to simultaneously improve strength, flexibility, balance and core stability. In general, in TRX suspension training, rope and cord are used, where muscle contraction occurs from the distance between the central axis of the rope and consists of two handles and a body. At the same time, TRX suspension training is more effective as it is done with wider and activities compared to traditional weightlifting exercises. In addition, TRX suspension training is seen as a good option for both young athletes and elite athletes due to its ease of use and management (Ratamess, 2011). Trainers use suspension devices to better regulate functional activities that can increase athletic efficiency (Behn & Colada, 2012). In general, TRX suspension training improves the functions of the muscle spindles and golgi tendons and improves balance and stability due to the stress on the abdominal muscles and pelvic floor muscles (Usgu, 2015). TRX suspension training uses varying levels of muscle strength in agonist (*i.e.*, prime mover), assistor (*i.e.*, secondary mover) and synergistic (*i.e.*, stabilizer) skeletal muscle, which can be manipulated quickly and easily with various position modifications with intensity Pastuucha et al., (2012). Due to the nature of basketball, Considering the positive effects of TRX suspension training on physical fitness parameters, this type of suspension training may be suitable for basketball players aged 15-17. However, the literature on the effect of TRX Suspension training on physical fitness parameters for 15-17 year old basketball players is not very rich. Therefore, the aim of this study was to examine the effect of TRX Suspension Training applied to 15-17 year old male basketball players on some physical fitness parameters. This pilot study provides information on the feasibility and feasibility of TRX suspension training developed for basketball players aged 15-17.

2. Method

2.1 Participants

Our study was carried out in Bursa Uludağ University Faculty of Sports Sciences and Derin Sports Academy. 30 elite basketball players in the youth category of Turkey were included in the study. 30 elite basketball players in the youth category of Turkey were included in the study. When the athlete history of the football players who accepted to participate in the study was examined, it was determined that they had a training history of 8±0.4 years. Basketball players; 13 athletes (CG) with a mean age of 16.00±0.707 years and 17 Basketball players (EG) with a mean age of 16.05±0.747 years were randomly divided into two groups. Prior to our study, it was approved by This study was approved by Bursa Uludağ University Faculty of Medicine Clinical Research Ethics Committee Decision No: 2021-14/4 Date: 6 October 2021.

2.3 Training Program

TRX suspension training was introduced in a sample session (Table 1). The study was carried out in two sessions, familiarity and experimental. They did it at the same time in the morning, a week apart. The experimental group performed TRX suspension training 3 days a week for 1

week, and the Basketball players became familiar with the exercise procedures. In addition to routine basketball training (3 days/week) for 8 weeks, TRX suspension training with a total training duration of 45 minutes was given to the experimental group. In the control group, only routine basketball training was applied (Table 1).

Tablo 1. Training program

Movement	**1. Week**	**2. Week**	**3. Week**	**4. Week**	**5.Week**	**6. Week**	**7. Week**	**8. Week**
TRX Stepping Side Lunge (rpe)	8 right 8 left	8 right 8 left	8 right 8 left	10 right 10 left	10 right 10 left	10 right 10 left	12 right 12 left	**12 right** **12 left**
TRX Single Leg Squat (rp)	8 right 8 left	8 right 8 left	8 right 8 left	10 right 10 left	10 right 10 left	10 right 10 left	12 right 12 left	**12 right** **12 left**
TRX Squat (rpe)	8 right 8 left	8 right 8 left	8 right 8 left	10 right 10 left	10 right 10 left	10 right 10 left	12 right 12 left	**12 right** **12 left**
TRX Suspended Lunge	8 right 8 left	8 right 8 left	8 right 8 left	10 right 10 left	10 right 10 left	10 right 10 left	12 right 12 left	**12 right** **12 left**
TRX "Y" Deltoid Fly (rpe)	8	8	8	10	10	10	12	**12**
TRX Hamstring Curl Hips (rp)	8	8	8	10	10	10	12	**12**
TRX Push-Up (rpe)	10	10	10	12	12	12	15	**15**
TRX High Back Row (rpe)	10	10	10	12	12	12	15	**15**
TRX Chest Press (rpe)	10	10	10	12	12	12	15	**15**
Number of Set (rpe)	3	2	3	2	3	2	3	**2**
Rest between Repeats (sn)	30-60	30-60	30-60	30-60	30-60	30-60	30-60	**0-60**
Set Break Rest (min)	2-3	2-3	2-3	2-3	2-3	2-3	2-3	**2-3**
Movement (min/rpe)	30	30	30	30	30	30	30	**30**
(Day/Week)	**3day/45min**	**3day/45min**	**3day/45min**	**3day/45min**	**3day/45min**	**3day/45min**	**3day/45min**	**3day/45min**

2.4 Experimental Procedure

The first measurements of the study were made during the preparation period of the annual training period, and the last measurements were made at the beginning of the competition period. Before the research, all of the athletes were given detailed information about the risks they may encounter and the possible negative aspects of the research, and the volunteering form was read to them. The parents of the athletes were asked to fill in and sign a consent form in the form of a parent approval letter. In addition, it was explained to the athletes and their families that there was no injury before or during the training that could affect the training. A preparatory session with demonstrations and practice of tests was conducted for all subjects to familiarize themselves with the test procedures prior to the pretest. Before TRX suspension training, pre-tests of 2 groups consisting of 30 athletes (leg extension leg curl, push-ups, sit-ups, (20m) sprint, vertical jump and agility were taken at the end of 8 weeks of TRX suspension training (Table 2). General and special warm-up was done for 20 minutes before the tests. The subjects were not given a heavy training program within 24 hours before the test.

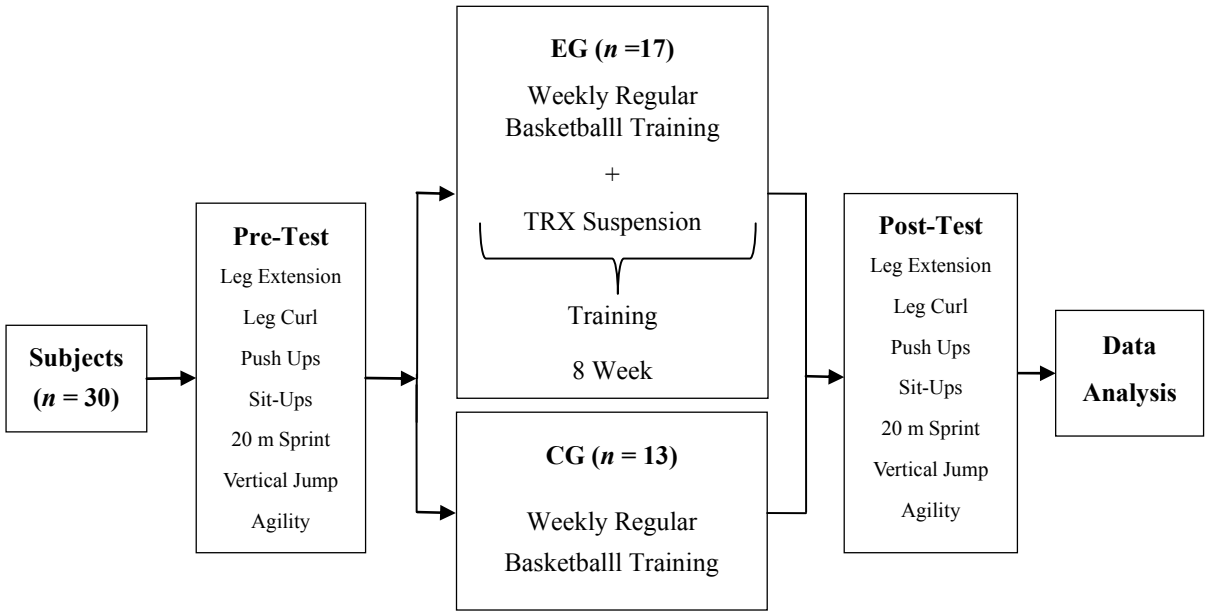

Figure 1. Flow chart of intervention

2.4.1 Body Composition

Subjects' heights were measured barefoot using a precise height scale (Soehnle-Waagen GmbH & Co. KG). Bodyweight was measured using a bioelectrical impedance device (TANITA, TBF-300, Tokyo, Japan) barefoot while the subjects had light clothing on.

2.4.2 1 Repetition Maximum Tests (Leg)

1 RM: 1 RM of the study was determined according to the Brzycki equation. According to this formula, 1 RM is estimated as follows: 1 RM = Weight ÷ [1.0278 − (0.0278 × Number of repetitions)] (Brzycki, 1993).

2.4.3 The Push-Up Test

A 1/1000 precision stopwatch was used in the 30-second push-up test of the subjects. The subjects were placed in the starting position on the gymnastic mat on the floor, arms shoulder-width apart, elbows straight, knees not touching the ground and not hanging down in the waist area. Start with command, the athlete brought his body close to the ground 90 degrees and returned to the starting position again. In this position, the test was continued for 30 seconds. The value obtained by the subjects at the end of the test period was taken as the test score (Mackenzie, 2005).

2.4.4 Sit-Ups Test

A 1/1000 precision stopwatch was used in the 30-second shuttle test of the subjects. With the subjects lying on their back, knees bent, hands on the back of the neck and soles of the feet touching the ground, the athlete did sit-ups quickly for 30 seconds with the Start command. During the sit-ups, the feet were held to be stable. While the subjects were in the lying position, the shoulders were on the ground, and when they straightened, the elbows touched the knees. In this position, the test was continued for 30 seconds. The value obtained by the subjects at the end of the test period was taken as the test score (Pekeli, 2007).

2.4.5 (20 m) Sprint Test

After the 20 m distance was determined as a running track, 2 wireless Sinar (Turkey) brand photocells were installed. The subjects were asked to complete the limited distance of 20 m by running at maximal speed in the high starting position. The best score was obtained by measuring the run time with a photocell in ‘sec’ and repeating the test twice (Ayan & Mülazimoğlu, 2009).

2.4.6 Vertical Jump Test

For the vertical jump test, a 2 m long, 60 cm wide board was fixed to the wall at a height of 155cm from the floor. Subjects were asked to first touch the highest point where they could extend their arm and then touch the highest point they could reach by jumping. The distance between the height that the subjects could reach while standing and the distance they could reach with the maximal jump was taken as a score in cm (Kamar, 2008).

2.4.7 Illinois Agility Test

Newtest timer electronic two-door photocell was used in the Illinois agility test. Four rectangular cones were placed at each corner of an area 10 m long and 5 m wide. The area was divided vertically (2.5 m), 4 cones at 3.3m intervals were placed on a line. The subject started running at maximum speed with the start command and aimed to cover the distance between

the start and finish in the shortest time. The time run was measured with a photocell in 'sec' and the test was repeated twice to get the best score (Kizilet, Atalin, & Erdemir, 2010).

2.5 Data Analysis

Within each study group 2 (training group: EG and CG) ×2 (time: pre and post-test) fully repeated measures ANOVA were employed to make comparisons over the 8 - weeks training sessions for the EG and CG groups separately for pre and post measurements. Values reported are mean and standard deviation (SD). The significance level was set to $p < 0.05$.

3. Results

In this study, the effect of TRX suspension training applied to 15-17 years old male basketball players on some physical fitness parameters was investigated. The comparison of the values obtained as a result of the statistical analysis explained in detail in the data analysis subsection of the method section and their descriptive values are presented in Tables 2 and 3. 50/5.000 Volunteer (n = 30) basketball players participated in the study. The mean age of the experimental group was 16.05±0.747 years, the mean height was 181.00±4.43 (cm), and their body weight was 82.84±8.12 (kg). The physical fitness parameters of the basketball players whose mean age was 16.00±0.707 years, average height 179.00±3.26 (cm) and body weight 80.52±3.46 (kg) in the control group are given in Table 2.

Table 2. Comparison of descriptive characteristics of (EG) and (CG) subjects

Variables	**(EG) (n = 17)**			**(CG) (n =13)**		
	Mean±SD	Min	Max	Mean±SD	Min	Max
Age (years)	16.05±0.7	15	17	16.00±0.7	15	17
Height (cm)	190±4.4	181	202	184.2±3.2	179	190
Weight (kg)	82.8±8.1	67.5	101.7	80.5±3.4	75.8	87.9

When the pre and post-measurements of the groups were compared; A statistically significant difference was observed between the comparison of the values obtained as a result of the data analysis and the descriptive values of leg extension, leg curl, push-ups, sit-ups and vertical jump tests ($p < 0.05$). In the comparison between the groups (20 m), statistically significant difference was observed between the sprint and agilityt test examinations ($p > 0.05$). Table 3 is also given.

Table 3. Comparison of the changes in 8-weeks training between (EG) and (CG) subjects

Variables	(EG) (n = 17)		(CG) (n =13)		*F*	*P*	η_p^2
	Pre-test Mean±SD	Post-Test Mean±SD	Pre-test Mean±SD	Post-Test Mean±SD			
Leg Extension (kg)	96.07±19.32	103.76±20.02	84.38±10.72	79.59±8.17	32.821	.000	.73
Leg Curl (kg)	79.61±11..64	84.69±12.65	73.76±13.24	70.00±13.94	22.289	.000	.650
Push-ups (Rp)	24.38±13.81	29.23±11.89	25.92±9.03	24.23±0.03	33.814	.000	.738
Sit-Ups (Rp)	19.38±4.21	28.92±3.80	19.15±3.80	17.76±4.12	67.702	.000	.849
(20 m) Sprint (sec)	3.21±.165	3.17±.228	3.31±.261	3.41±.303	5.397	.039	.310
Vertical jump (cm)	34.00±8.40	36.15±5.82	39.46±8.40	34.69±7.20	12.526	.004	.511
Agility (sec)	16.21±.819	15.89±.786	17.34±.918	17.34±.994	7.832	.016	.395

4. Discussion

The aim of this study was to examine the effect of TRX suspension training applied to 15-17 years old male basketball players on some physical fitness parameters. The main findings in the present study show that; When the preliminary and final measurements of the groups after TRX suspension training were compared; According to the analysis of the data, a significant difference was observed in the values of leg extension, leg curl, push-ups, sit-ups and vertical jump tests ($p < 0.05$). In the comparison between the groups (20m), statistically significant difference was observed between the sprint and agilityt test examinations ($p < 0.05$). trength is one of the main physical fitness features in basketball. Although jumping power and shooting power come to the fore, the importance of thigh, chest, back and arm muscles is very important for the formation of these abilities (Dendas, 2010). Accelerating or decelerating the body by creating dynamic stabilization in sports branches such as basketball, which consists of successive regular movements, requires many muscle activations. When the literature is scanned; Functional movements such as TRZ increase neuromuscular efficiency with movement patterns specific to the sport branch, as well as contribute to functional proforma (Distefano et al., 2013). The goal of functional exercises is to develop features such as strength, flexibility, balance and coordination required for movement (do Rosario, 2017). Basketball is a dynamic and explosive sport full of intensity and contact. Athletes can simulate mobility on the basketball court using TRX suspension training exercises. Thanks to the diversity and uneven loads in TRX suspension training, it further develops the core muscle strength and stability element necessary for movements on the field (Tyshchenko et al., 2016). In a similar study, Elite high school baseball players applied a 16-week program of functional exercises and an increase in the strength characteristics of the athletes was observed (Gayagay, 1998). TRX suspension training found an increase in vertical jump performance due to the positive adaptation of core muscles, back muscles and leg muscles (Usgu, 2015). Shaik and Mondal

(2012), in their study examining the effects of functional training on motoric features, functional training provided a 5.2% increase in vertical jump for 8 weeks. They found an increase of 0.42 cm as a result of functional strength exercises in 33 baseball players (Jenkins & Kieffer, 2011). 21 male elite swimmers in the 13 age group participated in the research titled 21 male elite swimmers aged 13 years participated in the research titled "The effect of strength training using functional exercise band and body weight on swimming performance", and an increase in vertical jump value was observed as a result of the 8-week study (Şenol, 2015). They stated that strength training affects vertical jump positively (Sannicandro, Cofano, & Rosa, 2015). These studies are similar to our study. The results of this study show an improvement in explosive strength and power (leg extension, leg curl, push-ups, sit-ups), which means neurological adaptations of the TRX training program, and this leads to the improvement of the vertical jump feature. The results of the current study show that even 8 weeks of TRX suspension training can be effective in developmental stages for young athletes. Mate-Munoz et al, (2014), on the other hand, performed the speed tests of elite and non-elite football players after the end of the season and did not find a statistically significant difference in the 30m speed test value. When the studies in the literature were examined, when the leagues of elite football teams were compared with their physical fitness characteristics, they did not find a statistically significant difference, similar to our study, in terms of speed values (Arnason, 2004). Tomljanovic et al. (2011) compared functional training with traditional strength training on 23 healthy people in 5 weeks, and there was no change in the speed before and after training in both groups. Similar to our findings, this may be the result of performing most of the exercises in the training in a bilateral vertical plane, due to the lack of agility-specific exercises demanded by agility tests in the training program (*e.g.*, changes of direction, breaking, starting movements) and the relative lack of improvement in sprint performance. Differences in strength training between the selected sprint distance and protocols may have an effect. In addition, it may be related to the inadequacy of specific speed training and the effect of functional exercises on speed during this study period. Insignificance in agility test $p > 0.05$), A total of 41 volunteer male athletes, including 13 defensive, 14 midfield and 14 offensive players, playing football in the U-16 and U-18 youth teams of a professional sports club participated in this study. First, the anthropometric measurements of the athletes, then 10-30 m speed, active and squat jumping, flexibility and finally 20 m shuttle run tests were performed and the measurements were completed. Stadiometer measuring height of the subjects with mm precision, body weight tanita device, 10-30 m speed values newtest 1000 battery and photocell device, active and squat jump values, newtest 1000 battery and mat tool on which the subjects jumped, flexibility measurement values The reachreach flexibility table and shuttle run values were also taken using the shuttle run test timer and the measurements were completed (Egesoy et al., 2021). We think that the meaninglessness in the agility test ($p > 0.05$) is due to the fact that the suspension training content we programmed is more focused on strength development.

5. Conclusion

As a result, it has become a tool for advancing technological possibilities to further the limits of human beings. However, many training tools are being developed to improve the physical

fitness characteristics of athletes. In our research, we used TRX suspension training, which is used today, and observed that TRX suspension training can better increase leg extension, leg curl, push-ups, sit-ups and vertical jump performances in male basketball players aged 15-17 for 8 weeks. According to these studies, we can say that the use of TRX suspension training in male basketball players aged 15-17 will make positive contributions.

References

Anderson, C. E., Sforzo, G. A., & Sigg, J. A. (2008). The effects of combining elastic and free weight resistance on strength and power in athletes. *The Journal of Strength & Conditioning Research, 22*(2), 567-574. https://doi.org/10.1519/JSC.0b013e3181634d1e

Arnason, A., Sigurdsson, S. B., Gudmundsson, A., Holme, I., Engebretsen, L., & Bahr, R. (2004). Physical fitness, injuries, and team performance in soccer. *Medicine & Science in Sports & Exercise, 36*(2), 278-285. https://doi.org/10.1249/01.MSS.0000113478.92945.CA

Ayan, V., & Mülazimoğlu, O. (2009). An investigation of the physical characteristics and some performance profiles of 8-10 year old boys in sports talent selection and orientation to sports (Ankara Example). *Firat University Med. Journal of Health Sciences, 23*(3), 113-118.

Bastik, C., Kalkavan, A., Yamaner, F., Sahin, S., & Gullu, A. (2012). Investigation of basic motor skills according to TGMD-2 test on male athletes of 10 ages group who participated to competitions in different sports branches. *Social and Behavioral Sciences, 46*, 4741-4745. https://doi.org/10.1016/j.sbspro.2012.06.328

Behm, D., & Colado, J. C. (2012). The effectiveness of resistance training using unstable surfaces and devices for rehabilitation. *International Journal of Sports Physical Therapy, 7*(2), 226.

Bompa, T. O., & Haff, G. G. (2015). *Dönemleme: Antrenman kurami ve yöntemi*. Beşinci Basim, Ankara: Spor Yayinevi ve Kitabevi.

Brzycki, M. (1993). Strength testing—Predicting a one-rep max from reps-to-fatigue. *Journal of Physical Education, Recreation & Dance, 64*(1), 88-90. https://doi.org/10.1080/07303084.1993.10606684

Cometti, G. (1999). *Fútbol y musculación.* INDE Publicaciones, Barcelona, Spain.

Dendas, A. M. (2010). *The relationship between core stability and athletic performance* (Unpublished doctoral dissertation, Humboldt State University, California).

Dishman, R. K., Washburn, R. A., & Heath, G. W. (2004). *Physical activity epidemiology*. Champaign, IL: Human Kinetics.

Distefano, L. J., Distefano, M. J., Frank, B. S., Clark, M. A., & Padua, D. A. (2013). Comparison of integrated and isolated training on performance measures and neuromuscular control. *J Strength Cond Res, 27*(4), 1083-90. https://doi.org/10.1519/JSC.0b013e318280d40b

do Rosario, J. T., da Fonseca Martins, N. S., Peixinho, C. C., & Oliveira, L. F. (2017). Effects of functional training and calf stretching on risk of falls in older people: A pilot study. *Journal of Aging and Physical Activity, 25*(2), 228-233. https://doi.org/10.1123/japa.2015-0316

Egesoy, H., Gümüşdağ, H., Kirkaya, İ., İlhan, A., & Işik, A. S. (2021). The comparison of the structural and motoric properties of junior players according to their positions in soccer. *International Refereed Academic Journal of Sports, Health and Medical Sciences, 38*, 1-12. https://doi.org/10.17363/SSTB.2020/ABC89/.38.1

Fort-Vanmeerhaeghe, A., Montalvo, A., Latinjak, A., & Unnithan, V. (2016). Physical characteristics of elite adolescent female basketball players and their relationship to match performance. *Journal of Human Kinetics, 53*(1), 167-178. https://doi.org/10.1515/hukin-2016-0020

Gayagay, G., Yu, B., Hambly, B., Boston, T., Hahn, A., Celermajer, D. S., & Trent, R. J. (1998) Elite endurance athletes and the ACE I allele—The role of genes in athletic performance. *Hum Genet, 103*(1), 48-50. https://doi.org/10.1007/s004390050781

Gümüşdağ, H. (1994). *Measurement and Evaluation of Physiological Components of Professional Soccer Players of MKE Ankaragücü, Petrolofisi and Şekerspor Soccer Teams* (p. 15, Unpublished Master Thesis, Middle East Technical University, Ankara).

Jenkins, N. D., & Kieffer, H. S. (2011). The effects of a functional vs. traditional pre-season resistance training program on athletic performance, *Medicine & Science in Sports & Exercise, 43*(5), 835. https://doi.org/10.1249/01.MSS.0000402327.09468.45

Kamar, A. (2008). *Aptitude, Skill and Performance Tests in Sports*. Ankara: Nobel Publications.

Kizilet, A., Atilan, O., & Erdemir, İ. (2010). The effect of different strength trainings on the quickness and jumping abilities of basketball players aged 12-14 years. *Ataturk University Journal of Physical Education and Sports Sciences, 12*(2), 44-57.

Mackenzie, B. (2005). Performance evaluation tests. *London: Electric World PLC, 24*(25), 57-158.

Maté-Muñoz, J. L., Monroy, A. J. A., Jiménez, P. J., & Garnacho-Castaño, M. V. (2014). Effects of instability versus traditional resistance training on strength, power and velocity in untrained men. *Journal of Sports Science & Medicine, 13*(3), 460.

McInnes, S. E., Carlson, J. S., Jones, C. J., & McKenna, M. J. (1995). The physiological load imposed on basketball players during competition. *Journal of Sports Sciences, 13*(5), 387-397. https://doi.org/10.1080/02640419508732254

Narazaki, K., Berg, K., Stergiou, N., & Chen, B. (2009). Physiological demands of competitive basketball. *Scandinavian Journal of Medicine & Science in Sports, 19*(3), 425-432. https://doi.org/10.1111/j.1600-0838.2008.00789.x

Obour, A., Moses, M. O., Baffour-Awuah, B., Asamoah, B., Sarpong, P. K., Osei, F., & Appiah, E. J. (2017). Differences in physical, physiological and motor performance traits between volleyball and basketball athletes in a university in Ghana. *Nigerian Journal of Physiological Sciences, 32*(1), 27-31.

Pastucha, D., Filipcikova, R., Bezdickova, M., Blazkova, Z., Oborna, I., Brezinova, J., & Bajorek, J. (2012). Clinical anatomy aspects of functional 3D training—Case study. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub, 156*(1), 63-69. https://doi.org/10.5507/bp.2012.016

Pekel, H. A. (2007). *A normative study on some variables in children aged 10-12 years, depending on the search for abilities in athletics (example of Ankara province)* (Unpublished Doctoral Dissertation, Gazi University, Institute of Health Sciences, Ankara).

Ratamess, N. A. (2011). Strength and conditioning for grappling sports. *Strength & Conditioning Journal, 33*(6), 18-24. https://doi.org/10.1519/SSC.0b013e31823732c5

Sale, D. G. (2002). Postactivation potentiation: Role in human performance. *Exercise and Sport Sciences Reviews, 30*(3), 138-143. https://doi.org/10.1097/00003677-200207000-00008

Sannicandro, I., Cofano, G., & Rosa, A. R. (2015). Strength and power analysis in half squat exercise with suspension training tools. *Journal of Physical Education and Sport, 15*(3), 433-440.

Shaikh, A., & Mondal, S. (2012). Effect of functional training on physical fitness components on college male students—A pilot study. *Journal of Humanities and Social Science, 1*(2), 01-05. https://doi.org/10.9790/0837-0120105

Şenol, M. (2015). *The effect of strength training exercises performed using a functional exercise band and body weight on swimming performance* (Unpublished Master's Thesis, Marmara University Institute of Health Sciences, İstanbul).

Tomljanović, M., Spasić, M., Gabrilo, G., Uljević, O., & Foretić, N. (2011). Effects of five weeks of functional vs. traditional resistance training on anthropometric and motor performance variables. *Kinesiology, 43*(2), 145-154.

Tyshchenko, V., Hnatchuk, Y., Pasichnyk, V., Bubela, O. O., & Semeryak, Z. (2018). Factor analysis of indicators of physical and functional preparation of basketball players. *Journal of Physical Education and Sport, 18*, 1839-1844.

Usgu, S. (2015). *The effect of functional training on performance-related physical fitness parameters in professional basketball players* (Unpublished PhD Thesis, Hacettepe University, Ankara).