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ORIGINAL RESEARCH

Investigation of the Effect of Anthropometric Measurements of 11-12 Years Old Female Swimmers on Flexibility Parameter

Abstract

This study was conducted to investigate the effect of anthropometric measurements on flexibility parameter of 11-12 years old female swimmers. 36 female swimmers aged 11-12 who trained in the Van Indoor Olympic Swimming Pool voluntarily participated in the study. The participants had an average age of 11.44 years, average height of 153.0 cm and average body weight of 44.04 kg. Diameter, perimeter, length and subcutaneous fat fold values were recorded with the anthropometric set. For the flexibility measurement, sit-reach test was taken and for the other flexibility measurements; shoulder flexibility test, dorsal and planter flexion, V-sitting test and hamstring flexibility test were used. The data collected were analyzed using the SPSS 21.0 statistical package program. Pearson correlation test and descriptive statistics were used in the analysis of the data and their significance levels were examined ($p<0.05$). A statistically significant difference was found between some of the anthropometric measurements and the sit-reach test of the female swimmers ($p<0.01$). A statistically significant difference was found between the anthropometric measurements and other flexibility tests of the female swimmers ($p<0.01$). A statistically significant difference was found between upper body length the left wrist planter flexion ($p<0.05$). A statistically significant difference was found between height-overarm difference and shoulder diameter and foot length ($p<0.05$). In conclusion, the effect of anthropometric measurements on flexibility parameter of 11-12 year old female swimmers was found to be significant in our study. Female swimmers aged 11-12 who receive regular swimming training can be said to have improved flexibility levels and increased sporting performance.

Keyword: swimming, anthropometry, flexibility, women.

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This study was prepared as a Master thesis.

INTRODUCTION

Sports are preferred in the development of physical and mental health, in the use of leisure time, in meeting the need to move, for entertainment and games. Sports significantly contributes to the physical and mental development of children, especially in the developmental age. It is known that growth and development change with physical activities as well as factors such as hereditary characteristics, nutrition and environment. Although the concept of sports has a period as old as human history, it has become an increasingly important place in society as time passes. In ancient times, people used their skills in swimming and diving to get rid of wild animals and their enemies and avoid water accidents. It is known that in ancient times, people swam across the river instead of building a bridge. (Şen, 2001; Aracı, 1999; İnal, 2003; Heper, 2012; Soydan, 2006; Bozdoğan, 1986).

Swimming is one of the sports performed in water providing physical development in the most perfect way. Due to the fact that this sport is carried out against the water resistance, swimming improves body resistance without any wear-out effects. In addition, swimming, one of the rare sports used in Physical Therapy, provides symmetrical and balanced development of body muscles (Bozdogan, 2006). Swimming requires a combination of physical strength and technical skill (Bozdogan, 1986; Bozdogan and Özüak, 2003).

When the sport branches are examined individually, it is observed that athletes engaging in these branches have different physical properties such as different body weights, height and body fat index. Various evaluation methods are used to evaluate the athletes' inclination to the branch they engage in, the risk of injury and training, or to understand the changes happening on the body. These can also be classified as anthropometric and physiological measurements (Bayraktar and Kurtoglu, 2009). Measurement taken from designated points of the body to evaluate the structure and composition of the body, such as diameter, perimeter, length and subcutaneous fat fold values are called anthropometry (Ergen et al., 2002).

In swimming, both the intensity of the training and the fact that the exercises are done against a certain resistance in the water are an important reason for the increase of flexibility. It is known that this has a positive effect on athlete development. The most important feature of a healthy athlete is good static and dynamic flexibility (Odabaş, 2003).

It is known that the wide angle of movement of the ankle, shoulders and waist in swimming give the athlete an important advantage. Swimmers are therefore known to be extremely flexible (Odabaş, 2003). Flexibility is one of 5 basic motoric features. Furthermore, flexibility is explained as the movements made at the widest angle and at ease (Dündar, 2012). When evaluated in terms of body structure and athletic fitness, flexibility is a crucial performance criteria and it is known to be connected with anthropometric characteristics (Özer, 1993). Within the individual sports, swimming gets more interest by people day by day with the help of the Olympic Games. Children who start swimming at an early age are more likely to succeed. More and more families understand the importance of swimming and encourage their children to take part in this sport. The aim of this study is to determine whether anthropometric characteristics of 11-12 year old female swimmers are related to the effect of flexibility parameter.

MATERIALS and METHODS

The System of Research

The group of the study consists of 11-12 age group swimmers and the sample consists of 36 female swimmers aged 11-12 who trained in the Van Olympic Swimming Pool.

36 female athletes who participated in the study voluntarily underwent sit-reach tests, shoulder mobility tests, v-sit tests, and hamstring flexibility measurements with goniometer, dorsi flexion-planter flexion tests. In addition, anthropometric measurements of length, diameter, perimeter and subcutaneous fat folds were taken with the Holtain brand anthropometric set. The Anthropometric Assessment Form created to record the information of the students involved in the research is given to the participants. As well as the personal information of the students, this Anthropometric Evaluation Form consists of individual charts to determine the somatotype structures of the students, such as height, weight, perimeter, length and subcutaneous fat fold and flexibility test results.

Taking Anthropometric Measurements

Anthropometric measurement tools: Seca brand inflexible tape measure, Tanita brand electronic scale, Holtain brand skinfold caliper and anthropometric measurement set were used for anthropometric measurements. Anthropometric evaluation of the swimmers participating in the study was repeated twice at the beginning and end of the study. The swimmers have been measured in swimsuits. Measurements were conducted by the same person each time, every measurement was conducted twice and the average score was recorded as the study data.

Flexibility Tests Used

The subjects were asked to do warm-up movements before taking flexibility tests, and then they were given comfortable clothing that would not restrict flexibility. Flexibility data taken from subjects in appropriate positions in areas where flexibility tests were conducted were carefully measured and recorded.

Statistical Analysis

In the analysis of the data obtained from the study, SPSS 20 package software was used for descriptive statistics such as arithmetic mean (x), minimum and maximum values of standard deviation (Sd), and Pearson Correlation parameter was used to evaluate the relations between Flexibility, Planter Flexion, Dorsiflexion, Shoulder Mobility Test, Goniometric Test Procedures With Hamstring Criteria and right and left foot Anthropometric variables.

FINDINGS

Table 1. Table of Correlation between Some Anthropometric Measurements and Sit-Reach Test of Female Swimmers Participating in the Study

		Height	Body Weight	Biceps Flexion Perimeter	Thigh Perimeter	Calf Perimeter	Upper Body Length	Height-Overarm Difference
Height	r.							
	Sig.							
Body Weight	r.	.717**						
	Sig.	0.000						
Biceps Flexion Perimeter	r.	.516**	.865**					
	Sig.	0.001	0.000					
Thigh Perimeter	r.	.544**	.692**	.804**				
	Sig.	0.001	0.000	0.000				
Calf Perimeter	r.	.647**	.823**	.858**	.880**			
	Sig.	0.000	0.000	0.000	0.000			
Upper Body Length	r.	.331*	.273	.190	.148	.180		
	Sig.	0.049	0.107	0.267	0.391	0.293		
Height-Overarm Difference	r.	.349*	.225	.139	.251	.287	.210	
	Sig.	0.037	0.188	0.418	0.140	0.090	0.219	
Sit-Reach Test	r.	-.724**	-.498**	-.377*	-.423*	-.472**	-.223	-.150
	Sig.	0.000	0.002	0.023	0.010	0.004	0.192	0.383

A statistically significant difference was found between some of the anthropometric measurements and the sit-reach test of the female swimmers ($p<0.01$). However, there was no significant difference between the upper body length and height difference and the sit-reach test ($p>0.05$).

Table 2. Correlation Chart between Anthropometric Measurements of Female Swimmers and Other Flexibility Tests

		Height	Body Weight	Thigh perimeter	Calf perimeter	Upper Body Length	Height-Overarm Difference	Pelvis diameter	Shoulder diameter	Foot length
Height	r.									
	Sig.									
Body Weight	r.	.717**								
	Sig.	.000								
Thigh Perimeter	r.	.544**	.692**							
	Sig.	.001	.000							
Calf Perimeter	r.	.647**	.823**	.880**						
	Sig.	.000	.000	.000						
Upper Body Length	r.	.331*	.273	.148	.180					
	Sig.	.049	.107	.391	.293					
Height-Overarm Difference	r.	.349*	.225	.251	.287	.210				
	Sig.	.037	.188	.140	.090	.219				
Pelvis diameter	r.	.717**	.632**	.548**	.616**	.307	.272			
	Sig.	.000	.000	.001	.000	.069	.109			
Shoulder diameter	r.	.792**	.700**	.467**	.572**	.306	.398*	.762**		
	Sig.	.000	.000	.004	.000	.070	.016	.000		
Foot length	r.	.690**	.491**	.512**	.623**	.117	.492**	.522**	.519**	
	Sig.	.000	.002	.001	.000	.496	.002	.001	.001	
Dorsi flexion Right wrist	r.	-.645**	-.518**	-.371*	-.468**	-.188	-.263	-.511**	-.527**	-.554**
	Sig.	.000	.001	.026	.004	.271	.121	.001	.001	.000
Dorsi flexion Left wrist	r.	.667**	-.556**	-.394*	-.476**	-.215	-.255	-.528**	.578**	-.539**
	Sig.	.000	.000	.017	.003	.208	.133	.001	.000	.001
Planter Flexion Right wrist	r.	-.586**	-.571**	-.449**	-.481**	-.304	-.104	-.392*	-.425**	-.433**
	Sig.	.000	.000	.006	.003	.071	.547	.018	.010	.008
Planter left wrist flexion	r.	-.615**	-.546**	-.430**	-.454**	-.367*	-.093	-.417*	-.476**	-.456**
	Sig.	.000	.001	.009	.005	.028	.589	.011	.003	.005
Shoulder mobility test	r.	.053	-.162	-.207	-.042	-.061	-.055	.060	-.039	.163
	Sig.	.761	.346	.225	.809	.724	.750	.730	.821	.343
Measurement of hamstring flexibility with goniometer right foot	r.	-.760**	-.552**	-.428**	-.483**	-.271	-.203	-.489**	-.597**	-.556**
	Sig.	.000	.000	.009	.003	.110	.235	.002	.000	.000
Measurement of hamstring flexibility with goniometer left foot	r.	-.687**	-.545**	-.397*	-.417*	-.314	-.115	-.381*	-.491**	-.381*
	Sig.	.000	.001	.017	.011	.062	.504	.022	.002	.022

Table 2. Correlation Chart between Anthropometric Measurements of Female Swimmers and Other Flexibility Tests

		Dorsi flexion Right wrist	Dorsi flexion Left wrist	Planter Flexion Right wrist	Planter left wrist flexion	Shoulder mobility test	Measurement of hamstring flexibility with goniometer right foot
Dorsi flexion Right wrist	**r.**						
	Sig.						
Dorsi flexion Left wrist	**r.**	.973**					
	Sig.	.000					
Planter Flexion Right wrist	**r.**	.727**	.751**				
	Sig.	.000	.000				
Planter left wrist flexion	**r.**	.738**	.761**	.976 **			
	Sig.	.000	.000	.000			
Shoulder mobility test	**r.**	-.178	-.076	-.082	-.130		
	Sig.	.300	.661	.635	.452		
Measurement of hamstring flexibility with goniometer right foot	**r.**	.838**	.863**	.820**	.828**	.003	
	Sig.	.000	.000	.000	.000	.984	
Measurement of hamstring flexibility with goniometer left foot	**r.**	.676**	.701**	.752**	.749**	.193	.920**
	Sig.	.000	.000	.000	.000	.189	.000

Anthropometric measurements of female swimmers and other flexibility tests were found to be statistically significant ($p<0.01$). Although there was a significant difference between upper body length and left wrist planter flexion ($p<0.05$), there was no significant relationship between the other variables ($p>0.05$). Although there was a significant difference between height-overarm difference and shoulder diameter and foot length ($p<0.05$), there was no significant relationship between the other variables ($p>0.05$).

However, there was no significant difference between body weight and upper body and height difference; thigh perimeter and upper body length difference; calf perimeter and upper body length ($p<0.05$). There was no significant difference between shoulder mobility test and anthropometric measurements and other flexibility tests ($p>0.05$)

DISCUSSION and CONCLUSION

In this study where the effect of anthropometric measurements on the flexibility of 36 female swimmers aged 11-12, the average biceps perimeter was found, (23.3±2.5cm), average biceps flexion perimeter was (24.7±2.4cm), forearm perimeter average was (21.3±2.3cm), upper leg perimeter average was (47.8±4.7cm), thigh perimeter average was (41.5±6.7cm) and calf perimeter average was found (30,3±2,9cm). In their studies of swimmers aged 11-12 (n=80), Ostrowska et al. (2005) states the measurements of biceps perimeter measurements 23.15±2.34 cm and calf perimeter measurements 29.75±2.10 cm of female swimmers aged 11; the measurements of biceps perimeter measurements 24.28±2.72 cm and calf perimeter measurements 31.48±3.05 cm of female swimmers aged 12. Şenel et al. (2017), in the other hand, states the measurement of thigh perimeter 43.84±3.18, calf perimeter 31.94±2.6 and arm perimeter 23.98±2.73 of female swimmers aged 11-12. The fact that the studies have values close to the perimeter measurement averages can be attributed to the fact that the athletes are in a developmental age.

Various diameter averages of 36 female swimmers aged 11-12 are as below: shoulder diameter average (34.10±1.79), pelvis diameter average (23.38±1.89), elbow diameter average (4.94±0.49), wrist diameter average (4.43±0.40), knee diameter average (8.03±.40), and ankle diameter average (5.87±.48). In the study concluded by Ayan (2006) various measurement results are as such: elbow diameter measurement for female students: 4.97±0.56 cm, elbow diameter measurement for male students: 5.17±0.57 cm. Among other diameter measurements, knee diameter measurements were 7.54±0.67 cm for female students and 7.93±0.69 cm for male students. Our study showed similar results when the diameter measurements were examined, suggesting that children in the pre-puberty period may differ by external factors such as nutrition levels, training and climate.

Other measurements of 36 female swimmers aged 11-12 are as below: the height averages: (153.0±.08), foot length averages: (23.5±1.2), upper body length averages: (78.9±9.9), two arm length averages: (156.1±8.9), height difference averages: (4.0±2.5). As a result of a study of 12-week swimming training, the average measurement results of the experimental group of Mühürhancı (2011) are as follows: overarm length: 155.46±6.49, height-overarm difference: 0.86±4.12, effigy length: 81.35±3.78, leg length: 73.25±5.04, foot length: 23.5±1.09. Control group averages: overarm length: 151.35±10.55, height-overarm difference: 0.65±3.2, effigy length: 76.06±4.83, leg length: 74.6±9.15, foot length: 23.11±1.13 (in cm). Since the athletes are competitors and train for at least 3-4 days per week, the results differ in our study; however, the fact that there was no obvious difference in the height measurements, it can be said that the athletes show similar development before puberty.

In our study, it was found out that the swimming performances of 36 female swimmers aged 11-12 were in good shape, due to their training being at least for 2 years and training for 3 or 4 times a week on average. Good results were obtained when looking at the relationship between anthropometric measurements and flexibility. From studies supporting the effect of swimming on anthropometric measurements, Özlü (2012), found a significant relationship between the anthropometric measurements of 50 mt freestyle technical swimming time and body weight, biceps, triceps, chest, abdominal, lower and upper legs, body fat percentage, flexion biceps, humerus bicondylar diameter, endomorph and mesomorph ($p<0.05$; $p<0.01$). However, there was no statistically significant relationship between the other anthropometric measurements ($p>0.05$).

In his study, Alemdağ (2009) took anthropometric measurements from children attending the swimming course aged 8-15 every 10 weeks, and found a statistically significant result when the relationship between the control group was examined. In the study conducted on anthropometric measurements of swimmers aged 8-16, Helmuth (1980) found a positive correlation between 100 m freestyle span and shoulder width, chest perimeter, hand and foot size and lean weight. From studies finding opposing results to our study, Çelebi (2008) found that regular swimming practices did not contribute to the physical development of boys and girls between the ages of 9 and 13 years as a result of the 12-week study examining the impact of regular swimming training. Şenel et al. (2017) found no significant association between the places in the competitions of 100 mt freestyle techniques of female swimmers aged 11-12 and the height measurements.

In their studies examining the relationship between freestyle swimming training characteristics and anthropometric characteristics are analyzed, Pelayo et al. (1996) found that the speed and the number of swims were connected to the gender and height of the swimmer, and therefore no significant difference was observed between the anthropometric characteristics.

In our study, it was determined that shoulder width has an effect on shoulder flexibility and that foot length is also important in ankle flexibility. It is concluded that shoulder flexibility and ankle flexibility have little impact on performance values of other flexibility parameters due to variables such as training conditions, age ranges and gender.

A statistically significant difference was found between some of the anthropometric measurements and the sit-reach test of the female swimmers (p<0.01). Sit-reach test, the most commonly used parameter for flexibility measurements, height, v. weight, biceps flexion perimeter, thigh perimeter, calf perimeter, upper body length and height-overarm correlation were examined and as a result, a negative correlation was found. In addition, there was no significant difference between the upper body length and height difference and the sit-reach test (p>0.05).

Simoneau (1998) examined the effect of various anthropometric and flexibility measurements on sit-reach testing, and found that the level of association between sit-reach and move sequence performance was r=0.78 (p<0.01). All other flexibility tests and anthropometry variables (leg and arm length) were not well correlated with sit-reach test performance. In our study where the sit-reach test and anthropometric measurement levels were in a significant level, the relationship between the length measurements and flexibility tests also bear similarities.

Anthropometric measurements of female swimmers and other flexibility tests were found to be statistically significant (p<0.01). Although there was a significant difference between upper body length and left wrist planter flexion (p<0.05), there was no significant relationship between the other variables (p>0.05). Although there was a significant difference between height-overarm difference and shoulder diameter and foot length (p<0.05), there was no significant relationship between the other variables (p>0.05).

However, there was no significant difference between body weight and upper body length and height difference; thigh perimeter and upper body length difference; calf perimeter and upper body length (p<0.05). There was no significant difference between shoulder mobility test and anthropometric measurements and other flexibility tests (p>0.05).

In their studies examining the acute effects of static scratching exercises over the short-distance lie-flat stamp of the swimmers aged 11-12 (2012), Agopyan et al. found no significant difference between lie-flat stamp swimming distance duration scratching provisions (p>0.05).

Türkeri (2013) found no significant difference between flexibility measurements and perimeter width and length measures. The perimeter, length and width measurements were found to have a moderate to high level relationship between them.

Swimming is a sport that affects the whole body and is performed in horizontal position. It is also held at the Olympic level. In our study, female swimmers of 11-12 years of age were monitored as performance due to at least 2 years of swimming training and swimming at least 3-4 days per week. Anthropometric measurements of the swimmers in our study showed good results compared to their age groups. A statistically significant difference was found between anthropometric measurements and the sit-reach test and other flexibility parameters tests. However, there was no significant difference between body weight and upper body and height difference; thigh perimeter and upper body length difference; calf perimeter and upper body length. There was no significant difference between the shoulder mobility test and anthropometric measurements and other flexibility tests. Although there are studies that examine the anthropometric properties and flexibility levels of swimmers at the end of our study, studies that examine the effects of anthropometric properties of swimmers on flexibility are limited enough to be said to be absent.

REFERENCES

Agopyan, A., Bozdogan, F. S., Tekin, D., Yetgin, M. K., & Guler, C. G. (2012). Acute effects of static stretching exercises on short-distance flutter kicking time in child swimmers. *International Journal of Performance Analysis in Sport, 12*(3), 484-497.

Alemdağ, S. (2009). Trabzon ilinde yaz dönemi boyunca yüzme ve basketbol kursuna katılan 8-15 yaş arası çocukların vücut ölçülerinin, herhangi bir kursa katılmayan yaşıtlarıyla karşılaştırılması. Karadeniz Teknik Üniversitesi Sağlık Bilimleri Enstitüsü Anatomi Anabilim Dalı. Yayınlanmamış yüksek lisans tezi.

Aracı, H. (1999). Okullarda beden eğitimi. Ankara. Bağırgan Yayınevi, 2(13), 3.

Ayan, V. (2006). 8–10 Yaş grubu çocuklarının antropometrik ve somatotip özelliklerine göre spora yönlendirilmesi (Ankara ili örneği). Gazi Üniversitesi: Yayımlanmamış Doktora tezi,

Bayraktar, B. & Kurtoğlu, M. (2009). Sporda performans, etkili faktörler, değerlendirilmesi ve artırılması. Klinik Gelişim, 22(1), 16-24.

Bozdoğan, A., (2006). Yüzme kitabı, 142- 243. istanbul : Morpa Kültür Yayınları.

Bozdoğan, A., (1986). Yüzme teknik analizleri ve yöntemi. İstanbul: Görsel Sanatlar Matbaacılık.

Bozdoğan, A. & Özüak A. (2003). Tüm stilleriyle temel yüzme. İstanbul: İlpress Basım ve Yayın,

Çelebi, Ş. (2008). Yüzme antrenmanı yaptırılan 9-13 yaş grubu ilköğretim öğrencilerinde vücut yapısal ve fonksiyonel özelliklerinin incelenmesi. Erciyes Üniversitesi Sağlık Bilimleri Enstitüsü. Kayseri. Yayınlanmamış yüksek lisans tezi.

Dündar, U., (2012). Antrenman teorisi. Ankara: Nobel Yayın Dağıtım.

Ergen, E., Demirel, H., Güner, R., Turnagöl, H., Basoglu, S., & Zegeroglu, A. M. (2002). Egzersiz fizyolojisi. Nobel Yayın Dağıtım, Ankara.

Helmuth, H. S. (1980). Anthropometric survey of young swimmers. *Anthropologischer Anzeiger*, 17-34.

Heper, E. (2012). Spor bilimlerine giriş. Eşkişehir: Açık Öğretim Fakültesi Yayını, 1. Baskı.

İnal, A. N. (2003). Beden eğitimi ve spor bilimi. Ankara. Nobel.

Mühürhancı Dal, A. (2011). 12 haftalık düzenli yüzme egzersizlerinin 11-12 yaş kız çocuklarında antropometrik, spirometrik ve kardiyovasküler uyum değerleri üzerine etkisi. Eskişehir Osmangazi Üniversitesi. Sağlık Bilimleri Enstitüsü. Fizyoloji Ana Bilim Dalı: Yayınlanmamış yüksek lisans tezi.

Odabaş, B. (2003). 12 haftalık yüzme temel eğitim çalışmalarının 7-12 yas gurubu kız ve erkek yüzücülerin fiziksel ve motorsal özellikleri üzerine etkisi. Kocaeli Üniversitesi Sağlık Bilimleri Enstitüsü. Yayınlanmamış yüksek lisans tezi.

Ostrowska, B., Domaradzki, J., & Ignasiak Z. (2006). Faktoranalysıs of anthropometrıc characterıstıcs in young swimmers aged 11 and 12. Acta University. Palacki. Olomuc., Czech Republic, Gymnastics, 36(1).

Özer, K. (1993). Antropometri sporda morfolojik planlama. İstanbul: Kazancı Matbaacılık.

Özlü, M. (2012). 50 m serbest yüzme performansına antropometrik ve kinematik parametrelerin etkisi. Selçuk Üniversitesi Sağlık Bilimleri Enstitüsü: Doktora tezi.

Pelayo, P., Wille, F., Sidney, M., Berthoin, S., & Lavoie, J. M. (1997). Swimming performances and stroking parameters in non skilled grammar school pupils: relation with age, gender and some anthropometric characteristics. *The Journal of sports medicine and physical fitness, 37*(3), 187-193.

Soydan, S. (2006). 12-14 yaş grubu bayan sporcularda klasik ve vücut ağırlığıyla yapılan 8 haftalık kuvvet antrenmanlarının 200m. serbest yüzmedeki geçiş derecelerine etkisi. Kocaeli Üniversitesi Sağlık Bilimleri Enstitüsü. Kocaeli: Yüksek lisans tezi.

Şen, Z. (2001). Yüzücülerde bireysel yapılan çıkıştaki kopma süresi ile bayrak çıkışındaki kopma süresi arasındaki farkın incelenmesi, Bursa, Uludağ Üniversitesi Lisans bitirme tezi.

Şenel, Ö., & Baykal, C. (2017). The relationship between stroke-rate, stroke-length and some anthropometric features in 11-12 year old swimmers 11–12 yaş yüzücülerde kulaç oranı ve kulaç uzunluğunun bazı antropometrik özelliklerle ilişkisi. *Journal of Human Sciences, 14*(4), 4077-4087.

Simoneau, G. G. (1998). The impact of various anthropometric and flexibility measurements on the sit-and-reach test. *The Journal of Strength & Conditioning Research, 12*(4), 232-237.

Türkeri, C. (2013). Sportif aerobik sporcularında antropometri ve esneklik arasındaki ilişki. *Spor Bilimleri, 8* (1), 1-11.