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COMPARISONS OF ANTHROPOMETRIC CHARACTERISTICS AND SOME PERFORMANCE PARAMETERS OF PRE-ADOLESCENT TENNIS PLAYERS AND SEDENTARY

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Abstract: This study aimed to investigate the anthropometric and somatotype characteristics, explosive power and agility characteristics of tennis-player and sedentary girls and boys age between 10-12. Participants were separated by gender and formed as experımental group (EG) and control group CG). Body weight (BW), body mass index (BMI), body fat percentage (BFP) and somatotype characteristics of the participants were determined. Then the agility test and to evaluate the explosive power the standing long jump test was applied. Statistical analyses were performed with SPSS software version 22.0. After the descriptive statistics of the participants were determined, whether the data showed normal distribution was evaluated with the Shapiro-Wilk test. T-test for independent samples was applied. Effect sizes (Cohen's d) were also calculated for each dependent variable. The statistical significance value was accepted as p<0.05. The study findings examination according to the sport status variable in the height, BW, BMI and BFP showed no statistically significant difference between the groups (p>.05). The somatotype characteristics were evaluated, no statistically significant difference was observed between the EG and CG in both genders p>.05. The performance tests were examined, there was no statistically significant difference between the girl pre-adolescents groups in the standing long jump test, while a statistically significant difference was found between the groups in favor of those EG in boy pre-adolescents (p_G=.589; p_B=.012). In the agility test, there was a statistically significant difference in favor of EG in both genders (p_G=.000; p_B=.000). As a result, it was observed that there was no difference among the EG and CG in terms of anthropometric and somatotype characteristics in both genders (p>.05). However, it was observed that the explosive power and agility characteristics of pre-adolescent boys EG were better than the CG (p<.05). On the other hand, it was observed the agility characteristics of pre-adolescent girls were better in EG compared to CG (p<.05).

Anahtar Kelimeler: Agility, anthropometric characteristic, explosive power, pre-adolescent, somatotype, tennis.

ERGENLİK ÖNCESİ TENİS OYUNCULARI VE SEDANTERLERİN ANTROPOMETRİK ÖZELLİKLERİNİN VE BAZI PERFORMANS PARAMETRELERİNİN KARŞILAŞTIRILMASI

Öz: Bu çalışma, 10-12 yaş aralığında, tenis oynayan ve sedanter kız ve erkek pre-adölesanların antropometrik ve somatotip özellikleri ile patlayıcı güç ve çeviklik özelliklerinin incelenmesini amaçlamaktadır. Katılımcılar cinsiyetlere göre ayrılmış; deney grubu (DG) ve kontrol grubu (KG) olmak üzere iki grup oluşturulmuştur. Katılımcıların vücut ağırlığı (VA), vücut kitle indeksi (VKİ), vücut yağ yüzdesi (VYY), somatotip karakteristikleri belirlenmiştir. Daha sonra çeviklik testi ve patlayıcı gücü değerlendirmek için durarak uzun atlama testi uygulanmıştır. İstatistiksel analizler SPSS yazılım versiyonu 22.0 ile yapılmıştır. Katılımcıların tanımlayıcı istatistikleri belirlendikten sonra verilerin normal dağılım gösterip göstermediği Shapiro-Wilk testi ile değerlendirilmiştir. Veriler normal dağılım gösterdiği belirlendikten sonra bağımsız örneklemler için t-testi uygulanmıştır. Her bağımlı değişken için etki büyüklükleri (Cohen's d) hesaplanmıştır. İstatistiksel anlamlılık değeri p<0.05 olarak kabul edilmiştir. Elde edilen veriler değerlendirildiğinde kız ve erkek DG ve KG arasında boy, VA, VKİ, VYY değerlerinde istatiksel olarak anlamlı fark saptanmamıştır (p>.05). Somatotip özellikler değerlendirildiğinde, kız ve erkek DG ve KG arasında istatiksel olarak anlamlı fark görülmemiştir (p>.05). Performans testleri incelendiğinde ise durarak uzun atlama testinde kız pre-adölesanlarda gruplar arasında istatiksel olarak anlamlı fark saptanmazken (p>.05), erkek pre-adölesanlarda gruplar arasında DG lehine istatiksel olarak anlamlı fark saptanmıştır (p_K=.589; p_E=.012). Çeviklik testinde ise hem kız hem de erkek pre-adölesanlarda DG lehine istatiksel olarak anlamlı fark görülmüştür (p_K=.000; p_E=.000). Bu çalışmanın sonucunda; kız ve erkek DG ve KG arasında antropometrik ve somatotip özellikler açısından fark görülmediği gözlenmiştir (p>.05). Bununla birlikte DG erkeklerin patlayıcı güç ve çeviklik özelliklerinin KG'a kıyasla daha iyi olduğu görülmüştür. Katılımcı kızlarda ise çeviklik özelliğinin DG'da KG'a kıyasla daha iyi olduğu görülmüştür (p<.05).

Key Words: Çeviklik, antropometrik özellik, patlayıcı güç, pre-adölesan, somatotip, tenis

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INTRODUCTION

In recent years, the interest indifferent competitive sports on anthropometric characteristics, body composition and somatotypes has increased considerably. A lot of sports, the physical profile shows whether a player will be fit to race in a particular sport at the highest level (Bourgois et al., 2000; Gabbett, 2005). The measuring anthropometric speciality of qualified athletes can be a key aspect in relating anatomic structure to productivity. Studies show that on account of achieving the expected success in sports, it is necessary to start sports activities in childhood. Accordingly, the attention of developed countries has locked in on childhood sports activities(Ayan & Mülazimoğlu, 2009). Many coaches and health professionals aim to improve children's equal competition, increase their chances of success and decrease the risk of injury (Baxter-Jones, 1995). In pre-adolescent individuals, the range of variability between chronological age and biological growth is quite large. The growth spurt is usually observed in the adolescent growth spurt phase (Iuliano-Burns, Mirwald, & Bailey, 2001). Similar age groups of children differ greatly in terms of physical characteristics such as height and weight, as well as basic motoric characteristics such as strength, speed and endurance. However, previous studies stated that the most common method to classify children is "age classification"(Mirwald, Baxter-Jones, Bailey, & Beunen, 2002). Consequently, the role of exercise in sedentary or active preadolescent is still understudied.

In the last twenty years, big changes have occurred in tennis in terms of technique and tactics and even the physical performance of the players. Kilit et al. notified that individuals who play tennis need mix of abilities .These abilities are coordination, power, agility and speed, combined with medium-to-high aerobic and anaerobic capacity (Bülent Kilit, Arslan, & Soylu, 2019; Ulbricht, Fernandez-Fernandez, Mendez-Villanueva, & Ferrauti, 2016). Today, tennis is one of the most common sports in the world and is researched comprehensively. Much of the recent studies have focused on physiological (Fernandez, Mendez-Villanueva, & Pluim, 2006; Seliger, Ejem, Pauer, & Šafařík, 1973) and biomechanical variables (Akutagawa & Kojima, 2005; Groppel, 1986) physical performance (Kibler, McQueen, & Uhl, 1988; Roetert, Brown, Piorkowskil, & Woods, 1996) and injury prevention and treatment (Faraj, Rahman, & Norton, 1999; Pluim, Staal, Windler, & Jayanthi, 2006). There is currently very little data on the anthropometric characteristics of pre-adolescent (Leone, Lariviere, & Comtois, 2002; Powers & Walker, 1982), sedentary or tennis players. For this reason, the purpose of this study is to analyze the anthropometric and somatotype characteristics, explosive strength and agility characteristics of girls and boys sedentary (CG) and playing tennis (EG) between the ages of 10-12.

METHOD

This study was conducted to compare the anthropometric characteristics, body compositions, somatotypes and some performance parameters of tennis players and sedentary pre-adolescents between the ages of 10-12. The experimental and quantitative research method was applied in the study.

Participants

Twenty EG (10 girls, 10 boys) and 20 CG (7 girls, 13 boys) pre-adolescent individuals between the ages of 10-12 participated in the study. Participants in EG had been playing tennis for at least 2 years and they had been training at least 2 days a week. Before the tests, the participants and their families were informed about the purpose of the study and the possible risks that may occur during the exercise. Ethical approval was obtained from the

University Ethics Committee for the current study, numbered 74546226-050.03-12131. In addition, since the participants were under the age of 18, an informed consent form was given to their families and they were asked to approve.

In anthropometric measurements, parameters of height, body weight, body fat percentage, body mass index, endomorphy, mesomorphy, ectomorphy, thigh circumference, skinfold thickness, femur diameter, humerus diameter, calf circumference, and biceps circumference in flexion were used. The standing long jump and agility test results were recorded after each measurement.

Anthropometric Measurements

The heights of the participants were measured with a stadiometer (Holtain, UK) which was fixed to the wall with an error of +-0.1cm, and their body weights were measured with the body analyzer (A-401 Tanita, Japan). Skinfold thickness measurements were made using a skinfold caliper (Holtain, UK), which applies 10 g pressure to 1 mm^2 with an error of ±2 mm, circumference measurements were made using a Gulick anthropometric tape measure (Holtain, UK), and diameter measurements were made using a Harpenden Skinfold Caliper (Holtain, UK). measured with an error of ±1 mm.

According to the technique called Heath and Carter method (measuring thigh circumference, skinfold thickness, femur diameter, humerus diameter, calf circumference, and biceps circumference in flexion), the human body is formed by the combination of 3 different structures in various proportions: endomorph (fat), mesomorph (muscular) and ectomorph (weak). Heath and Carter's table was taken as a basis for the somatotype evaluation of our study. Heath and Carter's equation is as follows:

endomorphy = $- 0.7182 + 0.1451 (X) - 0.00068 (X^2) + 0.0000014 (X^3)$

X = (sum of triceps, subscapular and supraspinale skinfolds) multiplied by (170.18/height in cm).

This is called height-corrected endomorphy and is the preferred method for calculating endomorphy.

mesomorphy = 0.858 x humerus breadth + 0.601 x femur breadth + 0.188 x corrected arm girth + 0.161 x corrected calf girth – height 0.131 + 4.5.

Three different equations are used to calculate ectomorphy according to the height-weight ratio (HWR):

If HWR is greater than or equal to 40.75 then

ectomorphy = 0.732 HWR - 28.58

If HWR is less than 40.75 but greater than 38.25 then

ectomorphy = 0.463 HWR - 17.63

If HWR is equal to or less than 38.25 then

ectomorphy = 0.1

(Heath & Carter, 1967).

Standing Long Jump Test

Participants were asked to open their feet shoulder-width apart and squat down to a half squat position and jump as far (forward) as possible. After jumping, the distance between the heel of the foot, which is close to the starting point, and the starting point, was recorded in cm. The best score obtained from the standing long jump test performed in two repetitions was recorded as the score(Adams, 1998).

Agility Test

The agility test was used to measure the agility characteristics of pre-adolescents. The athlete started the first movement from the center point at the T point on the back line. Afterwards, the athletes returned to the center point each time after touching the 3 marks at the corners of the service line and at the midpoint with a fast run. When the athletes started the test, the photocell worked and at the end of the test, the test score was recorded with the photocell. Athletes were given two attempts and the best score was awarded (Çalişkan, 2014).

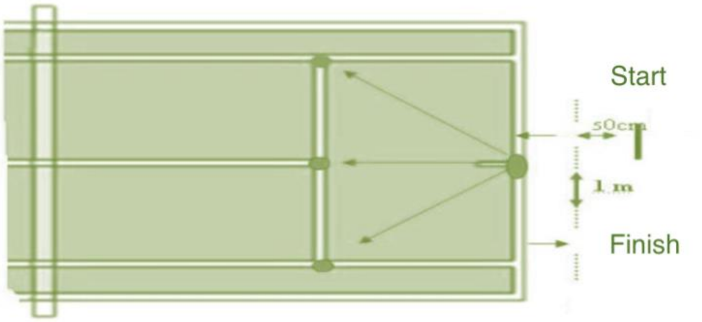

Figure 1. Agility Test

Data Analysis

Statistical analyses were performed with SPSS software version 22.0(SPSS Inc, Chicago, IL, USA. After the descriptive statistics of the participants were determined, whether the data showed normal distribution(Ntoumanis, 2003) was evaluated with the Shapiro-Wilk test. After it was determined that the data showed normal distribution, T-test for independent samples was applied. Effect sizes (Cohen's d) were also calculated for each dependent variable. The thresholds for effect size statistics were as follows: 0.2 trivial; 0.6 small; 1.2 moderate; 2.0 large; and .2.0 very large(Hopkins, Marshall, Batterham, & Hanin, 2009). The statistical significance value was accepted as $p<0.05$.

RESULTS

In this part of the study, the findings obtained as a result of the statistical analysis are presented.

Table 1 General demographic characteristics of the participants (N=40)

Parameters	Min	Max	Mean ± Sd
Age (years)	10	12	11.05 ± 0.63
Height (cm)	136.00	175.00	149 ± 8.49
BW (kg)	29.30	62.00	40.87 ± 8.84
BMI (kg/m^2)	14.38	23.79	18.11 ± 2.39

Table 2. Comparison of Demographic Characteristics of EG and CG

Parameters	EG/CG	Min	Max	Mean ± Sd	p
	Girls				
Age (years)	EG	10	12	11.40 ± 0.69	.127
	CG	10	11	10,71 ± 0.48	
Height (cm)	EG	143.00	160.00	152 ± 6.92	.638
	CG	139.00	165.00	147 ± 9.65	
BW (kg)	EG	33.60	60.90	45.99 ± 8.43	.190
	CG	30.10	62.00	37.52 ± 11.45	
BMI	EG	15.94	23.79	19.81 ± 2.69	.069
	CG	14.52	22.77	17.01 ± 2.73	
BFP	EG	10.13	19.66	13.96±2.91	.971
	CG	10.07	23.53	13.32±4.68	
	Boys				
Age (years)	EG	10	12	11.10 ±.73	.903
	CG	10	12	10,92 ± .49	
Height (cm)	EG	141.00	175.00	152 ± 10.59	.265
	CG	136.00	158.00	146 ± 6.27	
BW (kg)	EG	33.50	56.00	42.54 ± 7.41	.485
	CG	29.30	50.00	37.46 ± 7.14	
BMI	EG	16.72	19.98	18.10 ± 1.04	.877
	CG	14.38	21.08	17.40 ± 2.21	
BFP	EG	9.91	14.35	11.99±1.40	.991
	CG	9.15	17.26	11.80±2.58	

Age, height, BW, BMI and BFP mean values and t-test results of girl and boy EG and CG are given in Table 2.

Table 3. Comparison of Somatotype Characteristics of EG and CG

Parameters	EG/CG	Min	Max	Mean ± Sd	p	***d***
	Girls					
Endomorph	EG	2.19	7.71	4.19 ±1,55	.970	0.17
	CG	2.57	6.98	3.92 ±1,46		
Mesomorph	EG	1.59	4.33	2.96 ±1,13	.235	. 1.05
	CG	0,63	3.25	1.90 ±0,87		
Ectomorph	EG	.96	5.08	2.64 ±1.37	.122	0.99
	CG	1.94	5.31	3.89±1.13		
	Boys					
Endomorph	EG	2.25	4.02	3.17 ±0.60	.999	0.08
	CG	1.80	5.24	3.25 ±1,12		
Mesomorph	EG	1.03	4.15	2.58 ±1,02	.959	0.20
	CG	1.40	5.43	2.81 ±1.26		
Ectomorph	EG	2.64	4.90	3.52 ±0.64	1.00	0.05
	CG	1.71	5.35	3.57±1.16		

In Table 3, the mean values and t-test results of the somatotype characteristics of the EG and CG girl and boy participants are presented.

Table 4. Comparison of Performance Test Results of EG and CG

Parameters	EG/CG	Min	Max	Mean ± Sd	P	*d*
	Girls					
Standing long jump (cm)	EG	113.00	190.00	158 ± 21.64	.589	0.64
	CG	127.00	167.00	146 ± 15.26		
Agility Test (sn)	EG	11.90	14.14	13.00 ± 0.68	.000*	4.83
	CG	15.24	16.50	15.77 ± 0.44		
	Boys					
Standing long jump (cm)	EG	164.00	231.00	182 ±20.59	.012*	1.98
	CG	133.00	175.00	146 ± 15.26		
Agility Test (sec)	EG	11.00	13.02	12.26±0.62	.000*	5.11
	CG	14.12	15.92	15.01 ± 0.44		

In Table 4, standing long jump and agility test mean values and t-test results of EG and CG are presented. While no statistically significant difference was observed between EG and CG girl participants in the long jump test, a statistically significant difference was found in favor of girl EG participants in the agility test (respectively p=.589; p=.000). For boy EG and CG, a statistically significant difference was found in favor of boy EG in both the standing long jump test and the agility test (respectively p=.012; p=.000).

DISCUSSION AND CONCLUSION

In the literature, only a few studies have examined the physical characteristics of tennis players (Leone et al., 2002; Sánchez-Muñoz, Sanz, & Zabala, 2007; Söğüt, 2017; Söğüt, Müniroğlu, & Deliceoğlu, 2004). Our study aims to compare anthropometric characteristics, body composition, somatotype characteristics and some performance characteristics of 10-12 years old tennis players and sedentary pre-adolescent girls and boys. The reason why anthropometric measurements and performance results of girl and boy participants were evaluated independently of each other in our study is that girl and boy pre-adolescents show different developmental characteristics.

Diker et al. (Diker, Zileli, Özkamçı, & Ön, 2018), with 19 boy tennis players aged 10-12 years, height was found as 152±0.11cm and BW 44.76±7.87 kg, and these results are in line with our study. In another study conducted on 10-12 years old girls playing tennis and sedentary, age groups were handled separately. As a result of the study, height was 147.6 cm, weight 43.5 kg and BMI 20.0 in sedentary girls aged 10 years old, while it was recorded as 148.7 cm, weight 41.6 kg and BMI 18.8 in girls playing tennis (Haapasalo et al., 1998). In the same study, height was 157.9 cm, weight 46.6 kg, BMI 18.6 in sedentary girls and 157.5 cm in height, 45.2 kg and BMI 18.2 in girls playing tennis for 12 years old. In the study of Haapasalo et al., height, weight and BMI values of the sedentary and tennis players 12 years old group were higher when compared to the findings of the current study (Haapasalo et al., 1998). It is known that there is a rapid increase in physical development with age in the pre-adolescent period (Thomas &French, 1985). For instance, a study conducted with 13-year-old boy tennis players, (even when considered only in terms of height) the average height of the participants was measured 159±7.5 cm(Bulent Kilit & Arslan, 2019).In this study by Kilit and Arslan clearly illustrates the rate at which anthropometric measurements of pre-adolescents can progress in just 1 year. Considering that the 10-12 age group was evaluated together in our study, this difference was an expected result. In the study by Elliot et al., somatotype characteristics of sedentary girls indicate balanced endomorph, while in the current study, sedentary girls show ectomorphic endomorph characteristics (3.92 vs. 3.80, 1.90 vs. 3.61, and 3.57 vs. 3.41). In the same study, the somatotype characteristics of boy tennis players were examined, it was reported that they showed ectomorphic mesomorph characteristics (2.48, 4.06 and 3.52). When the somatotypes of the men playing tennis in the present study are examined, it is seen that they are endomorphic ectomorphs (3.17, 2.58 and 3.52). In addition, the somatotype characteristics of sedentary boys were found to be similar (ectomorphic mesomorph and endomorphic ectomorph) in both studies (3.25 versus 2.74, 2.81 versus 4.19, and 3.57 versus 3.42) (Elliott, Ackland, Blanksby, & Bloomfield, 1990). According to Copley, It has been reported that the somatotype characteristic of boy tennis players is expected to be ectomorphic mesomorph, while the endomorphic mesomorph characteristic is dominant in professional girl athletes (Copley, 1980).

Physical development in childhood shows a slow but steady progress. During childhood, a regular increase is observed in physical characteristics as well as motor skills. With the pre-adolescence period, physical and motor features continue to develop rapidly. Studies on the subject frequently mention that the physical and motor performances of children tend to increase with age (Akşit & Rudarlı Nalçakan, 2017). The standing long jump is a method that has been used for years to determine the anaerobic performance of professional and amateur athletes adapted to various sports branches (Porter, Ostrowski, Nolan, & Wu, 2010). According to the standing long jump results of our study (Table 4), there was no statistically significant difference detected between EG and CGgirl participants ($p>0.05$), while the standing long jump performances of EG boy participants were found to be significantly higher than CG boy participants ($p=0.012$). In a study conducted with boy participants playing football and tennis (10-12 years old), it was observed that the standing long jump results of pre-adolescents playing tennis were 181 cm on average (Diker et al., 2018). It should be noted that these results are very close (182 cm) to those obtained in the current study. In another study, it was reported that the standing long jump test results of pre-adolescents (10 years old) playing tennis were 149 cm in boys and 143 cm in girls (Akşit & Rudarlı Nalçakan, 2017). When this result is considered, a score well below the results of the current study is encountered. It is thought that the reason for this is that children in the adolescent age show a very rapid physical development and this directly affects their performance. In the current study, pre-adolescents aged 10-12 years were concerned, while in the study of Akşit et al., the performances of 10 years old pre-adolescents were recorded.

In many studies, it is stated that age and gender differences significantly affect some motor abilities such as power-related skills(Toole & Kretzschmar, 1993), standing long jump (Ikeda & Aoyagi, 2009), and girls are generally disadvantaged. In another study; in tests such as standing long jump and shuttle running, which are used in performance evaluation, it is shown that the average performance of girls and boys increases significantly with age. However, it is mentioned that the gender difference significantly affects performance after 9 years of age. In a meta-analysis study on gender differences in motor skills, 12 out of 20 motor skills showed a significant difference in favor of males with increasing age. It was reported that this difference increased in children aged 10-11 years, especially in motor skills requiring strength and power, and a greater difference was observed as the age got older (17-18 years old) (Thomas & French, 1985). Considering the results of our study, no difference was observed between standing long jump performances in EG and CGgirls. Considering the results of our study, while no difference was observed between standing long jump performances in EG and

CG girls, it can be thought that the reason for the significant difference in favor of EG in EG and CG boy participants may be due to the gender difference in development.

Agility is defined as the control and coordination skill that ensures the body and joints are in the correct position in space during very rapid direction changes during a series of movements (Hazır, Mahir, & Açıkada, 2010; Sheppard & Young, 2006). Especially coordination, agility and balance are motor features that should be developed at a young age (Sevim, 2007). Salonikidis and Zafeiridis reported that the agility skills of tennis players can improve because the ability to change of direction is frequently used in the tennis game (Salonikidis & Zafeiridis, 2008). In our results, it was seen that tennis players completed the agility test in a shorter time than CG in both boy and girl participants (Table 4), and these results were statistically significant ($p=0.00$). In a similar study, the agility test results of 11 years old tennis players and sedentary boys were examined, and it was found that the agility test scores of the tennis players were better than the sedentary participants. In the same study, the agility test scores of 11 years old girl tennis players were found to be higher compared to sedentary participants (Elliott et al., 1990). In a different study conducted with 61 boy participants aged 14 and playing elite and amateur level tennis, agility characteristics were measured with the spider test, and as a result, elite tennis players had better agility characteristics (Aoki, Demura, Nakaba, & Kitabayashi, 2018). Considering the literature and the results of our study, it can be said that involving into a tennis training has a positive effect on agility in adolescence. As a result, it was observed that there was no difference among the EG and CG in terms of anthropometric and somatotype characteristics in both genders ($p>.05$). However, it was observed that the explosive power and agility characteristics of pre-adolescent boys EG were better than the CG ($p<.05$). On the other hand, it was observed that the agility characteristics of pre-adolescent girls were better in EG compared to CG ($p<.05$).

In study; not to measure the maturation of the participants, not to compare the characteristics of those of the same age and not to compare the differences between the genders regardless of group differences can be acceptable as limitations of this research.

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