Cilt:5 Sayı:1,2022
Doi: 10.53025/sportive.1085993

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Elit Eskrimcilerin Performans Parametrelerinin İncelenmesi

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Orijinal Makale Gönderi Tarihi.10.03.2022 Kabul Tarihi:23.03.2022

Eskrim sporu doğası gereği içerisinde yüksek aerobik ve anaerobik aktiviteler bulundurmaktadır ve ayrıca yaş, cinsiyet, teknik düzeyi gibi farklı parametrelerden etkilenebilir. Bu yüzden, bu çalışmanın amacı, Türkiye genç milli eskrim takımı sporcularının performans parametrelerinin cinsiyet açısından incelenmesidir.

Milli takım kampındaki 19 milli sporcu (9 erkek yaş; 15.55±.88 yıl, boy; 1.79±.05 m, vücut ağırlığı; 71.22±9.33 kg. 10 kadın yaş;15.60±1.34, boy; 1.69±.06 m, vücut ağırlığı 57.00±8.81 kg) çalışmaya gönüllü olarak katılmıştır. Çalışmada eskrimcilerin antropometrik ölçümleri ve performans parametreleri ölçülmüştür. Çalışmada performans parametrelerini belirlemek için el kavrama kuvveti, çeviklik t-testi, Yo-Yo testi, dikey sıçrama testi (anaerobik güç) ,denge testi, 30sn şınav ve 30sn mekik testleri uygulanmıştır. Çalışmanın analizi 24 SPSS paket programı kullanılarak yapılmıştır. Pearson Korelasyon testi, Paired sample t-testi ve bağımsız örneklem t-testi kullanılmıştır.

Kadın ve erkek eskrimcilerin performans parametreleri karşılaştırıldığında, baskın el, baskın olmayan el kavrama kuvvetleri, çeviklik, aerobik dayanıklılık, anaerobik güc, çeviklik, 30sn şınav ve 30sn mekik parametrelerinde erkeklerin lehine anlamlı farklılık bulunurken toplam denge puanları arasında istatistiksel olarak anlamlı bir farklılığa rastlanmamıştır. Her iki grup için de baskın olan elin diğer elden istatistiksel olarak daha fazla kavrama kuvveti ürettiği bulunmuştur. Erkek eskrimcilerin performans parametrelerinde baskın el kavrama kuvveti ile anaerobik güç ve toplam denge ile şınav arasında anlamlı ilişki bulunmuştur. Kadın eskrimcilerin performans değerleri incelendiğinde; anaerobik gücün mekik ve her iki kavrama kuvveti ile arasında anlamlı bir ilişki bulunmuştur. Ayrıca mekik ile baskın el kavrama kuvveti ile baskın olmayan kavrama kuvveti arasında ilişki bulunmuştur. Dominant kavrama gücü ile baskın olmayan kavrama gücü arasında bir ilişki bulunmuştur.

Eskrim sporcularının performans parametreleri incelendiğinde; erkek eskrimcilerin performans parametreleri kadın eskrimcilere göre daha yüksek olduğu söylenebilir. Bir performans parametresindeki artışın ise diğerlerinin gelişimini de etkileyebileceği sonucuna varılabilir.

Anahtar Kalimeler: Kuvvet, Dayanıklılık, Denge, Eskrimciler, Yo-Yo testi.

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Investigation of Performance Parameters of Elite Fencers

Fencing sport, by its nature, includes high aerobic and anaerobic activities and can also be affected by different parameters such as age, gender, technical level. Therefore, the aim of the study was to examine the performance parameters of the Turkey junior national fencing team in terms of gender.

Nineteen national athletes (9 male age; 15.55±.88 years, body height;1.79±.05 m, body weight; 71.22±9.33 kg, 10 female age;15.60±1.34, body height; 1.69±.06 m, body weight; 57.00±8.81 kg) in the national team camp participated to the study voluntarily. In the study, anthropometric measurements and performance parameters of fencers were measured. In the study, handgrip strength, agility T-test, Yo-Yo IR1 test, vertical jump (anaerobic power), balance test, 30-sec push-up, and 30-sec sit-up tests were performed. The analysis of the study was made using 24 SPSS package programs. Pearson Correlation test, paired-sample t-test, and independent-sample t-test were used.

When the performance parameters of male and female fencers were compared, there were significant differences in favor of males in the parameters of the dominant hand, non-dominant handgrip strength, agility, aerobic endurance, anaerobic power, agility, 30s push-ups, and 30s sit-ups, but no statistically significant difference was found between total balance scores. In both groups, it was found that the dominant hand produced statistically more handgrip strength than the other hand. There was a significant relationship between dominant handgrip strength with anaerobic power and push-ups with total balance in male fencers' performance parameters. When the performance values of female fencers were examined; there was a significant relationship between anaerobic power with sit-up and both handgrips strength. Also, there was a relationship between dominant handgrip strength and non-dominant handgrip strength with the sit-up test. A correlation was found between dominant handgrip strength and non-dominant handgrip strength.

When the performance parameters of fencing athletes are examined; the performance parameters of male fencers are better than female fencers. The increase in one performance parameter also can affect the development of the others.

Keywords: Strength, Endurance, Balance, Fencers, Yo-Yo test.

INTRODUCTION

Fencing is a sports branch that allows the best use of physical and mental features, has a wide technique and finesse in its construction, provides regulation on the nervous system, and allows the widest stretching and stretching to different parts of the body (Enzo, 1985). Fencing is a sport performed with the sword, and its basis is the art of fighting with the sword (Di Cagno, 2020).

Success in fencing is closely linked to the interaction between physical abilities. Coaches need to implement scientifically validated recommendations for enhancing athletic performance and skills (Zadorozhna et al., 2018). During the competition, the fencing athlete must maintain defensive and offensive movements, so it is important that the performance in fencing is at a high level (Turna, 2020).

Fencing; is a skill that requires strength, speed, agility, endurance, balance, and power (Swatowska et al., 2020). Fencing is an open skill sport that requires the application of efficient playing strategies with explosive movements and complex body movements. Elite fencers need higher explosive power to accelerate the body over

about 600 milliseconds and travel about 1.4 m. Fencing has to follow the kinetic patterns of repetitive defense and offense during competition, which is critical for performance. Dynamic movements such as steps and jumps in different directions, as well as moves to touch the opponent, depending on muscle strength and power, and neuromuscular function, especially of the lower extremities. Agility is defined as the sudden movement of the whole. It activates the body by changing speed or direction in response to a particular stimulus (Turna, 2020). The quality of agility requires a partnership of speed, balance, strength, and coordination. Agility is a motor skill and can be developed with regular progressive exercise. Agility is a valid method used in sportive performance measurement batteries as an important element. In the fencing branch, agility is of great importance for this branch (Turna, 2020).

The “shuttle tests” are used as a measure of fencing skill, which consists of back and forth movement of the whole body performed as a series of rapid steps. The importance of lunge and shuttle for functional fencing performance is clear, so the lack of studies on anthropometric and physical characteristics and fencing skills is surprising (Tsolakis, 2010; Tsolakis, 2011).

In each fencing match, there are long-term preparatory movements with a submaximal intensity and shorter-term high-intensity movements for contact with the opponent (Roi, et al., 2008). Competition-level fencing performance is determined by a wide range of physical and psychological abilities, including aerobic endurance capacity. The aerobic endurance of fencers is considered an important prerequisite and is extremely important in determining performance (Weichenberger et al., 2012). The results of studies published to evaluate the relationship between fencing performance and VO_2max level are conflicting (Roi et al., 2008).

Physical abilities, which are predominantly reflected by strength and anthropometric variables, are important for evaluating the effects of training programs in various sports branches, developing talent determination methods, and distinguishing individuals at various competition levels (Tsolakis, 2010). Few studies have been conducted on the relationship between performance-specific skills and strength abilities in athletes. The relevant results are rather inconsistent. The strong relationship observed between strength and power measurements and jumping ability differs between sports branches and competitive athletes of different levels (Tsolakis, 2011).

Dynamic moves take place in the lunge move, which is the most used move in offense during a fencing match. When these movements are combined with power, imbalances in the lower and upper extremities can occur, problems related to balance in the lower and upper limbs. That's why it's important to focus on resolving muscle imbalance to prevent injuries in elite fencers. It is thought that studies on balance will change the biomechanical features of fencing athletes and improve balance (Taewhan Kim et al., 2015).

The fact that the studies examining performance parameters in the extremity branch are controversial and limited reveals that more studies should be done. This was aimed to examine the performance parameters of the Turkey Youth National Fencing Team in terms of men and women. It is thought that our study will make an important contribution to the literature in terms of benefiting fencing athletes, sports scientists, and trainers.

METHOD

Nine male (age; 15.55±.88 years, body height;1.79±.05 cm, body mass; 71.22±9.33 kg) and ten female (age;15.60±1.34, body height; 1.69±.06 cm, body mass; 57.00±8.81 kg) national fencers were voluntarily participated in the study in the national camp. All participants met the inclusion criteria: The measurements of the athletes participating in the study were taken during the camp period. The measurements were taken during the morning training hours of the athletes. Athletes were asked not to participate in heavy exercise for the last 24 hours, not to be sleep-deprived, and not to use any drugs that slow down the nervous mechanism. If there were athletes who did not comply with the specified conditions, they were excluded from the study. In the study, the anthropometric measurements (height, weight, BMI) of the participants were determined first. Then, performance measurements were taken after the participants applied a standard warm-up (fencing-specific warm-up movements for 5 minutes). Each of the performance measurements was taken on different days.

Table 1. The characteristic features of fencers

	Female Mean± std. dv.	Male Mean± std. dv.
Age (y)	15.60±1.34	15.55±.88
Height(m)	1.69±.06	1.79±.05
Weight (kg)	57.00±8.81	71.22±9.33
Body mass index (kg.m-2)	19.86±2.68	22.10±2.20

Research Publication Ethics

The risks that may occur in the study were explained to the participants. Written informed consent forms were obtained from the participants. The study was approved by Selcuk University Faculty of Sport Sciences Ethics Committee (Protocol no 122, 30.09.2021)

Anthropometric Measurements

Height and Body Weight Measurement: The height measurements of volunteer athletes were measured with a wall-mounted Stadiometer (Holtain Ltd, UK) with an accuracy of ±0.1mm. Scales were used to determine the body weight and body fat percentage of the volunteers. Measurements were taken when the volunteers stood upright and motionless by ensuring that both feet were on the scales equally (ACSM, 2012).

Body Mass Index: BMI= Weight (kg)/Height (m2) calculated using the formula (ACSM, 2012).

Performance Tests

Yo-Yo Intermittent Recovery Test (Level 1): All necessary information was given to the participants before starting the test. Before the test, the participants warmed up and started the test. In the test, Yo-Yo IR1, consisting of a total of 25 m track with 20 m running distance and 5 m active resting distance, was applied to the participants. In the test, active resting phases of 10 seconds were applied in a 5 m area after a 20 m run. The test started with a speed of 10 km/h and the speed was increased gradually. During the test, there were beeps that report an increase in speeds. The test of the participant who missed the signal tone 2 times in a row by acting with the beeps or left the test voluntarily was terminated. The heart rate of the participant whose test was terminated was also checked after the test (Akyıldız and Ocak, 2021; Bangsbo, Iaia, and Krustrup, 2008).

Vertical Jump Test: Vertical jump test was applied to athletes by starts from an upright position with hands free, followed by a downward movement, immediately into a vertical jump. The best results were recorded as "cm" from tool measuring digitally. "Takei jump-meter" (Takei Scientific Instruments, Tokyo, Japan) was used with measurement capacity between 5 cm to 99 cm, showing the distance digitally by leaping with waist stuck (Alp and Gorur, 2020).

Balance Measurement: The balance performances of the athletes were measured with the Balance Error Scoring System (BESS) and translated into Turkish as the Balance Error Scoring System (DHPS). Necessary information was given to the athletes about the test. Before starting the test, the athletes were asked to warm up. For the test, the athlete was asked to stay in the desired position for 20 seconds under 6 different conditions with his eyes closed and without any support. Tests were taken with 3 different standing positions on flat or foam floor. The postures are double leg, single-leg, and tandem. The order of application of the 6 conditions of the test; 1. Double leg flat floor, 2. Single leg flat floor, 3. Tandem stance flat floor, 4. Double leg foam floor, 5. Single leg foam floor, 6. Tandem stance foam floor. Times of 20 seconds for each of the test postures were measured with a stopwatch. The errors of the athletes in the determined time and positions were recorded as error points. Each mistake was evaluated as 1 point. The maximum error score for each test condition is 10. The score of each athlete and the values they will receive are recorded on the form (Aslan, 2014).

Handgrip Strength Test: Measurements were done using a hand dynamometer (Takei Scientific Instruments, Tokyo, Japan). Two measurements were taken by squeezing the instrument with their fingers while the subjects were in the anatomical

position with their right and left hands at the side and down, and the best value was recorded (Ateş and Ateşoğlu, 2007).

Agility Test (T-Test): Before the test, necessary information about the test was given to the athletes. Before the test, the athletes were asked to warm up. The T-test was carried out in an area of 10 m wide and 10 m long. There are 4 T-shaped contact points in this area. Athletes were asked to complete a series as soon as possible by including their movements in different ways and in different directions between the determined contact points. The difference between this test from other agility tests is that the athlete always looks in the same direction. It performs the change of direction by shifting steps to the right and left, or by running backward. In this test, in addition to two turns of 900 and 1800, a total distance of 40 meters must be covered, including 10 m forward, 10 m right, 10 m left, and 10 m backward (Özbay et al., 2018).

30 seconds Push-Up Test: 30 seconds push-up test: Before starting the test, the necessary information was given to the athletes about the test. On the gymnastics mat on the participant floor, the arms were open at the shoulder width, the elbows were stretched, the knees do not touch the floor and the waist area do not fall. Together with the start command, the participant moved the body closer to 90 degrees and returned to the starting position. In this way, the test was continued for 30 seconds and the value of the participant at the end of the test period was recorded as the test score (Erhan and Çelik, 2021).

30 Seconds Sit-Up Test: Test Before the 30-second sit-up test, the athletes were informed about the test. During the sit-up test, the athletes were asked to bring their hands together on the neck, to have their knees bent at ninety degrees, and to lie on their back with the soles of their feet touching the ground. The athletes were asked to flex their trunks until the elbows contacted the knee. It has been informed beforehand that if the athlete releases his hands from the back of the neck during the test, the sit-up movement will be invalid. Every shuttle that was not applied within the framework of the correct rules was made again. At the end of 30 seconds, the shuttle movements applied correctly were recorded on the form. At the end of the test, the athlete was informed (Erhan and Çelik, 2021).

Statistical Analysis

Shapiro-Wilk test was used to determine the normal distribution. While Independent Sample t-test was used for comparisons of different groups, Paired sample t-test was used to compare paired data of the same group. In addition, the Pearson correlation test was used in the analysis of the relationship levels. The $p<0.05$ level was chosen as an alpha value.

RESULTS

The comparison of performance parameters of male and female fencers are shown in Table 2.

Table 2. Comparison of performance parameters of male and female fencers

Parameters	Female Mean±std. dv.	Male Mean±std. dv.	95% Confidence Interval		p
			Lower	Upper	
Anaerobic power	823.94±157.07	1204.61±168.59	-538.28	-223.03	**.000****
VO_2max (kg/ml/dk)	41.08±1.32	47.47±4.86	-10.17	-2.59	**.004****
Push up	27.00±7.37	36.44±5.22	-15.70	-3.18	**.005****
Sit-up	24.50±3.68	31.11±4.56	-10.61	-2.61	**.003****
Hand grip strength dom	29.55±6.82	42.95±6.20	-19.74	-7.06	**.005****
Hand grip strength non-dom	26.60±6.73	37.56±3.97	-16.403	-5.53	**.001****
Agility	12.08±.53	10.85±.43	.76	1.70	**.000****
Balance total	10.70±4.49	9.77±5.47	-3.90	5.75	.696

Dom: dominant, Nondom: nondominant. Significance level (**) p <0.01.

When the performance parameters of male and female fencers were compared; there was a statistically significant difference in all performance parameters except the total balance parameter of men compared to women (p < 0.01**).
Dom and non-dom handgrip strength of male and female fencers are shown in table 3.

Table 3. Comparison of intra-group dominant and non-dominant handgrip strength

Group		Mean± std. dv.	95% Confidence Interval		**p**
			Lower	Upper	
Female	Dom	29.55±6.82	1.132	4.767	**.005***
	Non-dom	26.60±6.73			
Male	Dom	42.95±6.20	1.433	9.344	**.014***
	Non-dom	37.56±3.97			

Dom: dominant, Nondom: nondominant. Significance level (*) p <0.05.

When the dom and non-dom handgrip strength of female and male fencers were compared intragroup, there was a statistically significant difference favor to dom handgrip both female (t: 3.671;p < 0.01) and the male fencers (t:3.141;p<0.05).

Table 4. The correlation levels of performance values of male fencers

Pearson C. (n:9M)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Anaerobic power (1)	-,302	-,095	-,108	**,675***	,450	,499	-,053
VO_2max (kg/ml/dk) (2)	1	,342	,560	,216	,067	-,499	-,613
Push up (3)		1	,160	,257	-,299	,000	**-,779***

Sit-up (4)	1	,195	-,223	-,602	-,214
Handgrip strength dom (5)		1	,564	-,078	-,403
Handgrip strength non-dom (6)			1	,073	,229
Ability (7)				1	-,003
Balance total (8)					1

Significance level (*) =p<0.05. VO_2max = maximal oxygen consumption

Statistically significant relationships were found between the performance parameters of male fencers (p<0.05).

Table 5. The correlation levels of performance values of female fencers

Pearson C. (n=10F)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Anaerobic power (1)	,158	-,403	**,652***	**,747***	**,745***	-,361	,117
VO_2max (kg/ml/dk) (2)	1	,521	,550	-,133	-,014	-,091	-,147
Push up (3)		1	,029	-,493	-,462	,246	-,234
Sit-up (4)			1	**,654***	**,765****	-,390	,003
Handgrip strength dom (5)				1	**,930****	-,482	,409
Handgrip strength non-dom (6)					1	-,368	,263
Ability (7)						1	,058
Balance total (8)							1

Significance level (*)= p<0.05. VO_2max = maximal oxygen consumption

Statistically significant relationships were found between the performance parameters of female fencers (p<0.05).

DISCUSSION and CONCLUSION

In this study, the aim of this study was to examine the performance parameters of male and female fencing athletes. In addition, it is another aim to determine whether fencing performance was affected by gender. In the results of the study; The performance parameters of male fencing athletes were found to be higher than female fencing athletes. When the performance parameters of female and male fencing athletes are compared, there is a significant difference between all performance values except for the balance parameter. When the performance values of male fencers are examined; dom handgrip strength with anaerobic power; A relationship was found between push-ups and total balance. When the performance values of female fencers are examined; between anaerobic power and sit-up, dom handgrip strength and non-dom handgrip strength; between dom handgrip strength and non-dom grip strength with sit-up; A correlation was found between dom handgrip strength and non-dom handgrip strength.

The improvement in performance parameters is extremely important for the fencing branch. The fact that fencing international competitions last between 9 and 11 hours, represents 18% of the duration of the competition, and an effective fighting time of 17 to 48 minutes reveals the importance of this branch. It also consists of very short and violent actions (Roi et al., 2008). The observed effects on performance parameters in fencing are consistent with some studies. The deficiencies and discussions in the literature suggest that more studies should be done.

Competition-level fencing performance is determined by a wide range of physical and psychological abilities, including aerobic endurance capacity. The aerobic endurance of fencers is considered an important prerequisite and is extremely important in determining performance (Weichenberger et al., 2012). There are many studies examining the VO_2max values of fencing athletes. In our study, the VO2max values of male fencers were 47.47 ml/kg/min and 41.08 ml/kg/min for female fencers. While the results obtained from our study are compatible with some studies, they are not with others. Roi et al., (2008) in his meta-analysis study; Roi and Mognoni (1987) (48.8 ± 4.0 ml/kg/min VO_2max, Di Prampero (1970) (47.3 ± 2.5 ml/kg/min VO_2max), Rivera et al. 1998 (45.7 ± 6.2 ml/kg/min VO_2max) studies are compatible with our study. Some studies are not compatible with our research; Koutedaki et al., (1993); the British epe fencers were 58.0 ml/kg/min in the off-season and 54.8 ml/kg/min during the season, the Swedish national team male epe fencers' 50.2 ml/kg/min and 67.0 ml/kg/min, Roi et al., (2008); Competition estimated VO_2 values for Spanish female and male fencers, respectively; the average is 39.6 ml/kg/min and 53.9 ml/kg/min.

Reaction time is a measure of how long it takes for an individual to prepare and initiate the activities planned. In our study, a significant difference was found in favor of males between the visual reaction times of male and female fencers. Similar to our study, Kocan et al., (2018) found that male athletes had significantly better visual reaction times than females. Some studies are not similar to our study, Rumma et al., (2018) compared the visual reaction times of male and female fencing athletes in their study. According to the results of the study, there was no statistically significant difference between the visual reaction times of male and female athletes (Rumma et al., 2018). Although not similar to our study method, Duvan et al. (2010) measured male and female visual reaction times during maximal exercise and at rest. According to the study findings, the visual reaction times of male and female fencers increased significantly in maximal exercise time.

Considering the anaerobic power parameters of male and female athletes in our study, it was found that the anaerobic power output of male fencers was higher than the anaerobic power output of female athletes. Similar to the findings of our study, Kocahan et al. (2018) compared the anaerobic power outputs of women and women in their study and found that both peak and average power outputs were significantly higher in male fencers. Abdollah et al., (2014) compared the anaerobic power outputs

of three different fencing categories in their study. According to the study findings, the anaerobic power outputs of the three different fencing categories do not differ significantly.

Along with anaerobic performance, the athlete needs a certain muscle balance in order to use her maximal strength and turn it into optimal performance (Kocan et al. 2018). In the comparison of balance parameters in our study, no significant difference was found between male and female athletes. Kocahan et al., (2018) compared the balance performances of male and female fencers in their study. While there was no significant difference in the anterior balance parameter in the balance measurement of male and female fencing athletes, other parameters resulted in favor of male fencers (Kocan et al. 2018). The fact that some parameters are not similar to our study is thought to be due to the differences in the tests performed and the training levels of the participants.

Tsolakis et al., (2008) measured the handgrip strength of male athletes aged 13-15 in their study. In the findings of the study, they stated that the handgrip strength of the defenders was 28.4 kg. Witkowski et al., (2020) measured the handgrip strength of male and female athletes (all fencers were right-handed) between the ages of 14-20 in their study. In the findings of the study, they stated that the average handgrip strength of the fencers was 28.08 kg for the right hand and 23.41 kg for the left hand. The reason for the differences in the handgrip strengths of the results of these studies in the literature is thought to be due to the age differences of the participants.

Agility is one of the important parameters for performance. In the Abdel-Rahman and Magdy (2014) study; the agility performance values were 7.15. In our study; While the agility values of men are 10.85, it is 12.08 for women. In the studies, maximal treadmill test, anaerobic test, mean power, peak power, isokinetic dynamometry, maximal isometric force, and muscle cross-sectional area, isokinetic strength, flexibility, power, anthropometric, flexibility, technique, and tactical parameters of fencing athletes were examined. Anaerobic power, push-up, sit-up, handgrip strength dom, handgrip strength non-dom, and total balance values of fencing athletes were also measured in our study. However, there are still limited studies in literature examining these parameters for fencers. Detailed examination of the performance parameters reveals the originality of our study.

These results suggest that the performance parameters of male fencers were higher than female fencers. Also, there are relationships between parameters of fencers for both males and females. It can be said that improving some parameters with training also can affect other parameters. In future studies, it is recommended to investigate the performance parameters of fencers in different age groups.

Conflict of Interest: There is no personal or financial conflict of interest within the scope of the study.

Statement of Contribution of Researchers: Research Design- AT, BA, Statistical analysis- AT, Article preparation- BA, AT, Data Collection- VB, AT.

Information on Ethics Committee Permission

Name of the Committee: Selcuk University Sports Sciences Ethics Committee

Date: 30/09/2021

Issue/Decision Number: 122

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