Journal of Education and Learning; Vol. 9, No. 1; 2020
ISSN 1927-5250 E-ISSN 1927-5269
Published by Canadian Center of Science and Education

The Effect of Agility Training on Reaction Time in Fencers

Bulent Turna[1]

[1] Akdeniz University, Faculty of Sport and Physical Education, Antalya, Turkey

Correspondence: Bulent Turna, Akdeniz University, Faculty for Sport and Physical Education Antalya, Turkey. E-mail: bulentturna@akdeniz.edu.tr

Received: October 15, 2019 Accepted: November 12, 2019 Online Published: January 6, 2020

doi:10.5539/jel.v9n1p127 URL: https://doi.org/10.5539/jel.v9n1p127

Abstract

The aim of this study was to investigate the effects of agility training on reaction time in fencers. Accordingly, 48 athletes (24 females and 24 males) actively involved in fencing participated in the study. Fencers were divided into two groups as 24 fencers in the Agility Training Group (ATG: 12F, 12M) (aged 11.95 years, sports age 2.54 years, height 159 cm, body weight 48.08 kg and body mass index 18.81 kg/m²) and Conventional Training Group (CTG: 12F, 12M) (aged 12.12 years, sports age 2.20 years, height 156.54 cm, body weight 46.25 kg and body mass index 18.81 kg/m²). There was a statistically significant difference between the pre-test and post-test values in agility, vertical jump, simple reaction time and multiple reaction time tests in the ATG ($p<0.05$). There was a statistically significant difference between the pre-test and post-test values in agility and vertical jump tests in the CTG ($p<0.05$). There was a statistically significant difference in the pre-tests between the groups in the simple reaction time test ($p<0.05$). There was a statistically significant difference in post-tests between the groups in the agility, simple reaction time and multiple reaction time test values ($p<0.05$). Based on the results of the study, it was found that simple and multiple reaction time could be positively affected by active-reactive agility training applications.

Keywords: agility, fencing, reaction time

1. Introduction

Fencing is an open skill sport that requires the application of body movements and effective game strategies. In fencing, agility, explosive and anaerobic endurance are of great importance (Bianchedi, 2008). It consists of three branches: the épée, foil and the sabre. Physical fitness is the most important criterion in determining the physiological capacity (Çakmakçi et al., 2018; Tatlici & Cakmakci, 2019). In most sport branches, Skill-related components include speed, agility, strength, balance, coordination, and response time (Çakmakçı et al., 2019). In sport, this is well known that small times make teams or players winner (Tatlıcı et al., 2018). In addition to these physiological features, the athlete has to perfect these features through exercises (Tatlıcı et al., 2018). Therefore, athletes with excellent technique and tactics can achieve success if they develop their basic motoric features systematically (Ünlü & Tatlıcı, 2018). Skill related components include speed, agility, strength, balance, coordination, and response time (Aktaş et al., 2019). Points are scored by touching in the épée and foil whereas points are scored by hitting in the sabre branch. In fencing, touching or hitting is defined as touché (Szabó, 1997). As in chess, fencing is a sport that requires making quick thinking and decisions, thinking ahead of the opponent's moves, being smart and strong. In other words, it is the chess of swords. During the competition, the fencer must maintain defensive and offensive movements, so it is important that the performance in fencing is at a high level. Dynamic movements such as stepping back and forth and jumping, moves to make a *touché* to the opponent are directly proportional to the athlete's agility and muscle strength. In general, these performance parameters may vary depending on the body size and structure of the fencers, but they can compete with equal success. Furthermore, performance in fencing is closely related to the interaction between physical abilities and perceptual-psychomotor properties (Aquili, Tancredi, Triossi, Sanctis, Padua, D'Arcangelo, & Melchiorri, 2013). Researches carried out in the field of sports are aimed at improving performance and success. Performance is the level of efficiency produced by the athlete and consists of some components (physical, physiological, biomotor, psychological, mental, sociological, technical, tactical, etc.). A variety of training methods have been developed and combined training models have been used in performance development (Turna & Kılınç, 2016). Therefore, it is thought that agility training may have an effect on reaction time in fencers. Some studies have suggested that voluntary contractions from moderate to high intensity, such as dynamic warming, will increase power generation and performance by activating the nerve-muscle function before sporting performance. Dynamic heating, an element of sporting performance, is essential for the maximal strength and effective sporting performance. In addition, warm-up methods form a part of the preparation for competitions for trainers and instructors in many sports (Bishop, 2003; Turna, 2018). Agility is defined as the sudden movement of the whole body by changing speed or direction in response to a specific stimulus (Hazır, Mahir, & Açıkada, 2010). The quality of agility requires the partnership of speed, balance, power and coordination (Chelladurai, 1976). Agility is a motor ability and can be improved by regular progressive exercise. Agility, as an important element, is a valid method used in sports performance measurement batteries (Çömük & Erden, 2010). Reaction time plays a key role in everyday life (for example, the driver's quick response, catching objects falling off the table, etc.). In some sports, athletes must react quickly to different stimuli (tactile, visual and audible). It is clear that the main types of stimuli in fencing are tactile and visual, as evidenced by Borysiuk and Waskiewicz (Borysiuk & Waskiewicz, 2008). Therefore, it is important to remember that there are other important factors affecting fencing performance. These factors include inter-muscular coordination, technical level, tactics (5,14), psychological aspects (Balkó, Rous, Balkó, Hnízdil, & Borysiuk, 2017; Gracz & Tomczak, 2008) and several other effects. The reaction time also contributes to the overall duration of specific movement tasks. It is possible to say that the reaction time is very important in fencing because a faster reaction can reduce the total movement time. In fencing, unlike other sports, reaction time and muscle coordination level during movement play an important role in the evaluation of performance and physical strength (Iermakov, Podrigalo, & Jagiełło, 2016). Many researchers agree that the reaction time in fencing plays an important role in overall sports performance compared to other martial sports (Borysiuk, 2008; Gracz & Tomczak, 2008; Harmenberg, Ceci, Barvestad, Hjerpe, & Nyström, 1991). Comparing the reaction times of karate athletes and fencers, it was found that fencers showed shorter reaction times (Colin, 2008).

2. Method

2.1 Participants

Participants in the study consisted of 48 athletes, 24 females and 24 males, aged 11–14 years, who are licensed under Alanyaspor-Antalya fencing club and fill out the 'Informed Volunteer Consent Form'. The 48 athletes participated in the research were randomly divided into Agility Training Group (ATG: 24), (12 M, 12 F) and Conventional Training Group (CTG: 24), (12 M, 12 F). The mean age of the fencers in the ATG was 11.95±1.04 years, mean sports age was 2.54±1.13 years, mean height was 159.25±8.84 cm, mean body weight 48.08±8.27 kg and the mean body mass index was calculated as 18.81±1.85 kg/m². The mean age of the fencers in the CTG was 12.12±0.94 years, mean sports age was 2.20±0.90 years, mean height was 156.54±7.34 cm, mean body weight 46.25±5.23 kg and the mean body mass index was calculated as 18.81±1.04 kg/m².

Table 1. Physical properties of fencers

Group		N	Minimum	Maximum	Mean	SD
ATG	Age (years)	24	11.00	14.00	11.95	1.04
	Height (cm)		142.00	175.00	159.25	8.84
	Body weight (kg)		37.00	70.00	48.08	8.27
	Sports Age (year)		1.00	5.00	2.54	1.13
	Body Mass Index (kg/m²)		15.57	22.85	18.81	1.85
CTG		N	Minimum	Maximum	Mean	SD
	Age (years)	24	11.00	14.00	12.12	.94
	Height (cm)		142.00	165.00	156.54	7.34
	Body weight (kg)		35.00	55.00	46.25	5.23
	Sports Age (year)		1.00	4.00	2.20	.90
	Body Mass Index (kg/m²)		17.11	20.42	18.81	1.04

2.2 Procedure

In the study, free vertical jump values, Illinois Agility Test, simple reaction and multiple reaction times of athletes were measured as pre-test and post-test values. After the pre-test values of the fencers in the Agility Training Group were taken, active and reactive agility training was performed two days a week in addition to the traditional fencing training performed in the Traditional Training Group fencers for 6 weeks (Table 2). Post-test values were determined in both groups at the end of six weeks. Two values were determined as the pre-test and post-test values. Standard warm-up procedures were carried out before each test and training: 10-min. jogging, dynamic and static stretching exercises and hand and foot movements specific to the fencing. Preliminary tests were subsequently performed. At the end of the tests and training, cooling exercises were performed. The post-test was conducted after the implementation of the 6-week agility training program (Table 2). The participants were fully familiar with the exercise test procedures since they routinely performed these movements in fencing training. During the 24-hour period before the tests were performed, the participants did not engage in any tiring activities specific or related to fencing. In each test, athletes were orally encouraged to reach their maximum level in the tests.

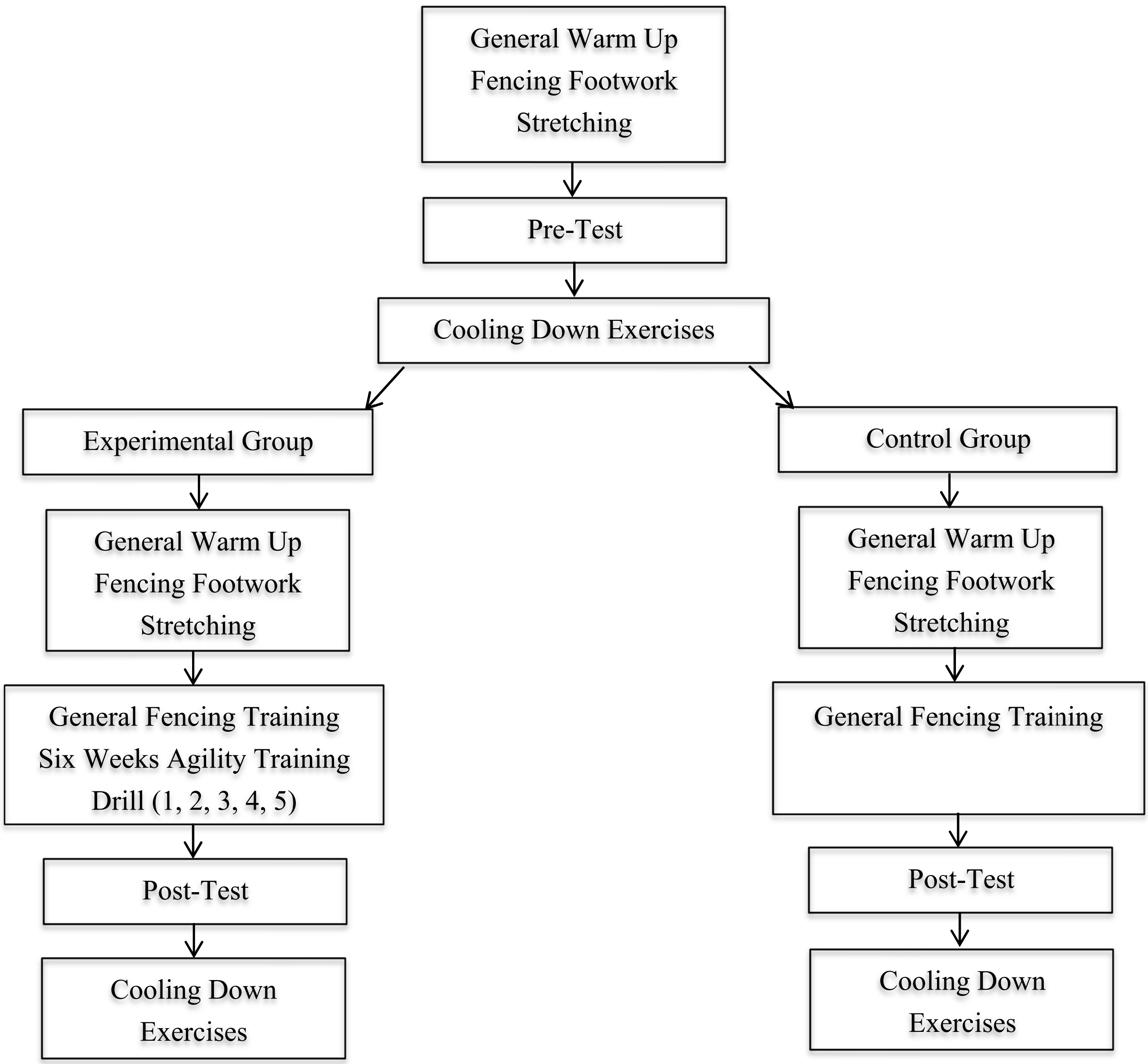

Figure 1. Test procedure

2.2.1 Agility Training

Drill 1: The athlete acts according to the number command or commands given by the trainer randomly to the numbered circles placed at equal intervals. The athlete runs to the number given by the coach and comes back to the starting point. If the coach tells more than one number, the athlete has to come back to the start after each reached circle.

Drill 2: To prepare the course, four cones are arranged as shown below. When the athlete is instructed to start, he starts from the "A" cone, runs straight to the "B" cone and touches the cone with his right hand. Then the athlete runs to the left with a side step to the "C" cone and touches the "C" cone with the left hand, then runs to the right to the "D" cone with a side step and touches it with the right hand. Then the athlete comes to the "B" cone with a side run and touches it with the left hand, then returns to the "A" cone with a run-back.

Drill 3: While the athlete waits in the stance position during the fencing, the coach throws him a badminton ball and asks him to push the badminton ball back to the coach with the hand he used in the fencing.

Drill 4: The athlete, with his feet parallel to each other and shoulders wide open, makes a right-to-left transition on a line standing in front of him/her and starts to run towards the coach with the command of the trainer. The trainer raises one arm to the approaching athlete and the athlete continues to run in the direction of the arm below.

Drill 5: The athletes are instructed to mutually stand across each fencer at an equal distance from the cones in the fencing stance position. With the yellow or red command of the trainer, the athletes are asked to take the cone of which its color is pronounced with the attack movement in fencing.

Table 2. Weekly training program

Training Group	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Agility Training Group (ATG)	General Fencing Training	General Fencing Training + Drill 1 Drill 3 Drill 5	General Fencing Training	General Fencing Training + Drill 2 Drill 4	General Fencing Training	General Fencing Training	-
Conventional Training Group (CTG)	General Fencing Training	General Fencing Training	General Fencing Training	General Fencing Training	General Fencing Training	General Fencing Training	-

General Fencing Training: 10 min. Jogging+5 min. Stretching Exercises+5 min Special Warm-Up+15 min. Fencing Footwork+5 min. Rest+10–15 min. Special Fencing Lesson+10–15 min. Tactical-Technical Special Fencing Movements+15–20 min. Fencing Combat.

2.3 Data Collection Tools

2.3.1 Body Mass Index (BMI)

Body mass index (BMI) of the study group was calculated by using body weights and heights;

Body Mass Index (kg/m^2)=Body Weight/$(Length)^2$

2.3.2 Illinois Agility Test

Illinois Agility Test was used to determine the agility. The test consists of three cones lined up on a straight line with a width of 5 meters, a length of 10 meters and at intervals of 3.3 meters in the middle section. The test consists of 180º turns every 10 meters with a 40-meter straight slalom run and 20-meter between the cones. Subjects leave the starting line of the test course in the prone position and hands in contact with the ground at the shoulder level. The time is started as soon as the athlete exits. The time stops as soon as the track finishes. The finish time is recorded in seconds. The time is measured by using a timer. With complete rest, the test is repeated twice, the best value is taken (Draper & Lancaster, 1985).

2.3.3 Vertical Jump Test

The Takei jump meter was attached to the abdominal area of the fencer and the fencer was asked to jump vertically on two hands in free position and land in the predetermined area. Two trials were performed and the best high value is recorded in cm.

2.3.4 Reaction Time Measurement Test

The accuracy of the keys (before and after the six-week test period) was tested using the Favero EFT-1 electronic fencing target manufactured by FAVERO ELECTRONIC Srl Arcade, Treviso, Italy. The device allows nine tests, but two different tests were used in the test procedure. Simple Reaction time and Multiple

Reaction time test procedures were conducted respectively (Witkowski, 2018).

- Simple Reaction Time Test Procedure

  The test results in a hit to a target to which the device signals. First, a target gives a red signal and the time starts. The fencer gives a signal to the target and then stops. The values are recorded in seconds. The test is performed twice and the best value is recorded.

- Multiple Reaction Time Test Procedure

  Multiple Reaction Time Test is performed by hitting the three red targets that are lit at the same time. The three targets give red signals at the same time and the time starts, after the fencer touches the red targets, the time stops. The values are recorded in seconds. The test is performed twice and the best value is recorded.

The test was conducted in two different procedures to make the test safer and to ensure the accuracy of the keys. In each of the tests, the fencer's task is to hit the red targets randomly flashing with the tip of the épée. The time on the instrument was recorded after each test procedure.

2.4 Data Analysis

Descriptive statistical values including arithmetic mean and standard deviation (x±SD) were calculated for all variables. Shapiro-Wilk normality test was used to determine whether the data showed normal distribution. The Paired t-Test was used to determine whether the changes over time in the variables recorded during the different measurement periods (pre-test, post-test) in the AGC and CTG were different.

In addition, differences between ATG and CTG for each measurement period were evaluated by the independent-samples t-test. Statistical procedures were performed in SPSS package software and α=0.05 error level was applied to all statistical procedures.

3. Results

Table 3. Agility training group and conventional training group pre-test and post-test comparisons

Group	Protocol	Test Order	Mean	SD	T	P
ATG	Illinois	Pre-Test	20.43	1.30	4.50	.000*
		Post-test	19.68	1.29		
	Vertical Jump	Pre-Test	18.91	3.37	-2.96	.007*
		Post-test	19.45	3.64		
	Simple Reaction	Pre-Test	.46	.04	6.27	.000*
		Post-test	.42	.04		
	Multiple Reaction	Pre-Test	1.77	.23	7.93	.000*
		Post-test	1.66	.21		
Group	Protocol	Test Order	Mean	SD	T	P
CTG	Illinois	Pre-Test	21.04	1.32	3.16	.004*
		Post-test	20.80	1.28		
	Vertical Jump	Pre-Test	19.35	2.47	-2.19	.038*
		Post-test	19.56	2.67		
	Simple Reaction	Pre-Test	.49	.04	.76	.450
		Post-test	.49	.05		
	Multiple Reaction	Pre-Test	1.78	.20	1.01	.321
		Post-test	1.77	.19		

Note. P<0.05, ATG: Agility Training Group, CTG: Conventional Training Group.

In the research, a statistically significant difference was found between the agility, simple reaction time and multiple reaction time test values in the evaluation of the pre-test and post-test results of the ATG ($p<0.05$).

On the other hand, there was a statistically significant difference between the agility and vertical jump tests in the evaluation of pre-test and post-test results ($p<0.05$).

Table 4. Comparison between the groups at different measurement periods (Pre-Test, Post-test)

Protocol	Test Order	Group	Mean	SD	T	P
Illinois	Pre-Test	ATG	20.43	1.30	-1.59	.118
		CTG	21.04	1.32		
	Post-test	ATG	19.68	1.29	-2.99	.004*
		CTG	20.80	1.28		
Vertical Jump	Pre-Test	ATG	18.91	3.37	-,51	.611
		CTG	19.35	2.47		
	Post-test	ATG	19.45	2.64	-.11	.911
		CTG	19.56	2.67		
Simple Reaction Time	Pre-Test	ATG	.46	.04	-2.33	.024*
		CTG	.49	.04		
	Post-test	ATG	.42	.04	-4.64	.000*
		CTG	.49	.05		
Multiple Reaction Time	Pre-Test	ATG	1.77	.20	-,21	.828
		CTG	1.78	.23		
	Post-test	ATG	1.66	.21	-1.95	.057
		CTG	1.77	.19		

Note. P<0.05b, ATG: Agility Training Group, CTG: Conventional Training Group.

In the present study, examining the differences between the ATG and CTG for each measurement period, a statistically significant difference was found in the comparison of pre-tests between groups and in the simple reaction time test ($p<0.05$). Examining the differences between ATG and CTG groups, a statistically significant difference was found between the agility, simple reaction time and multiple reaction time tests in the comparison of Post-test between groups ($p<0.05$).

4. Discussion

In the present research, it was found that in the comparison of the pre and post- test of the ATG, there was a statistically difference was found between the agility, simple reaction time and multiple reaction time test values ($p<0.05$). The agility and vertical jump tests in the evaluation of pre-test and post-test results was statistically significant ($p<0.05$). When the ATG and CTG simple reaction time test values were compared for pre-test, there was a significant difference ($p<0.05$). In the post-test, the agility, simple reaction time and multiple reaction parameters of the ATG and CTG were significantly different ($p<0.05$).

The ability to influence reaction time is difficult, and researchers have reported various findings on this subject in fencing. In sports events in which positive increases and differences in force and performance affect the result of the competition (Alp et al. 2018). Wang has reported that reaction time can be affected by training (Wang, 2009). Suna and Alp reported that even trainings in competition period can improve the performance of athletes (Suna and Alp, 2019). Most studies investigating reaction time include a comparison of reaction time between different performance groups of athletes (Balkó, Borysiuk, Balkó, & Spulak, 2016). Studies that investigate the development of reaction time in connection with training are less frequent than acute and different performances. The critical age range for the positive development of the reaction time with the effect of training is between 11 and 14 years (Balkó, Rous, Balkó, Hnízdil, & Borysiuk, 2017). In this study, fencers were selected within the sensitive age range that is expected to exhibit improvement in reaction time. However, it is important to add that improvement depends on many individual factors. Alter (1998) has stated that the reaction time in sports varies depending on age, static and dynamic stretching exercises and warm-ups. A study has stated that optimal warm-up can positively affect the conduction of the nerve pathway and signal transmission (Alter, 1998). In the light of this finding, the same type of stretching and warm-up (static or dynamic) was applied before the pre-test and post-test to ensure standard and equal conditions for all fencers. For the development of reaction time, agility training for the ATG athletes was conducted in connection with fencing and movements were integrated into fencing. This has enabled agility training to be performed optimally in fencing. In some previous studies, some interventions have been observed that may affect the measurement results of the reaction time (Balkó, Rous, Balkó, Hnízdil, & Borysiuk, 2017).

However, in the present study, the reaction times in pre- and post-tests were taken from the time meter on the target of electronic fencing. It is universally accepted that experienced athletes are faster and better than newcomers in terms of processing information. Schmidt has stated that sufficient experience can significantly affect reaction time (Schmidt & Wrisberg, 2008). On the other hand, there was no significant difference in simple reaction times between experienced athletes and beginners ($p=0.8065$) (Barcelos, Morales, Maciel, Azevedo, & Silva, 2009). This finding is also related to the study results of Kida et al. who did not determine a statistically significant difference in this variable between a group of experienced baseball players and beginners (Kida & Oda, 2005). In many sports, athletes can predict the sequence of successive events and choose the appropriate type and timing of the reaction (Schmidt & Wrisberg, 2008). This is related to "automation" during the processing of information in the central nervous system. Automation training is more efficient when we use the same stimulus that always initiates the same signal. The shortening of the reaction time occurs not only during the repetition of the same stimulus combination for simple reaction time but also when two or more stimuli are stimulated (Balkó, Rous, Balkó, Hnízdil, & Borysiuk, 2017). In the study which measures the effect of training on reaction time, the results of statistical analyses showed that there were differences in simple and multiple reaction time levels (Balkó, Rous, Balkó, Hnízdil, & Borysiuk, 2017). In the study, it was observed that the level of multiple reaction time that the fencers reacted to the three stimuli decreased significantly in the experimental group after training ($p=0.013$, $r=0.469$) (Balkó, Rous, Balkó, Hnízdil, & Borysiuk, 2017). In the case of simple reaction due to a single stimulus, a moderate effect occurred between the pre-test and post-test values between the experimental and control groups ($p=0.109$, $r=0.303$) (Balkó, Rous, Balkó, Hnízdil, & Borysiuk, 2017).

Based on the results of the study, it can be concluded that simple and multiple reaction times can be positively affected by appropriate training (Balkó, Rous, Balkó, Hnízdil, & Borysiuk, 2017). Differences in simple and multiple reaction times were observed between experimental and control groups to evaluate changes in reaction time (Balkó, Rous, Balkó, Hnízdil, & Borysiuk, 2017). Balko et al. (2017) have reported that there was no significant difference between the groups in terms of simple reaction time for post-test after a 9-week training. Balko et al. (2017) have also reported that the reaction time of the experimental group was significantly shorter than the control group after a 9-week-training ($p=0.116$, $d=0.722$). Based on these findings, it is believed that it is possible to determine whether there are effective methods to reduce reaction time by agility training, where reaction time plays an important role in overall fencing performance.

5. Conclusions and Suggestions

In the light of these evaluations, it can be suggested to apply traditional fencing training in combination with agility training. In addition to traditional fencing training, agility training can provide performance advantages to the athletes. It is known by all fencing coaches that the reaction time is of great importance in fencing. Agility training has a positive effect on reaction time. This information can be particularly useful for the improvement in athletes for fencing trainers.

References

Ağar, E. (2006). *9–11 Yaş erkek çocuklarda ip atlama ve interval koşu egzersizlerinin performans ile etkileşimi.* Yüksek Lisans Tezi, Bolu Abant İzzet Baysal Üniversitesi, Türkiye.

Aktaş, S., Tatlici, A., & Çakmakçi, O. (2019). Determination of Isokinetic Strength of Upper and Lower Body of Elite Male Boxers. *Turkish Journal of Sport and Exercise*, *21*(2), 188–191. https://doi.org/10.15314/tsed.600645

Alp, M., Çatıkkaş, F., & Kurt, C. (2018). Acute effects of static and dynamic stretching exercises on lower extremity isokinetic strength in taekwondo athletes. Isokinetics and Exercise Science, 26(4), 307-311. https://doi.org/10.3233/IES-183159

Alter, M. J. (1998). *Spor Stretch, 311 Stretches For 41 Sports*. Champaign, IL: Human Kinetics.

Aquili, A., Tancredi, V., Triossi, T., De Sanctis, D., Padua, E., D'Arcangelo, G., & Melchiorri, G. (2013). Performance analysis in saber. *The Journal of Strength & Conditioning Research*, *27*(3), 624–630. https://doi.org/10.1519/JSC.0b013e318257803f

Balkó, Š., Borysiuk, Z., & Šimonek, J. (2016). The influence of different performance level of fencers on simple and choice reaction time. *Revista Brasileira de Cineantropometria & Desempenho Humano*, *18*(4), 391–400. https://doi.org/10.5007/1980-0037.2016v18n4p391

Balkó, Š., Rous, M., Balkó, I., Hnízdil, J., & Borysiuk, Z. (2017). Influence of a 9-week training intervention on the reaction time of fencers aged 15 to 18 years. *Physical Activity Review*, *5*, 146–154. https://doi.org/10.16926/par.2017.05.19

Barcelos, J. L., Morales, A. P., Maciel, R. N., Azevedo, M. M. D. A., & da Silva, V. F. (2009). Time of Practice: A Comparative Study of the Motor Reaction Time Among Volleyball Players. *Fitness Performance Journal*, *8*(2), 103–109. https://doi.org/10.3900/fpj.8.2.103.e

Bianchedi, D. (2008). The Science of Fencing. *Sports Med.*, *38*, 465–381. https://doi.org/10.2165/00007256-200838060-00003

Bishop, D. (2003). Warm Up II: Performance Changes Following Active Warm Up And How To Structure The Warm Up. *Sports Med.*, *33*, 483–498. https://doi.org/10.2165/00007256-200333070-00002

Borysiuk, Z. (2008). Psychomotor Reactions In Fencing Dependence Of Stimuli Type. *Rev Bras Cineantropom Desempenho Hum.*, *10*(3), 223–229. https://doi.org/10.5007/1980-0037.2008v10n3p223

Borysiuk, Z. (2008a). The significance of sensorimotor response components and EMG signals depending on stimuli type fencing. *Acta Uni Palacki Olomuc Gymn*, *38*(1), 43–51.

Borysiuk, Z., & Waskiewicz, Z. (2008). Information processes, stimulation and perceptual training in fencing. *Journal of Human Kinetics*, *19*, 63–82. https://doi.org/10.2478/v10078-008-0005-y

Çakmakçı, E., Tatlıcı, A., Kahraman, S., Yılmaz, S., Ünsal, B., & Özkaymakoğlu, C. (2019). Does once-a-week boxing training improve strength and reaction time? *Uluslararası Spor Egzersiz ve Antrenman Bilimi Dergisi*, *5*(2), 88–92. https://doi.org/10.18826/useeabd.552086

Çakmakçi, E., Tatlici, A., & Yirmibeş, B. (2018). Comparıson of Some Performance Parameters of Physıcally Actıve Mentally Retarded and Inactıve Mentally Retarded Indıvıduals. *European Journal of Physical Education and Sport Science*, *4*(12), 49–57.

Chelladurai, P. (1976). Manifestations of Agility. *Journal of the Canadian Association of Health, Physical Education and Recreation*, *42*(3), 36–41.

Colin, W. (2008). Apects of fencing technology. *Sword*, *94*, 24.

Çömük, N., & Erden, Z. (2010). Artistik Buz Pateninde Üçlü Sıçrayış Performansının Çeviklik Ve Reaksiyon Zamanı İle İlişkisi. *Fizyoterapi Rehabilitasyon*, *21*(2), 75–80.

Czajkowski, Z. (2009). Tactics in Fencing – Preparatory Actions. *Studies in Physical Culture & Tourism*, *16*(4), 371–377.

Draper, J. A., & Lancaster, M. G. (1985). The 505 Test: A Test for Agility in the Horizontal Plane. *Aust J SciMed Sports*, *17*(1), 15–18.

Gracz, J., & Tomczak, M. (2008). Selected Temperamental Properties and Achievement Motivation of Fencers. *Studies in Physical Culture and Tourism*, *15*(2), 109–118.

Harmenberg, J., Ceci, R., Barvestad, P., Hjerpe, K., & Nyström, J. (1991). Comparison of different tests of fencing performance. *International Journal of Sports Medicine*, *12*(06), 573–576. https://doi.org/10.1055/s-2007-1024736

Hazır, T., Mahir, Ö. F., & Açıkada, C. (2010). Genç Futbolcularda Çeviklik İle Vücut Kompozisyonu Ve Anaerobik Güç Arasındaki İlişki. *Hacettepe J. of Sport Sciences*, *21*(4), 146–153.

Iermakov, S., Podrigalo, L. V., & Jagiełło, W. (2016). Hand-Grip Strength as an Indicator for Predicting the Success. *Martial Arts Athletes*, *12*, 179–186.

Kida, N., Oda, S., & Matsumura, M. (2005). Intensive baseball practice improves the Go/Nogo reaction time, but not the simple reaction time. *Cognitive Brain Research*, *22*(2), 257–264. https://doi.org/10.1016/j.cogbrainres.2004.09.003

Kılınç, F. (2008). An Intensıve Combined Training Program Modulates Physical, Physiological, Biomotoric and Technical Parameters in Basketball Player Women. *Journal of Strength and Conditioning Research*, *22*(6), https://doi.org/10.1519/JSC.0b013e3181854bca

Schmidt, R. A., & Wrisberg, C. A. (2008). *Motor learning and performance: A situation-based learning approach* (4th Ed.). Champaign IL: Human Kinetics.

Suna, G., Alp M. (2019). Comparison of strength, heart rate, oxygen saturation and technical test values of 12–14 year male tennis players in competition period. Journal of Education and Learning; Vol. 8, No. 6: 187-194. https://doi.org/10.5539/jel.v8n6p187

Szabó, L. (1997). *Fencing and the Master*. SKA Swordplay Books.

Tamer, K. (1995). *Sporda Fiziksel–Fizyolojik Ölçümler ve Değerlendirilmesi* (p. 40). Türkerler Kitabevi.

Tatlıcı, A., Çakmakçı, E., Yılmaz, S., & Arslan, F. (2018) Comparison of Visual Reaction Values of Elite Deaf. *Turkish Journal of Sport and Exercise*, *20*(2), 63–66. https://doi.org/10.15314/tsed.440813

Tatlici, A., & Cakmakci, O. (2019). The effects of acute dietary nitrate supplementation on anaerobic power of elite boxers. *Medicina Dello Sport*, *72*(2), 225–233.

Tatlici, A., Sercan, Y., & Samet, A. (2018). *Türkiye'de işitme engelliler ve spor* (pp. 589–598). Türkiye birliği yayınları.

Turna, B. (2018). *Dinamik ve Statik Germe Egzersizlerinin Biyomotorik özelliklere akut etkisi*. LAP Lambert Academic publishing, Saarbrücken.

Turna, B., & Kılınç, F. (2016). "Examining the Relation Between the Performance Levels of the Footballers and the Data Obtained with the Routine" Combined Performance Analyses. *Us-China Education Review*, *6*, 657–668. https://doi.org/10.17265/2161-623X/2016.11.005

Ünlü, G., & Tatlıcı, A. (2018). Elit Güreşçilerde Proprioseptif Nöromuskuler Fasilitasyon (Pnf) Uygulamalarının Dinamik Denge Performansına Akut Etkileri. *Sportif Bakış: Spor ve Eğitim Bilimleri Dergisi*, 57–63.

Wang, J. (2009). Reaction-Time Training for Elite Athletes: A Winning Formula for Champions. *International Journal of CoachingScience*, *3*(2), 67–78.

Witkowski, M. (2018). Evaluation of the Effectiveness of a Transfer Training Program in the Early Stages of Fencing Training. *The Journal of Sports Medicine and Physical Fitness*, *58*(9), 1368–1374.