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ORIGINAL ARTICLE

Developing the Speed of Fencers at the Level of the Lower and Upper Limbs through a Combined Program of Non-Specific and Fencing-Specific Exercises

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ABSTRACT

Background. The fencing assault is a fight between two competitors, in which they alternate the offensive with the defensive attitude while attacking and retreating in the hope that one will strike the other with the tip of the blade, with impressive speed and precision. The fencer who is faster will have the advantage of scoring touch and has a better chance of winning the competition. **Objectives.** This study aims to verify whether training programs that use both non-specific and specific fencing exercises develop the speed of fencers at the level of the lower and upper limbs. **Methods.** The study subjects were divided into two homogeneous groups. The experimental group consisted of 10 athletes (5 boys and 5 girls), and the control group also included 10 athletes (5 boys and 5 girls). The experimental group followed a training program including one set of exercises to develop limb speed, the set of exercises being different every month, with a total duration of the intervention of 3 months; the control group followed traditional training, without emphasizing the development of the limb speed. **Results.** After three months of training, we could notice a significant difference between the two groups in terms of defining the speed of the athletes' lower and upper limbs. **Conclusion.** Considering the results obtained from the tests, we can state that the innovative and different training methods significantly developed the speed of the fencers in the experimental group.

KEYWORDS: ***Innovative Methods, Speed Development, Favero EFT-1, Optojump Next.***

INTRODUCTION

In different fields of sports, athletes must react rapidly to different stimuli (tactile, visual, and audio). As previously demonstrated by Borysiuk and Waskiewicz (1), the major types of stimuli in fencing are tactile and visual. Fencing is a sport in which speed is a crucial component of performance (2). Sorel (3) highlighted the importance of high levels of coordination, explosive force, speed, accuracy, and rapidity in the case of fencers. Fast reaction, which is closely related to the visual or tactile stimuli processing, muscle coordination during movement, technical and tactical abilities, or optimal mental state represent the elementary determinants influencing the overall performance in fencing (4). Fencers are exposed to a variety of stimuli (mainly visual and tactile) during their training or matches in tournaments which means that fencing can be considered a sports discipline where the reaction time is a significant component of the overall speed of the offensive and defensive actions (4). Fencing not only

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involves a rapid change of position and well-coordinated movements of the dominant hand but also fast movements and good physical training. These elements are required to perform technical and tactical techniques and achieve high sports results (5).

Considering that speed and accuracy of movement have been demonstrated to be related to fencing performance (6), workouts consist of training power and repeated changes of direction, to improve the fencing performance (7).

Fencing requires quick responses and powerful reactions. A fencer who does not possess these skills will find it difficult to keep up with his/her opponents and will have to make an enormous effort to develop them as they are closely related to the accuracy of the fencer's offensive actions.

Speed is a determining factor suggesting the quality of an attack or defense made by the competitor using different moves accompanied by sudden changes or implementing another move while fighting, which requires quick response skills. He/she must take the right decision, at the right time, by using confusion and evasion to have an effective attack against the opponent. Therefore, the required speed of the motor response differs from one assault to the other, depending on the technical and tactical requirements of each fencer and according to the changes that occur during an assault. The importance of a quick response is undeniable in fencing, the shorter the motor response time, the higher the level of physical performance will be, leading to a better result (8).

Fencing is a sport that relies on a complex interplay of numerous performance characteristics. The evaluation of these characteristics is important in the field of talent identification and talent development. Multidimensional test batteries have proven their value in different sports (9). The device (i.e. Favero EFT-1) was found to be highly reliable and therefore could be used in fencing athletes as an additional test with ecological validity, and by inference, as an additional training tool. Future studies should aim to investigate the use of this device as a training tool (10).

The objectives of this study were the development of the fencers' speed at the level of upper and lower limbs by applying innovative training methods consisting of specific and non-specific fencing exercises, the identification of different functional methods for the development of speed, and the evaluation of their effectiveness in the athletes' training.

MATERIALS AND METHODS

Participants. Athletes from the ACS Floreta fencing club Timișoara, aged between 10 and 14, participated in this study. The athletes' parents/legal guardians gave their written consent for the athletes' participation in the study. In the research process to be as real and valuable as possible, the research subjects had to be selected according to certain inclusion and exclusion criteria. The criteria were divided into two categories. These criteria were the following:

a) Inclusion criteria:

- Subjects must be aged between 10 and 14 years at the time of selection;
- They should have at least 6 months of experience in fencing;
- They must have the written consent of their parents/legal guardians for their participation in the study.

b) Exclusion criteria:

- The unmotivated absence from training sessions (not more than 4 times/month) and tests;
- The excused absence from more than 4 training sessions (one month, in a cumulated form) during the whole study. This kind of absence can be encountered in the context of competitions, training camps, school exams, or the occurrence of some illnesses.

The athletes were divided into two groups: the experimental group (10 athletes: 5 boys and 5 girls) and the control group (10 athletes: 5 boys and 5 girls). The groups were homogeneous in terms of age, gender, and training level, and the allocation was done randomly, by drawing lots, both for girls and boys.

The athletes in the experimental group followed a program consisting in specific fencing training which includes a set of exercises for speed development, twice a week, general fitness training, and one more specific fencing training combined with assaults (either themed or free assaults). As a whole, the experimental group had 4 training sessions per week, see Table 1.

The intervention. For each month (Tables 2-4) a set of 10 exercises was developed for speed development, alternating their action areas (the upper and lower limbs). This set of exercises contains both fencing-specific exercises and exercises borrowed from other sports. There were

exercises in which certain helpful objects were used (tennis balls, reaction balls, agility ladders, sticks, cones, etc.), but there were also free exercises.

The group control benefited from a general training program, without any specific training in speed development, with a total of 4 pieces of training per week.

Table 1. The weekly training schedule of the experimental group

Day / Group	Monday	Tuesday	Wednesday	Thursday	Friday
Experimental group	General fitness workout	Specific fencing training including the set of exercises for the speedy development	Day off	Specific fencing training including the set of exercises for the speedy development	Specific fencing training combined with assaults
Control group	General fitness workout	Specific fencing training	Day off	Specific fencing training	Specific fencing training combined with assaults

Table 2. Intervention – Month 1

A set of exercises to develop the speed of the upper limbs:	**A set of exercises to develop the speed of the lower limbs:**
Non-specific: 1. The tennis ball is tossed up, claps, the ball is caught with one hand; 2. The tennis ball is launched and, when it bounces off the ground, it is caught with one hand at arm's length (from the guard position); 3. The reaction ball is launched, and the athlete catches it with one hand after it bounces off the ground; 4. The same exercise, from movements (from the guard position); 5. In The same exercise, the ball is caught, after which the lunge is performed. Specific: 6. Strike the dummy with the foil in different numbered circles. The trainer calls out a number and the athlete hits with an arm stretch in the shortest time; 7. A glove is released from above the dummy and the athlete catches it with an arm-outstretched hit; 8. Favero EFT-1 using program no. 1; 9. Favero EFT-1 using program no. 5; 10. Favero EFT-1 using program no. 7.	Non-specific: Agility leather exercises: 1. Close-close-far-far; 2. Ankle game 2 boxes forwards, 1 back; 3. Ankle game forwards, stepping outside the box with the right leg; 4. Angle game forwards, stepping outside the box with the left leg; 5. From the guard position, 2 steps forwards, 1 back. Specific: 6. From the guard position, steps forward to the first line, then steps back (relay), to the next line again, and so on; 7. Fencing steps from the guard position, the direction of movement changes in a sound signal (clap); 8. Step forwards, quick steps backward on a signal; 9. Free movement, a lunge is performed on a sound signal; 10. Keeping the distance from the trainer (visual signals).

Measurement. At the beginning of the research, baseline tests were conducted both for the experimental and the control group. To measure the speed of the upper limbs we used the Favero EFT-1 device, and we evaluated the reaction speed at the level of lower limbs with the Optojump Next device.

Favero EFT-1. Favero EFT-1 (Figure 1a) – is a device for the evaluation and training of the reaction and strike speed. This device has 5 targets, and each of these has 2 lights: a red one, which lights up when the signal appears, and a green one, which lights up when the target has been reached. The device is programmable, and the trainer can prepare 9 different exercises (11). The execution of the test: the athlete is in the guard position which also implies the position of the arm to be in sixth (the arm is bent and parallel to the ground), at an optimal distance to hit with an arm extension from the apparatus (figure 1b). The device is turned on by the trainer, and the athlete is waiting for the luminous signal. When the red light appears, the timer on the device starts automatically, and the athlete must strike in the shortest time. If the strike was successful, the red light turns off and the green light turns on.

Table 3. Intervention – Month 2

A set of exercises to develop the speed of the upper limbs:	**A set of exercises to develop the speed of the lower limbs:**
Non-specific: 1. The tennis ball is tossed up, the ball is caught with the dexterous hand, and a forward arm stretch is performed in the shortest possible time; 2. 2 athletes, face to face, one of them launches the tennis ball from chest level, and the other athlete must catch it with his dexterous hand; 3. 2 forelocks of different colors in front of the athlete, at the color called by the trainer, the athlete touches the forelock in the shortest time; 4. 2 forelocks of different colors, 2 athletes, face to face, must take the forelock in the shortest time (reaction play); 5. 2 forelocks at a distance of 2 meters between them, 2 athletes, face to face, at the color called perform additional steps to the forelock and touch the forelock. Specific: 6. Hit the dummy with the foil in different areas. The trainer calls out a zone, where the athlete strikes with an arm stretch in the shortest time (shoulder, chest, flank, and belly); 7. Favero EFT-1 using program no. 1; 8. Favero EFT-1 using program no. 2; 9. Favero EFT-1 using program no. 3; 10. Favero EFT-1 using program no. 4.	Non-specific: Agility leather exercises: 1. Jumps in each box on the left leg; 2. Jumps in each box on the right leg; 3. Double jumps in each box: 4. Two forward jumps on two feet, followed by a backward jump; 5. Jumps from far to near. Specific: 6. From the guard position, on the signal, 2 steps forward at the highest speed, after which the athlete remains on guard and waits for the next signal; 7. Exercise NO. 6 is repeated, steps back; 8. Free movement, on the signal the pace of movement is changed; 9. Free movement, on the signal, quick steps backward, to the end of the board; 10. Free movement, lunge on the signal, return to guard, two quick steps backward, and resume with lunge steps.

Table 4. Intervention – Month 3

A set of exercises to develop the speed of the upper limbs:	**A set of exercises to develop the speed of the lower limbs:**
Non-specific: 1. Two goalposts of different colors are placed in front of the athlete. At the color called out by the coach, the athlete must touch the goalpost with his dexterous hand in the shortest time; 2. In pairs, the athletes have a goalpost between them, at the coach's signal they must take the goalpost in the shortest time, the athlete who takes it first wins; 3. Exercise no. 2 is repeated, and the coach shouts different commands: hand on knee, hand on head, etc. When he shouts hand on the pole, the athletes must take the pole as soon as possible; 4. In pairs, in the "rock, paper, scissors" game, the athlete who wins must take the pole in his hand and run 5 meters backward, without being touched by his teammate; 5. In pairs, an athlete has 2 tennis balls, one in each hand, he chooses to launch a ball from the chest level, and his teammate is face to face with him, and he must catch it with his dexterous hand. Specific: 6. Strike the dummy with the foil on different signals: - a clap: a straight shot; - two claps: two short strikes; 7. A clap: arm stretch strike, two claps: lunge strike; 8. Shots on the Favero EFT-1 device using program no. 5; 9. Favero EFT-1 using program no. 6; 10. Favero EFT-1 using program no. 7.	Non-specific: Relays: 1. Al. Ankle game on the spot, on the signal, 25 m speed run; 2. Al. Swing the shanks backward, on the signal, 25-speed run; 3. Al. With the knees up, on the signal, 25 m speed run; 4. Jumps on the spot, from two feet to two feet, on the signal, 25 m speed run; 5. Jumps from far to near, on the signal, 25-speed run. Each exercise is repeated only once, given the fact that speed does not develop due to fatigue. The break between exercises lasts 30 seconds. Specific: 6. From the guard position, move at full speed for 20 seconds; 7. Fencing steps forwards and backward, on signal, ankle play from the guard position at full speed; 8. Fencing steps forwards and backward, on the signal run with knees up from the guard position at full speed; 9. Free movement, on signal two quick steps backward, then an energetic lunge forwards; 10. Free movement, the coach's signals: the right arm raised means that the athlete must perform a lunge at full speed, and the left arm raised means that the athlete must perform a step–lunge at full speed.

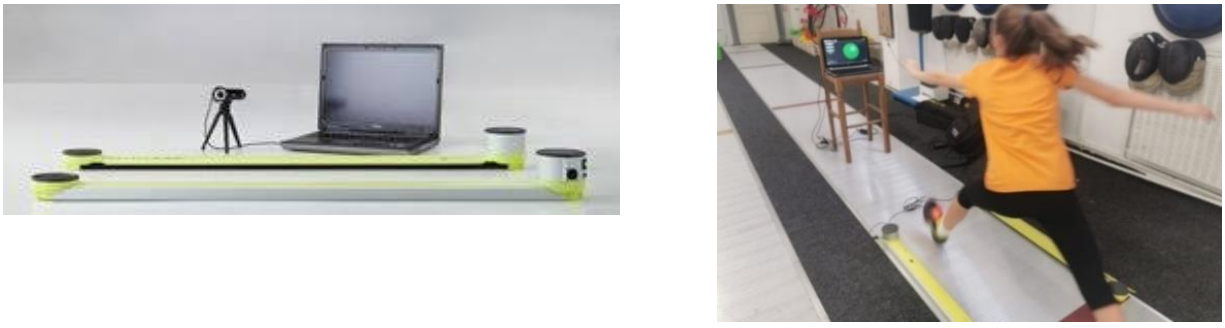
The execution of the test: the athlete is in the guard position which also implies the position of the arm to be in sixth (the arm is bent and parallel to the ground), at an optimal distance to hit with an arm extending from the apparatus (figure 1b). The device is turned on by the trainer, and the athlete is waiting for the luminous signal. When the red light appears, the timer on the device starts automatically, and the athlete must strike in the shortest time. If the strike was successful, the red light turns off and the green light turns on.

Considering the programs on the device, we have chosen programs 1, 5, and 7 for testing. In program no. 1, the athlete must hit each target (maximum time - 1.30 s), with a total of 10 strikes. In program no. 5, the athlete must hit two consecutive targets (maximum time - 2.5 s), similarly to the first program, i.e.10 times. And in program no. 7, there are 3 consecutive targets (maximum time - 3 s), also 10 times, similar to programs 1 and 5.

Optojump Next. Optojump Next (Figure 2a) – is an innovative system of analysis and measurement which, in fencing, allows the measurement of the reaction speed and movement time, necessary for the fast performance of the lunge, while showing us how long it takes to perform a lunge. The execution of the test: the athlete is in the guard position, with the heel of the front foot (the skilled one) at the predetermined line, between the two plates of the device. The laptop, with the program turned on, is one meter away from the athlete, at the level of his/her face. The test is started by the coach and from this moment a red dot appears in the program; the athlete is waiting for the moment when the red dot changes into a green one, and this is the signal to lunge (Figure 2b). The waiting time for the green dot is randomized by the program. As soon as the athlete reaches the ground again, with the front foot, the program records the results which can be subsequently exported into an Excel table (12).

(a) **(b)**

Figure 1. Favero EFT-1 device. a) Electronic target. b) Favero EFT-1 during its use.



(a) **(b)**

Figure 2. Optojump Next device. a) The components of the device. b) Optojump Next during its use.

RESULTS

The results recorded at the initial and final tests were registered in tables 5-9, processed statistically, and represented graphically (figures 3-5). Tables 5-7 show the evolution of the upper limb speed in the experimental group of programs P1, P5, and P7, and we can notice significant differences ($p<0.05$) between the initial and final tests for all 3 programs.

Table 5. Evolution of the experimental group at program No. 1 – Favero EFT-1

Experimental group		P1	
No.	Athletes' initials	I.T (s)	F.T (s)
1.	A.A.	0.57	0.42
2.	C.O.	0.64	0.49
3.	E.F.	0.71	0.54
4.	F.M.	0.72	0.57
5.	M.A.	0.54	0.54
6.	M.B.	0.68	0.68
7.	M.M.	0.59	0.63
8.	N.V.	0.81	0.56
9.	O.P.	0.62	0.62
10.	P.R.	0.83	0.61
Arithmetic mean		0.67	0.57
Standard deviation		0.10	0.07
Amplitude		0.29	0.26
Coefficient of variability		14.58	13.23
Paired T-test (p)		0.0113	

P1 – program no. 1 (one hit, 10 repetitions); I.T. – initial testing; F.T. – final testing.

Table 6. Evolution of the experimental group at program No. 5 – Favero EFT-1

Experimental group		P5	
No.	Athletes' initials	I.T (s)	F.T (s)
1.	A.A.	0.97	0.81
2.	C.O.	1.05	1.02
3.	E.F.	1.14	1.16
4.	F.M.	1.65	1.16
5.	M.A.	1.26	1.24
6.	M.B.	1.3	1.55
7.	M.M.	1.49	1.21
8.	N.V.	1.49	1.34
9.	O.P.	1.82	1.43
10.	P.R.	2.08	1.41
Arithmetic mean		1.43	1.23
Standard deviation		0.35	0.22
Amplitude		1.11	0.74
Coefficient of variability		24.71	17.47
Paired T-test (p)		0.0521	

P5 – program No. 5 (two consecutive hits, 10 repetitions); I.T. – initial testing; F.T. – final testing.

Regarding the development of the lower limb speed, in Table 8 we have the data referring to the experimental group at the initial testing, using the Optojump Next device, and in Table 9 we can see the data of the final testing. After applying the intervention, we can notice a relevant difference regarding the three evaluated indices (the reaction time, total time required to perform a lunge, and lunge speed), the statistical „p" being lower than the significance threshold.

Comparing the results of the groups, we have obtained the following data: at the initial testing (M0) there were no significant differences between the groups in any parameter evaluated (figures 3-5). Considering the evolution of the average reaction time of the groups (when lunging) (figure 3), we can notice a significant difference between the two groups established right after the first month of specific training; The average of the total time needed to perform the lunge also evolves in the same way (figure 4), showing a significant difference between the groups right after the first month of training ($p=0.0137$). Regarding the average speed of the lunge (figure 5), we can observe a significant difference between the groups, as in the first two parameters, after the first month of training. After the three months of specific training, these significant differences between the groups were maintained.

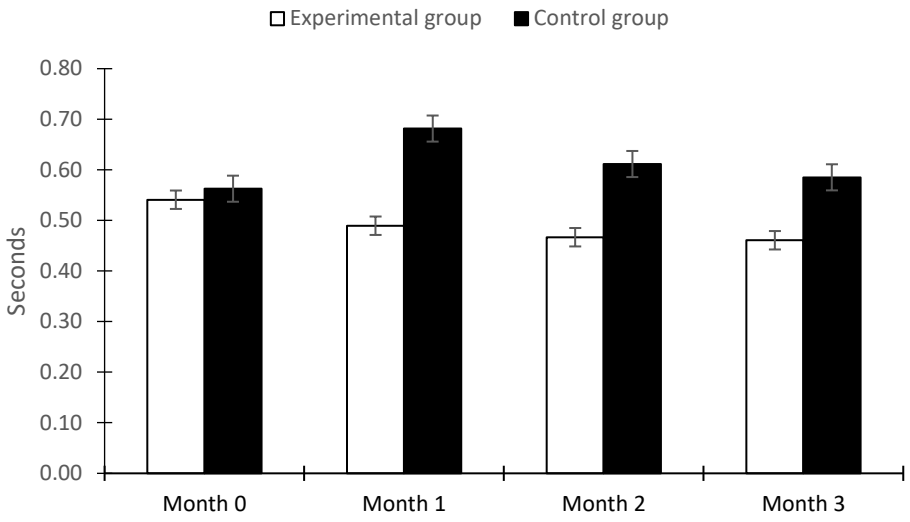


Figure 3. Evolution of the average reaction time in both groups

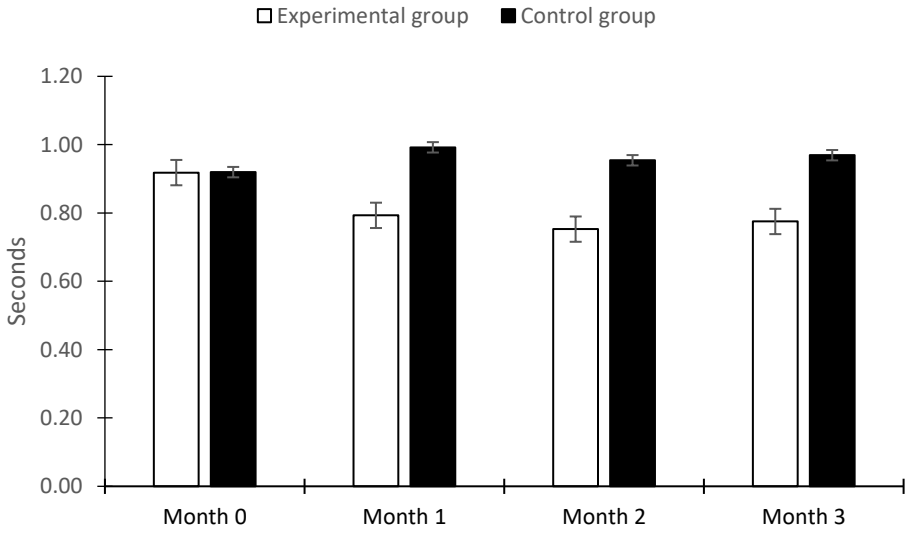


Figure 4. The evolution of the average total time needed to perform the lunge of the groups

DISCUSSION

Considering the test results, we can state that the objectives of the research were achieved, and the athletes' speed was improved both in the lower and upper limbs. We have also found different effective methods for developing speed, based on the combination of non-specific and specific exercises in the context of fencing, and the electronic systems used, which proved to be useful both in the training program and in the athletes' testing. The positive result is due to both fencing non-specific and specific exercises.

According to several studies published in recent years, the development and testing of fencing speed have benefited from the consistent contribution of dedicated devices, the Favero EFT-1 device being one of the most used ones (1, 10, 13). Moreover, De Georgio et al. (10) demonstrated the reliability and validity of this device in testing athletes as well.

Thus, we considered it necessary to use this device both in the training for the development of the upper limb speed of young fencers and in its evaluation.

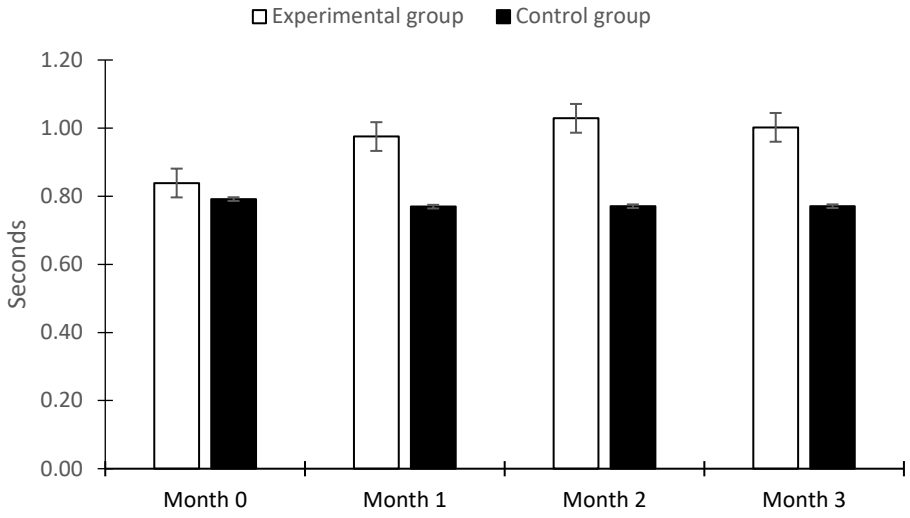


Figure 5. The evolution of the average speed of the lunge of the groups

Table 7. Evolution of the experimental group at program No. 7 – Favero EFT-1

Experimental group		P7	
No.	Athletes' initials	I.T (s)	F.T (s)
1.	A.A.	1.55	1.35
2.	C.O.	1.73	1.44
3.	E.F.	2.01	1.48
4.	F.M.	2.47	1.48
5.	M.A.	2.02	1.68
6.	M.B.	2.01	2.04
7.	M.M.	2.07	2.02
8.	N.V.	2.46	1.86
9.	O.P.	2.26	1.99
10.	P.R.	2.76	2.13
Arithmetic mean		2.13	1.75
Standard deviation		0.36	0.29
Amplitude		1.21	0.78
Coefficient of variability		16.96	16.83
Paired T-test (p)		0.003	

P7: program No. 7 (three consecutive hits, 10 repetitions); I.T. initial testing; F.T. final testing.

Table 8. Initial testing for the experimental group – Optojump

No.	Athletes' initials	Twait[s]	Treac.[s]	Tflight[s]	T Total[s]	Length [m]	Speed [m/s]
1.	A.A.	7.38	0.568	0.363	0.931	0.87	0.93
2.	C.O.	7.112	0.591	0.352	0.943	0.58	0.62
3.	E.F.	7.183	0.496	0.216	0.712	0.7	0.98
4.	F.M.	7.59	0.434	0.495	0.929	0.94	1.01
5.	M.A.	5.762	0.395	0.41	0.805	0.8	0.99
6.	M.B.	7.876	0.598	0.318	0.916	0.73	0.80
7.	M.M.	7.007	0.465	0.47	0.935	0.7	0.75
8.	N.V.	6.55	0.663	0.321	0.984	0.64	0.65
9.	O.P.	6.427	0.514	0.381	0.895	0.6	0.67
10.	P.R.	6.442	0.685	0.447	1.132	0.79	0.70
Arithmetic mean			0.54	0.38	0.92	0.74	0.81
Standard deviation			0.10	0.08	0.11	0.12	0.16
Amplitude			0.29	0.28	0.42	0.36	0.40
Coefficient of variability			17.80	21.99	11.88	15.79	19.27

TWaits [s] – waiting time (until the visual signal appears); Treac. [s] – reaction time (since the signal appears until the athlete lifts his front leg); Tflight [s] – flight time (how long the athlete has his leg in the air); T Total [s] – total time (the sum of reaction time and flight time); Length [m] – length of the lunge; Speed [m/s] – speed of the lunge.

Table 9. Final testing for the experimental group – Optojump

No.	Athletes' initials	Twait[s]	Treac.[s]	Tflight[s]	T Total[s]	Length [m]	Speed [m/s]
1.	A.A.	7.063	0.419	0.221	0.64	0.87	1.36
2.	C.O.	6.759	0.435	0.366	0.801	0.58	0.72
3.	E.F.	5.248	0.476	0.283	0.759	0.70	0.92
4.	F.M.	7.239	0.438	0.238	0.676	0.94	1.39
5.	M.A.	5.375	0.407	0.308	0.715	0.80	1.12
6.	M.B.	6.36	0.526	0.359	0.885	0.73	0.82
7.	M.M.	5.575	0.478	0.372	0.85	0.70	0.82
8.	N.V.	7.244	0.459	0.43	0.889	0.64	0.72
9.	O.P.	7.489	0.49	0.25	0.74	0.60	0.81
10.	P.R.	6.242	0.48	0.317	0.797	0.79	0.99
Arithmetic mean			0.46	0.31	0.78	0.74	0.97
Standard deviation			0.04	0.07	0.08	0.12	0.25
Amplitude			0.12	0.21	0.25	0.36	0.67
Coefficient of variability			7.87	21.49	10.96	15.79	25.39

TWaits [s] – waiting time (until the visual signal appears); Treac. [s] – reaction time (since the signal appears, until the athlete lifts his front leg); Tflight [s] – flight time (how long the athlete has his leg in the air); T Total [s] – total time (the sum of reaction time and flight time); Length [m] – length of the lunge; Speed [m/s] – speed of the lunge.

The 3-month testing provided us with some interesting information regarding the evolution of the upper limb speed of the fencers in the two groups; thus, if in the case of the initial testing, there were no significant differences between the contexts of the two groups in any of the programs used on the Favero EFT-1 device, this aspect changed during the intervention. The Favero EFT-1 device, like in the studies conducted by Balkó (1), Patial (14), Witkowski (15), and Witkowski (16), was also introduced in the speed development program and we can say that it had a positive impact on the upper limb speed development. After one month of training, we noticed significant differences between the two groups in program no. 1 (p=0.0428). Regarding programs no. 5 and 7, we noticed significant differences after the second month of training. At the end of the intervention, after the three months of training, there were significant differences between the groups in all three programs (p=0.0341 in program 1, p=0.034 in program 5, and p=0.0158 in program 7). We can say that these differences between the groups appeared after the intervention.

We used the Optojump Next to test the lower limbs, and this device allowed us to evaluate the following parameters: the reaction time, the total time needed to perform the lunge, and the speed of the lunge. As we have not found any other studies that used the Optojump Next device, connected to the idea of the lunge, we cannot make any comparisons. However, there are studies in which it was also used to evaluate different types of jumps, for example, CMJ and SLCMJ (17, 18); SJ, CMJ, and 7R-HOP (7); SJ, CMJ, and DJ (19), and also for the measurement of the flight time (19, 20).

As Turner also specifies (21), the fencing lunge is an offensive movement in which the success of the action depends on the speed of execution. We found it appropriate to assess the lunge speed using the Optojump Next device, as this is a fencing-specific movement, and we consider that if we keep monitoring it we can gather extremely useful data regarding the contribution of the lower limbs in the fencing-specific actions. With the help of this device, we can obtain concrete and objective data regarding the lunge by evaluating the speed of reaction to a visual stimulus, the time of the flight, and the total time needed to perform the lunge, and by measuring the length of the lunge we can calculate the speed of its execution. These parameters are indispensable for an objective analysis of the lunge speed.

Considering the initial testing, there were no significant differences between the groups in any of the parameters assessed. Given the evolution of the reaction times in the case of the two groups, we can notice a relevant difference between them, which materialized right after the first month of intervention. The total times required to perform the lunges evolved similarly, showing a significant difference between the groups after the first month of training (p=0.0137).

Regarding the lunge speed of execution, the significant differences between the two groups also emerged after the first month, as in the case of the first two parameters. After the three months of specific training, these significant differences between the groups were maintained.

Numerous studies have shown significant results in the improvement of fencing speed. Many researchers are dealing with the development of reaction speed, specifying that it develops between the ages of 11 and 14 (1). What is interesting to note is that many researchers talk about speed (measured in m/s), although the evaluated parameters are at times (measured in s). A more in-depth analysis of this approach and its implication in the interpretation thereof would be desirable. In principle, if we discuss the individual results, given the fact that the movement distance is approximately the same in the case of the same individual, the speed is similar; Yet, when comparing the results of the times between two different fencers, where the displacement differs (especially due to anthropometric differences), the value of the speed will not be calculated from the same distance, so we cannot equate the comparison of times with that of speed .

Improving the system of training young fencers requires finding and justifying new forms of organization of the training process based on modern scientific achievements. Physical training in fencing is one of the most important components of sports training. It depends on a quick start, maneuvering on the fencing track, a long wait for a successful moment of attack, and the ability to immediately make the right decisions (5).

The ability to influence reaction time is difficult, and authors have reported varied findings in this regard. Wang states that the level of simple reaction time can be efficiently influenced by training. The critically sensitive period for reaction time improvement occurs at approximately 13 – 14 years of age (1).

Poliszczuk (22) emphasizes the importance of developing a speed of response to both auditory and visual stimuli. Petronijevic (23) underlines the role of speed in the work of the fencer's hands. Torun (24), similarly to the study herein, used both specific and non-specific exercises in speed training, with significant results both in the upper and lower limbs .

We consider that the strengths of our study are the following: there are not many studies in the field of fencing, and only some of these focus on fencing speed; The introduction of the Optojump Next device in the methods of evaluation, as this has never been used in the field of fencing to test the lunge; the particularities of the intervention carried out in the group of study, comprising three different sets of exercises during three months.

As the limitations of our study, we can mention that we had a relatively small number of subjects and that we did not check to see if the increase in the speed of the upper and lower limbs was reflected in the improvement of the athletic performance in the case of the analyzed fencers. The latter may be an objective of further research. Also, considering the age of participants perhaps could have been added dietary recommendations.

CONCLUSION

The use of electronic training devices in the specific training of young fencers and the addition of specific exercises for the development of the upper and lower limb speed determine its increase while also resulting in the improvement of sports performance.

APPLICABLE REMARKS

- Coaches need to have access to several types of training that develop fencers' speed. In this study, we also described the complete training method.
- This research supports that the sets of specific and nonspecific exercises included in fencers' training improved their speed at the level of upper and lower limbs.
- Also, the electronic devices used for testing and developing the speed were practical and efficient.

AUTHORS' CONTRIBUTIONS

Study concept and design: Petra Magyar; Mihaela Oravițan. Acquisition of data: Petra Magyar, Valentin Niță. Analysis and interpretation of data: Valentin Niță, Gabriela Dințică. Drafting of the manuscript: Petra Magyar; Mihaela Oravițan. Critical revision of the manuscript for important intellectual content: Mihaela Faur, Valentin Niță, Gabriela Dințică. Statistical analysis: Valentin Niță. Administrative, technical, and material support: Petra Magyar, Valentin Niță. Study supervision: Mihaela Oravițan

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this study.

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