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## Preliminary study on physical training in tennis performance U16

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### Abstract

**Aim.** The purpose of this preliminary research was to determine the training model used, by measuring the anthropometric parameters and studying the specific means that were used in order to achieve the objectives. These were to mark the content of the physical preparation lessons in order to establish the intensity of the training, the number of repetitions, the frequency, the duration and the components of the of the training cycle. Another objective of the study was to see if there are any significant differences between the results of the boys in comparison to those of the girls.

**Methods.** Twenty two romanian tennis players, eleven girls and eleven boys, between the ages of 14 to 16 years were part of this preliminary study. The group of tennis players were followed during 12 weeks of their usual physical training. At the end of this time period the following measures were conducted sprint 5-10 m, 30 m run, 6 times 20 m, long jump, successive lateral jumps performed on both legs over the gym bench, medicine ball throw from the spot with one hand, overhead medicine ball throw test, added step, hexagon test, planned agility test and push ups. Depending on the test, they were measured by time in seconds, number of repetitions or length in cm.

**Results.** The group of tennis players were followed during 12 weeks of their usual training. The used variables were expressed by mean and standard deviation. To identify whether there were significant differences between genders, the t test was used for independent samples. In order to determine the degree of relevance we used  $P < 0.05$ .

**Conclusions.** After comparing the results, it was shown that the development of motor skills of boys under 16 is superior compared to those of girls, in all physical tests.

**Key Words:** physical preparation, tennis, motor skills.

### Introduction

Tennis is a sport, that requires not just the tennis skill, which in later times was the primary prerequisite, in order to have a very good performance, but also a complex of several physical components, such as strength and agility and metabolic pathways (aerobic and anaerobic).

Reid and Fernandez-Fernandez are stating that tennis is an anaerobic sport with breaks in between the rallies, which makes the players execute short bursts of an high-intensity exercise, intermixed with periods of repaus or low-intensity activities during a longer period of time (2-4 hours). (Fernandez-Fernandez et al., 2009, Reid and Schneiker, 2009)

Regarding the effort in tennis, it's associated with intermittent high-intensity efforts combined with periods of a low-intensity activity, where active recovery, which occurs between points, and passive period (those between the changeover breaks) occur over an extended period of time up, to four-five hours in Grand-Slam tournaments. (Fernandez-Fernandez et al., 2009)

Some authors recommend the following: tennis players need a combination of fitness qualities. (Kovacs, 2007) This contains agility, speed, and power and nevertheless a well-developed aerobic fitness in order for them to

achieve high performance. (Fernandez-Fernandez et al., 2012) Also, they need to have a quick reaction towards the actions of their opponent. Initial agility and acceleration are explosive and decisive actions when the tennis player is implicated in quick gameplay. We can define initial acceleration as a short sprint (1-10 m) (Kovacs et al., 2008) and agility can be seen as the ability to switch direction and also start and stop quickly. (Sheppard and Young, 2006).

Speed can be defined as the ability to reach a high pace and is an indicator of strength (for example explosive force) used for a specific technique or movement. (Cronin and Hansen, 2005) On average, a tennis player sprints over a distance of 4-7 m during a match point, which means approximately four changes of direction.

It seems that the competitive players should concentrate more on improving their ability to perform several times high-intensity exercises and also to be able to recover fast point after point. (Malliou et al., 2010). This is one of the reasons why tennis training should concentrate not just on anaerobic fitness but also on the aerobic.

Most of the time a tennis player will spend on the baseline, moving from one side to another, so that they

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cannot achieve a maximal speed. This fact can be considered a limiting factor in tennis. (Weber, 2007). But there are no papers about Romanian performance tennis players.

In order to maximize the individual improvements, together with the training efficiency, content and goals need to be defined in line with a precise workload and the limited performance factors. Individual physical and technical needs have to be fulfilled in order to accomplish an ideal cost-benefit ratio of the training input. This is the reason why it is important to achieve sufficient research, in order to provide general guidelines, so that coaches and players gather equitable data about the player's physical performance. Along this way, general and individual programs are established and bring objective feedback and leading coaches but also players to work better. (Laursen and Jekins, 2002)

### Methods

**Participants.** Twenty-two junior Romanian tennis players (11 females and 11 males, aged 14-16 years) voluntarily participated in this preliminary study. They all were right-handed and had a national singles ranking (U16) between 1 and 158 and had a training average background of  $5 \pm 1.1$  years, that was concentrated on tennis-specific training (technical vs tactical skills), strength training, anaerobic and aerobic training, both specific and general which consisted in off and on-court exercises. All participants were healthy and were informed about the research procedures, benefits, and requirements. No subject was injured during the study.

**5-10 m Sprint.** This test aims to evaluate the speed over a short distance, 5 or 10 m. The athlete will start at the sound of a signal and will cover a distance of 5 or 10 m at the fastest speed. The running time will be recorded. The run will be performed twice and the best time will be recorded.

**Test 6x20 m.** In this test, the athlete is required to run the distance of 20 m, 6 times, and the rest time between repetitions will be 20". It is also necessary for the athlete to run this route at the maximum speed each time. As for the start command, it is: on your mark- get set- go. The time for each run will be recorded separately.

Previous research pointed out that repeated sprint training improves neuromuscular performance. (Fernandez-Fernandez et al., 2015)

**Long jump.** A pit with sand is required for this test. We measured the distance from the start line to the first visible trace on the sand. Two jumps will be made and the best will be taken into account. This test was also used in previous research. (Kuroda et al., 2015)

### Medicine ball throw (one and both arms)

The purpose of this exercise is to test the level of explosive power occurring in the upper limbs, and the strength of the abdominal and back muscles. The subject is in a standing position with one leg in the front and the

opposite arm holding the medicine ball. The foot in front, shall not cross the line from which the throw is made. Once the correct position has been established the medicine ball throw can be performed

**Added steps.** The aim is to assess the speed of the added steps along with the ability to stop and change direction. The tennis player, is in a standing position at the service line, facing the net. He performs a run with added steps, up to the doubles line, which he will touch with his right leg. Then he continues to the other side where he and returns to the starting point.

**Hexagon test.** This test is evaluating the athlete's agility and speed and also their ability to stop, balance and restart, in a series of movements performed at high speed over short distances. Each side of the hexagon will measure 61 cm and with an angle of 120 degrees between them. The athlete shall perform jumps on the outside of each side of the hexagon with the return to the starting point.

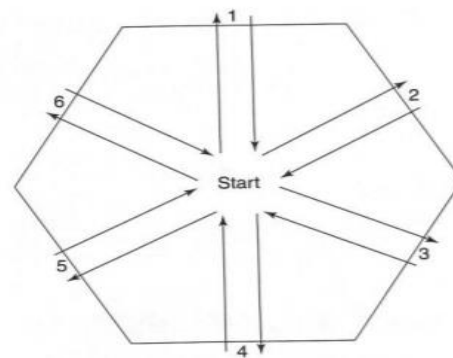
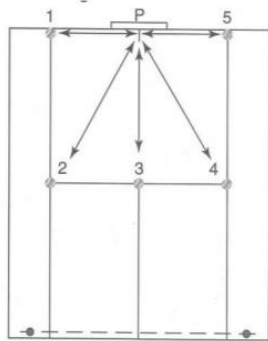


Fig.1 Hexagon test

**Spider run** This test is measuring the specific speed run, with starts, stops, and changes of directions. Measuring techniques: the athlete is standing on the baseline of the court, next to the center mark, holding the racket; from this point the athlete initiates lateral and oblique movements, returning from each side to the center point of the court and continues from there. 5 points are marked on the court, which needs to be reached with the sole surface.



**Fig.2 Spider run test**

**Push-ups** The purpose of this test is to measure upper limb strength and specific strength. Measuring techniques: flexion and extension of the upper limbs are performed, keeping the body perfectly stretched, and without any oscillations at the hip or knee joints; the palms are placed in continuation of the width of the shoulders, with the fingers pointing forward. Material requirements: a stopwatch. Assessment: the number of repetitions performed in a limited time, sorted depending on the age group.

**Training Program**

The participants were performing 3 sessions of physical training program each week. We followed them for a period of 12 weeks. Regarding the tennis-specific training, they were performing it every day during 8-9:30 am or 2- 3:30 pm besides Sunday. Physical training was done after the tennis-specific training on Monday, Wednesday, and Friday. Usually, the warm-up consisted of 5' of stretching and gymnastics, 15' run and then

again 5 min of gymnastics and stretching followed by 2 series of 30 m (3/4), 2 series 30 m (I=80%) In the main part of the physical training they were performing 5 series of different strength exercises (jumps, skipped steps, specific added steps with 100 m of 70% intensity run 100 m of walking and 90 seconds between series. Another strength resistance training was consisting of exercises with the body mass such as jumps, abs training, push-ups, medicine ball exercises forehand, backhand, overhand, medicine ball sideways core, and overhead throw between 2 participants. Other tennis-specific trainings (main part) were consisting of short specific drills over 10 m, max speed, added specific steps, different drills, and different rhythms depending on the exercise. Another specific performed 1 time in two weeks was the plyometric exercises for agility. In order to be included in the research, the adolescents needed to conclude 90% of the consecutive total performed training.

**Statistical analysis**

The gathered data has been analyzed using SPSS 24.

It has been reported as mean and standard deviation. The normality of the variance and covariance has been measured with the Shapiro-Will test.

To identify if there were significant differences between genders, independent t-test has been used. For statistical significance  $P \leq 0.05$  has been taken into consideration.

Table 1. Mean values

Variables	Males	Females
Age	0,074	0,788
Hight	7,501	0,013
Weight	2,942	0,102
Sole leinght	11,076	0,003
Waist (cm)	3,892	0,062
Arm amplitude	4,9	0,039
5 m run V1	13,29	0,002
5 m run V2	18,969	0,001
10 m run V1	10,452	0,004
10 m run V2	7,72	0,012
20 m run V1	3,595	0,073
20 m run V2	6,761	0,017
20 m run V3	5,078	0,036
20 m run V4	2,391	0,138
20 m run V5	6,263	0,021

20 m run V6	0,522	0,479
30 m run V1	0,03	0,864
30 m run V2	0,411	0,529
30 m run V3	0,347	0,562
Spider run V1	2,431	0,135
Spider run V2	0,757	0,395
Hexagon Test V1	2,679	0,117
Hexagon Test V2	0,935	0,345
Added steps V1	0,007	0,935
Added steps V2	2,149	0,158
Long jump V1	0,314	0,581
Long jump V2	0,436	0,517
Succesive jumps V1	1,56	0,226
Succesive jumps V2	4,566	0,045
Med ball throw 1h V1	0,358	0,557
Med ball throw 1h V2	0,284	0,6
Med ball throw 2h V1	0,856	0,366
Med ball throw 2h V2	1,015	0,326
Push-ups V1	0,426	0,521
Push-ups V2	0,322	0,576
Flexibility V1	0,111	0,742
Flexibility V2	0,012	0,912

**Table 1. Mean Values**

### Results

No injuries happened during the training or testing sessions. After the normality was verified through Levene test, we managed to see that there are significant differences regarding the height, the length of the sole, the length of the arms, the 5 m run version 1 and version 2, the 10 m run version 1 and version 2, the 20 m run version 2, version 3, version 5 and the jumps performed successively sideways version 2, which means that for these variables, cannot be compared.

Regarding the variables age, weight, waist circumference of the participants, 20 m run version 1, 20 m run version 4, 20 m run version 6, 30 m run version 1, 30 m run version 2, 30 m run version 3, spider run version 1, spider run version 2, hexagon test version 1,

hexagon test version 2, added step version 1 and added step version 2, long jump version 1, long jump version 2, jumps performed successively over the gymnastics bench version 1, one-handed medicine ball throw version 1, one-handed medicine ball throw version 2, two-handed medicine ball throw version 1, one-handed medicine ball throw version 2, push-ups version 1, push-ups version 2, flexibility test version 1, flexibility test version 2, girls results can be compared with boys' results as they are homogeneous. In order to identify if there are significant differences between the genders we used independent T-test. According to it, although there is homogeneity between girls' and boys' groups, there are significant differences between them, as boys perform significantly better than girls in the mentioned tests. (Table 2)

**Table 2. T-Test Mean differences between boys and girls**

Variabile	T-Test	Sig	Average Masc.	Average Fem
Body weight	3.258	0,004	1.7991	1.6582
20m V1 run	-4.271	0,000	7.4736	8.41
20m V4 run	-3.801	0,000	7.7918	8.6691

20m V6 run	-3.397	0,003	7.8618	8.5382
30m V1 run	-2.887	0,009	4.6227	4.9973
30m V2 run	-2.162	0,043	4.6491	4.92
30m V3 run	-2.263	0,035	4.5736	4.8682
Spider run V1	-0.851	0,405	18.3764	18.9045
Spider run V2	-0.983	0,338	18.0973	18.6309
Hexagon V1	-3.693	0,001	8.28	8.9191
Hexagon V2	-4.454	0,000	8.0855	8.83
Added steps V1	-8.333	0,000	6.26	6.7527
Added steps V2	-8.912	0,000	6.1845	6.7527
Long jump V1	1.457	0,161	2.1245	2.0636
Long jump V2	1.92	0,069	2.1636	2.0636
Successive side jumps	2.6	0,017	13.9091	11.3636
Med ball throw V1	6.04	0,000	15.0845	11.3355
Med ball throw V2	5.86	0,000	15.3436	11.6118
Push-ups V1	5.358	0,000	25.7273	16.7273
Push-ups V2	4.979	0,000	26.4545	17.4545
Mobility Test V1	-1.334	0,197	1.3636	4.3636
Mobility Test V2	-1.715	0,102	2.7364	6.2727

**Table 2. T-Test Mean differences between boys and girls**

### Discussion

Tennis is a sport that requires agility, explosive power, speed, aerobic conditioning and also reaction time. (Fernandez-Fernandez et al., 2009, Reid and Schneiker, 2009)

The presented training programme is a predominant strength based and specific one. After following the athletes during their trainings we wanted to check in which tests there is statistical difference between the boys and the girls.

A previous study, that checked differences between genders has shown that before training there was just one significant difference between genders and this one was the distanced hopped on a single leg test. Males athletes are hopping further compared to females on both sides. (right leg ( $148 \pm 24$  cm and  $120 \pm 26$  cm with  $p=0.004$ ) and left leg ( $147 \pm 35$  cm  $122 \pm 19$  cm, with  $p=0.009$ ). After the training in this study, there were no significant differences between genders referring to the percent improvement in the given tests. (Barber-Westin et al., 2015) However, this study refers to adult tennis players and not to juniors. We could not find any other study that was checking the differences between genders in Romanian junior tennis players.

Also, after testing the athletes and comparing the results to the National Romanian Federation guide. Following the preliminary research data, through the statistical-mathematical means that were used, it was observed the influences on the tests carried out: it was

observed that the average for the 5m run is 0.5664 seconds and the average for the 10m run is 1.36, which places the athletes in the very good average according to the FRT scales. Concerning the 30m distance run the average for girls was 4.9 seconds, being categorized as poor and for boys 4.6 being average. This means they should concentrate more on speed and agility training in order to obtain better results.

In terms of throws, the average for the one-handed throw was 9.69m for girls and 13.029m for boys, an average result, and the average for the two-handed throw was 15.34m for boys and 11.61m for girls, seen as excellent according to the Romanian Tennis Federation (FRT) ([http://www.frt.ro/v2/\\_public/resources/files/ATF](http://www.frt.ro/v2/_public/resources/files/ATF))

Concerning the specific tests, the results in the spider test averaged 18.09 seconds for boys and 18.6 seconds for girls, poor results; in the hexagon, the average for boys was 8.08 m and for girls 8.8 m, being average. In the added step the boys have an average result of 6.1 seconds and the girls an excellent 6.7 seconds. For the torso lift test from the prone (push-ups) the average for boys is 26.45 and for girls 17.45, in the average range.

Regarding the used evaluation tests in our program, they were cost and time economic. When using electronic photocells the data is more precise than when using a digital stopwatch in order to record the times of the athletes. Anyway, the tests can be conducted at any tennis court without any extra special equipment.





### Conclusions

As per our obtained results in the evaluation tests, these athletes should concentrate more on strength-specific agility training, in order to obtain better physical fitness.

Also, regarding the differences between genders, we noticed that the development of physical fitness at U16 of the boys is superior to those of the girls.

As a recommendation, feminine junior tennis players from our study should concentrate more on strength and specific training in order to obtain better results.

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#### Authors' Contributions

All authors have contributed equally to this study and should be considered as main authors.

### References

- Barber-Westin SD, Hermeto A and Noyes FR, 2015, Journal of athletic enhancement.
- Cronin JB and Hansen KT, 2005, Strength and power predictors of sports speed. *J Strength Cond Res* 19: 349–357.
- Fernandez-Fernandez J, Mendez-Villanueva R, 2016, Review, The Effects of Sport-Specific Drills Training or High-Intensity Interval Training in Young Tennis Players, *Reserchgate*.
- Fernandez-Fernandez J, Sanz Rivas D, Sanchez-Munios C, Pluim BM, Tiemessen I, 2009, A comparison of the activity profile and psychological demands between advanced and recreational veteran tennis players. *J Strength Cond Res*.
- Fernandez-Fernandez J, Sanz-Rivas D, and Mendez-Villanueva, 2009, A review of the activity profile and physiological demands of tennis match play. *Strength Cond J* 31: 15–26.
- Fernandez-Fernandez J, Sanz-Rivas D, Kovacs MS, 2015, In-season effect of a combined repeated sprint explosive strength training programme on elite junior tennis players, *Journal Strength Cond., Res Feb*.
- Fernandez-Fernandez, J, Zimek, R, Wiewelhoeve, T and Ferrauti, A, 2012, High-intensity interval training vs. repeated-sprint training in tennis. *J Strength Cond Res* 26: 53–62.
- Kovacs MS, 2007, Tennis physiology. *Sports Med* 37: 189–198.
- Kovacs MS, Roetert EP, and Ellenbecker TS, 2008, Efficient deceleration: The forgotten factor in tennis-specific training. *Strength Cond J* 30: 58–69.
- Kuroda Y, Suzuki N, Dei A, Umabayashi K, Takizawa K & Mizuno M, 2015, A comparison of the physical fitness, athletic performance and competitive achievements of junior and senior tennis players..
- Laursen PB, Jenkins DG, The scientific basis for high-intensity interval training: optimising training programmes and maximising performance in highly trained endurance athletes. *Sports Med*.
- Malliou VJ, Beneka AG, Gioftisidiu A, Kallistatos E, 2010, Young tennis players and balance performance *J Strength and conditioning Res*.
- Reid M, Schneiker K, 2008, Strength and Conditioning in tennis.
- Sheppard J and Young W, 2006, Agility literature review: Classifications, training and testing. *J Sports Sci* 24: 919–932.
- Weber K, Pieper S and Exler T, 2007, Characteristics and significance of running speed at the Australian Open 2006 for training and injury prevention. *Med Sci Tennis* 12: 14–17.
- [http://www.frt.ro/v2/\\_public/resources/files/ATF](http://www.frt.ro/v2/_public/resources/files/ATF).