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Preliminary Research on Physical Performance in Junior Tennis Players U16

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Abstract: Physical performance regarding the rankings of U16 junior tennis players is not precisely understood. The purpose of this preliminary research was to check if the top-ranked players had better results in the evaluation of physical tests than the lower-ranked ones. Therefore, the scope was to determine if the national ranking is related to the physical characteristics. The physical tests used were approved by the Romanian Tennis Federation.
The following research methodology has been used: protocol methodology, the recording of data in research methodology, test in research methodology, and the statistical methodology. The tennis players followed their usual physical training for three months and at the end of this period, they were tested.
Twenty-two tennis players, eleven girls, and eleven boys, between 14 and 16 years old, were part of this preliminary research. The following measures were conducted: 5-10 m sprint, 30 m sprint test, 6 x 20 m sprints, long jump, repeated lateral jumps performed on both legs over the gym bench, one-handed medicine ball throw with, overhead medicine ball throw test, lateral steps test, Hexagon test, agility test, and push-ups test. Results The group of tennis players was followed during 12 weeks of their usual training. The variables were expressed in mean and standard deviation. The purpose was to check if there is any correlation between the ranking and the morphological parameters. Pearson correlation has been used. The normality of the variance and covariance was certified with Shapiro-Wilks Normality Test. Conclusion After comparing the results, it was shown that the players from the group with better ranking positions, had superior results in the evaluation tests.

Keywords: *physical preparation; speed; specific training.*

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Introduction

Tennis, in our days, does not require just the tennis skills, as it used to. To be able to achieve great performance, several physical components are required, such as agility, strength, and metabolic pathways (aerobic and anaerobic) (Laursen & Jenkins, 2016). On the other hand, Fernandez et al (Fernandez, 2016) define tennis to be an anaerobic sport that contains breaks in between the played points, so players perform short high-intensity exercises, mixed with short breaks or low-intensity activities, relying on a longer period of time. As Fernandez- Fernandez et al. (2012) states, tennis players demand a mix of fitness qualities. As per previous studies, it has been demonstrated that tennis players need various fitness qualities such as speed, agility, and power combined with good aerobic resistance to achieve high performances. For them to have a straightaway reaction to the actions of their opponent, acceleration and agility play a very important role. These are explosive and quick actions while the athlete is involved in fast gameplay. Initial acceleration can be seen as a short sprint (>10 m) (Barber & Noyes, 2012). On the other hand, agility can be defined as the ability to change direction, start and stop as quickly as possible. (Fernandez, 2015) Another fitness quality required for a tennis player is velocity, which can be seen as the capacity to reach a high pace in a short period and is also evaluated as an indicator for strength, that is used for a specific movement. On average, a tennis athlete sprints over approximately 4 to 7 m and 4 changes of direction, during a point (Jones, 2002).

Usually, the tennis player moves from side to side, at the baseline, so this is considered a limiting factor in tennis, as it is not possible to achieve maximal speed. (Weber et al., 2007). Regarding the correlations, previous studies have shown, that there is a strong correlation between the sprint times (10 m and 20 m sprint) and vertical jumps the same as power during countermovement jumps (Kale et al., 2009). Previous research highlighted the importance of muscle power and strength in the lower body part to contribute to explosive actions in tennis (Kramer, Gerard, 2015).

Methods

Participants

A total of 22 junior tennis players participated in this study, 11 males and 11 females of category U16. The players were all right-handed and had a national ranking between 1 and 158. Every athlete has been playing tennis for approximately 5 years (5 ±1.1). Their training was mostly specific tennis

training for improving technical and tactical skills. Regarding the physical part, it included anaerobic and aerobic training off and on-court and strength training. Subjects were informed about the procedures of the research, requirements, and benefits. The subjects did not get injured during this study.

5-10 m Sprint

The purpose of this physical test is the speed over a short distance, 5 or 10 m. The tennis player will start to run at a signal and will cover 5 or 10 m as fast as possible. The time will be recorded with a stopwatch. The run will be performed twice and the best out of the two will be taken into consideration (Federatia Romana de Tenis, 2012).

30 m Sprint

The purpose of this test is to measure the cyclic speed while running. The start will be given from a semi-high position, at the command: on your mark, get set-, go. For this test, a track or a tennis court, a stopwatch, a starter, and a recorder is needed. The time will be measured in seconds.

Test 6x20 m

The athlete needs to run the distance of 20 m, 6 times. The rest time between repetitions will be 20 seconds. The athlete must run at the maximum speed each time. The start command 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.

Long jump

A pit with sand or a flat surface is required. The distance from the start line to the first trace visible on the sand will be measured. Two attempts are permitted and, the best one will be taken into account. This test was used in previous research.

Consecutive lateal jumps

The scope of this physical test is measuring the explosive strength of the lower limbs, and the general endurance. The subject stands next to the gym bench approximately 20 cm away. Side jumps are performed over the gym bench. The number of jumps performed within 20 seconds will be measured. Between series, there be will about 3-4 minutes break. This test is done twice, and the best result is validated.

Medicine ball throw (one and both arms)

The purpose of the test is to check the level of explosive power occurring in the upper limbs, and the strength of the back and abdominal muscles.

The athlete is in a standing position having one leg in the front and with the opposite arm, holding the medicine ball. For the throw with both hands, legs will be parallel, and the knees flexed. Once the correct position has been established the throw can be performed.

Standing on the gym bench, bending the torso forward

The scope of this exercise is to establish hip joint mobility. Regarding the measurement technique, the athlete is positioned sitting on the gym bench and holding the lower limbs outstretched. Then will lean forward with the knees fully stretched. This position needs to be maintained for at least 2 seconds (Moise, 2011)

Lateral steps test

This test aims to determine the velocity of added steps and the ability of the subject to stop and change direction. The athlete is in front of the service line, facing the net. This run will be performed by using lateral added steps, up until the doubles line is reached and touched. This will also be executed to the other side returning to the start**.**

Hexagon test

The hexagon test is evaluating the athlete's, speed, agility, and their ability to stop, balance, and restart. This should be done using a series of movements executed at a high speed over short distances. All the sides of the hexagon must be measured. The length should be 61 cm and the with an angle of 120 degrees between them. The tennis player jumps on the outside of each side of the hexagon returning each time to the starting point for as many times as possible in 20 seconds.

The Spider run

Spider run is measuring the specific tennis speed performed specifically on the court, with starts, stops, and changes of directions. The techniques used for measuring: The subject is in a standing position next to the center mark and holding the tennis racket. After the start is given, the subject initiates lateral and oblique movements to each side of the court, coming back from to the center. Five points need to be marked on the court.

Push-ups

The purpose of this test is to measure the upper limb and also the specific strength. Regarding the measuring technique, the number of push-ups during a period of time is counted, by flexing and extending the upper limbs. The body needs to remain straight, without any oscillations either on the hip or knee joints. The palms will be placed on the ground aligned with the shoulders, holding the body's weight. The fingers will be pointing forward. Material requirements: a stopwatch.

Training program

The physical training program done by the athletes was held 3 times per week. The athletes were observed during a 12 week period. The specific tennis training was done usually every day, besides Sunday, during 8:00-9:30 a.m. or 2:00-3:30 p.m. The fitness training was done after the tennis training on Monday, Wednesday, and Friday. The trainning would start with the warm-up 5 minutes stretching, gymnastics, 15 minutes run, and then repeating the 5 minutes of stretching. Afterward, they were performing 2 times 30 m sprints (I=3/4), 2 times 30 m sprints (I= 80%). After the warm-up, they were doing 5 series of diverse strength exercises (skipped steps, jumps, lateral run combined with 100 m run (I=70%) followed by 100 m of walking. Between the series, there were 90 seconds of break. The athletes also performed strength resistance training with their bodyweight. As examples, different kinds of jumps, core training, medicine ball exercises have been performed, such as forehand, backhand, overhead throw between 2 or more participants and medicine ball sideways core. Other specific fitness training exercises performed were short 10 m drills and also other specific drills. They were having also one Plyometric training every 2 weeks that was concentrated on agility. The condition to be included in the research was to be present to minimum 90% of the training.

Statistical analyses

The data was analyzed with SPSS 24. Normality has been measured with the Shapiro-Wilk test. The descriptive statistics for the data have been determined. The variables were expressed by standard deviation and mean. Also, there was established a correlation between the national ranking of the players and the physical tests performed.

Variables	Mean (Male)	Mean (Female)
Age	0,074	0,788
Height	7,501	0,013
Weight	2,942	0,102
Sole length	11,076	0,003
Waist (cm)	3,892	2,942
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

Table 1. Mean Values 1
Source: Authors' own conception

Variables	Mean (Male)	Mean (Female)
Spider run v2	0,757	0,395
Hexagon test v1	2,679	0,117
Hexagon test v2	0,935	0,345
Lateral steps v1	0,007	0,935
Lateral steps v2	2,149	0,158
Long jump v1	0,314	0,581
Long jump v2	0,436	0,517
Consecutive jumps v1	1,56	0,226
Consecutive 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 2. Mean Values 2
Source: Authors' own conception

Results

There were no injuries during the training or the evaluation sessions.

First, a Pearson correlation was performed, between the national ranking and the morphological performance parameters. The following can be noticed, the higher the national ranking (weaker, i.e. 5 place is better than 20'th place), the lower the height of the participants. We can state that if athletes are taller, they are more likely to rank higher in the national ranking. The significance, in this case, is P> 0.006. This correlation is even stronger as it contains two asterisks' signs. Its value is 0.570, which is classified as a moderate correlation.

There is also another correlation noted with two asterisks signs, i.e. as the national ranking increases, the weight of the participants decreases. This correlation is 0.620. This result represents a moderate correlation. Another correlation related to the ranking of the players was noticed. When ranking increases, the sole length decreases, meaning that lower-ranked players have a shorter sole length. This correlation is noted with a single asterisk sign.

Another correlation, noted with a single asterisk sign, is: as ranking increases, the time in the 5 m sprint will increase. It is explained by the fact that a lower-ranked player in the national rankings will also have a lower time in the 5-10 m sprint. The correlations in the 5-10 m sprint have a value between 0.426- 0.522 representing a low correlation.

As for the correlation between the ranking and the 20 m sprint, we can notice the fact that it is noted with two asterisks signs. The higher the ranking, the weaker the time in the 20 m sprint. This means that lower-ranked players have weaker times compared to the higher-ranked players. The correlation, in this case, has values even above 0.760, which shows a high correlation.

Concerning the correlation between the ranking and the 30 m run, we could notice in the first series a correlation marked with two asterisks signs, and another one in the other two series with one Asterix sign. In the same way, the higher the ranking position (increases), the weaker is the result. The correlations in these three series range from 0.603 to 0.462.

Regarding the Spider test, just at the second series, we can see a weak correlation with the ranking. The value of this correlation is 0.438.

The higher the position in the national rankings, the weaker the time on the Spider test will be. This means that an athlete with a better ranking position will have a better time.

Talking about the hexagon test, there is a correlation in terms of player rankings noted with two asterisks signs, indicating a link between them. The longer the time to perform the Hexagon test, the higher and the lower the ranking. The correlation between them is moderate at 0.699.

When testing and performing lateral steps test it is observed, the higher the ranking, the more time it takes to perform this test. This means that the better the placement, the lower the lateral step test time. The correlation, in this case, is 0.549.

Regarding the correlation between the ranking and the one-handed medicine ball throw, is a negative and moderate correlation with values between -645 and -670. This means that the lower the ranking, the weaker the throws of the athletes will be.

As for the correlation between the ranking and the medicine ball throw, supported with both hands, a moderate negative correlation is observed with similar values between -571 and -572. The weaker their ranking, meaning that time will increase, the weaker they will perform the throw.

Next, regarding the first correlation between ranking and performing trunk lifts from face lying (push-ups), with a value of -0.688, meaning a moderate negative correlation, and regarding the second one, it is a high negative correlation with a value of -0.705. The higher the number in the ranking, i.e. the weaker, the fewer push-ups they will perform.

Only in these samples were correlations found. As for the correlation between ranking and flexibility, it is not relevant, as there is no asterisk sign.

Discussion

The participants and their parents gave their written consent for participating in this study. They were also informed that there are no consequences in case of withdrawing. This study aimed to analyse the correlation between ranking and different physical tests on Romanian tennis players. It has been shown that the highest correlations in our study were between ranking and the 20 m repeated sprint. There were average correlations noticed with the participant's weight, height and with the long jump, throws, lateral steps test, and Hexagon test.

Other studies have also tested the correlation between ranking and other different tests such as maximal power and work output assessed by 30 seconds Wingate Test. It has been shown that there was no correlation regarding junior elite tennis players and this test (Ziemann et al., 2013).

It also has been assumed that since the total sprint time that was accumulated and is strongly correlated to the best sprint time, just one 20 m sprint should be enough and less tiring for the athletes. Either way, more research is needed in this regard. Perry found out that there is a positive correlation between different motions such as overhead, diagonal med ball throw, and stroke velocity (Haugen et al., 2019).

Studies done on female tennis players showed a relationship between strength and performance in jump test results and in sprint time over the distance of 10 – 30 m in different intermittent sports. Another correlation was between serve velocity and individual rankings and has been considered a predictable and stable measure of on-court tennis performance. The use of jumps tests and also medicine ball throws is already part of the physical testing of the players belonging to different National Tennis Associations.

Other studies, having as sampls junior tennis girl players showed positive correlations between maturation and the power of the lower body part for female players U13 and tennis performance. In U16 female tennis players, only the variable maturation correlated with the tennis performance, this meaning 13%. They showed that girls maturing later will have a better tennis performance at U16.

Conclusions

In conclusion, national ranking is related to physical characteristics. After reviewing the results of the group, the following conclusions have been made: the higher (weaker) the ranking, the lower the height of the participants. Another moderate correlation has been observed between the national ranking and the weight of the participants.

It was pointed out that players who are higher in the ranking have better results in physical tests. Average correlations were observed in terms of participants´ height, participants´ weight, Hexagon test, lateral steps test, long jump, and throws. There is a moderate correlation between the specific tests and the ranking of the participants in this group. High correlations were observed in the 20 m sprint and push-ups.

As per the obtained results, the national ranking is related to the physical characteristics of the tennis players.

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Authors' Contributions

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

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