# THE INFLUENCE OF TENNIS MOTOR ABILITIES AND ANTHROPOMETRIC MEASURES ON THE COMPETITION SUCCESSFULNESS OF 11 AND 12 YEAR-OLD FEMALE TENNIS PLAYERS

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A sample of 75 young female tennis players, aged 11 and 12, was included in a research project aimed at establishing the influence of selected anthropometric measures and tennis motor abilities on the competition successfulness of young tennis players. The selected tennis motor variables include: the muscular power of arms and shoulders, elastic power of the legs, repetitive strength of the trunk, speed of movement, speed of alternative movements with the arm, flexibility of the back, agility, and hand-eye coordination.

The results of regression analysis of anthropometric measures reveal a statistically significant connection with the criterion variable (0.36). The system of predictor variables can explain 13% of the variance of the criterion variable. The same applies to tennis motor variables, where the relevant value is somewhat closer, reaching 0.64, while the system of predictors explains 41% of the variance of the criterion variable.

Of the anthropometric measures three variables (calf girth, body weight and abdominal /suprailiac/ skinfold) explain the criterion variable with statistical significance. Among the tennis motor variables the above-mentioned variable is represented by the 2400-m run, used for measuring running endurance, and the 5-m run, used for measuring speed of movement.

*Keywords: Tennis, successfulness, anthropometric measures, tennis motor tests.*

## INTRODUCTION

Tennis is a dynamic sports game played with a racquet and a ball. Success in tennis is defined by several factors that can be divided into social (sport infrastructure, sport popularity, etc.), external (competitor, coach, parents, training conditions) and internal factors (potential capacity, realisation of mobility capacity and competition experience).

In the present research, the competition successfulness of young female tennis players, aged 11 and 12, is explained on the basis of selected tennis motor tests. The selected tests measure the muscular power of arms and shoulders, the elastic power of the legs, repetitive strength of the trunk, speed of movement, speed of alternative movements with the arm, flexibility of the back, flexibility in the shoulders, flexibility of hips, agility, coordination, hand-eye coordination and dynamic balance.

Muscular strength is defined as the ability of a muscle or a group of muscles to exert maximal force during contraction. Muscular power is a combination of strength and speed. The test measures how quickly we apply our muscular strength.

In this field the following works of research have been consulted. Müller (1989) carried out 21 motor tests on 80 subjects, aged between 10 and 13. The criterion variable was the estimate of tennis strength. The highest correlation with the criterion variable was recorded in reaction tests, the 20-meter run and the Sargent jump.

Bunc, Dlouhá, Höhm, & Šafařík (1990) have conducted research on 80 boys and girls aged 13 and 14 with a test battery which was composed of eight tennis motor tests and anthropometric measures. Based on the comparison between tests and competition successfulness in tennis they established that speed was of high importance for young tennis players.

Filipčič (1993) compared competition successfulness with the results of basic motor and tennis tests on 43 tennis players between 15 and 23 years of age. The results of regression analysis show a statistically significant connection between the system of predictor variables and the criterion variable. By applying the system of used predictor variables approximately 40% of the criterion variance can be explained.

Unierzyski (1994) used a sample of 217 boys and 163 girls to – among other things – establish the connection between the national tennis scale ranking and seven mo-

tor tests. He succeeded in explaining 36.5% of competition successfulness with motor variables in 11-year old girls and 65.4% of the criterion variable in 14-year old girls. He discovered the great significance of first step acceleration in movement and of agility and strength in explaining competition successfulness.

Filipčič (1996) compared competitive and potential success to regression analysis and expert modelling on 87 young tennis players, aged between 12 and 14. Regression analysis was initially performed separately on motor, morphological and functional parts of the expert tree. Using morphological predictor variables, 50% of the criterion variable was explained, using tennis motor predictor variables, 63% of the criterion variable was explained, and using functional predictor variables, 53% of the criterion variable was explained. Regression analysis was furthermore performed on the highest level of the three dimensions, which helped explain 66% of the criterion variable. Congruity of the results obtained through expert modelling and regression analysis with morphological dimensions turned out to be 0.40, with motor dimensions being 0.65 and with functional dimensions at 0.58. On the highest level, i.e. the level of potential successfulness of young tennis players, the congruity of the results was 0.71. The congruity of the results obtained through expert modelling and regression analysis on the one hand and the criterion variable on the other hand turned out to be 0.53 considering the first method and 0.81 considering the second method.

Šerjak (2000) determined a connection between tennis motor tests and competition successfulness of 51 female tennis players aged 11 to 14. The results of regression analyses showed that the system of tennis motor variables had a statistically significant connection with the criterion variable. Variables of muscular strength, speed of movement, flexibility and coordination have the highest prediction value.

## METHODS

### Subjects

The sample of subjects consisted of 75 active female tennis players in the category 11 to 12 years of age. The study covered only the players satisfying the following conditions:

- tennis players were ranked on the STA ranking list for the U12 category;
- they participated in the process of regular training;
- they completed all the tests relevant to the research.

**TABLE 1**
General characteristics of the subject sample

| | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|
| **Age /years/** | 11.52 | 12.99 | 12.3442 | 0.42814 |
| **Height /cm/** | 140.9 | 171.5 | 157.814 | 6.8941 |
| **Weight /kg/** | 32.5 | 65.5 | 46.102 | 8.6037 |

### Procedures

The measurements were carried out at the Faculty of Sport in Ljubljana within regular annual measurement – taking organised for the members of the Slovenian national team. Apart from these candidates, the best female tennis players from different tennis clubs were invited to take part in the project. The measurements were carried out within one day. The tests of speed of movement and speed of alternative movements of the arm were carried out immediately after warming up, while the tests of repetitive strength of the trunk were carried out last.

### Anthropometric measures

Anthropometric measurements were carried out before the motor ones in accordance with the International Biological Programme. The battery consisted of 25 anthropometric measures which are often used, thus the descriptions are not given. Only some measures were selected for further research (Lasan, 1987).

**TABLE 2**
Predictor variables of anthropometric measures

| Code | Name of measure | Area of measurement |
|---|---|---|
| BH | Body Height | Longitudinal measure |
| LL | Leg Length | Longitudinal measure |
| AL | Arm length | Longitudinal measure |
| CG | Calf girth (circumference) | Body circumference |
| CHG | Chest girth | Body circumference |
| KB | Knee breadth (diameter) | Body diameter |
| BW | Body weight | Body mass |
| AS | Abdominal (suprailiac) skinfold | Body fat |
| BS | Biceps skinfold | Body fat |

### Description of tennis motor tests

### Medicine Ball Put (MBP)

TASK: The subject stands behind a line (a right-hander with his/her left side towards the direction of the throw), holding the ball in his/her dominant hand, the left hand supporting the ball from the bottom. After a slight arch backward, the ball is thrown straight ahead with a move similar to a serve. The distance from the line to the point where the ball landed is measured.

**Quarter Jump (QJ)**

TASK: The subject, from a sideways stance with his/her feet apart behind the line, takes four alternate jump steps, landing on both feet. The distance from the line to the last set of footprints (heel) is measured.

**Sit-ups 60 s (SU60)**

TASK: The subject lies back down with legs bent and the soles of the feet resting on the ground about 30 cm apart, hands behind the head, fingers interlocked. On the signal, the subject sits up, twisting the trunk and touching one elbow with the opposite knee, then lies back flat again. The sit-up is repeated, the other elbow touching the other knee; the test is continued without interruption as many times as possible for a period of 60 seconds or as long as the subject can continue.

**5-m Run (R5)**

TASK: The result is the time of the subject's running a 5 m distance, starting from standing position at the start.

**Tapping 20 s with hand (TAP20H)**

TASK: For twenty seconds the subject has to tap alternately two plates on the tapping board with his/her dominant hand, while holding the other hand in between the two plates. The result is the number of alternate double hits.

**Tapping 20 s with leg (TAP20L)**

TASK: For twenty seconds the subject has to tap alternately two plates on the tapping board with his/her dominant leg, while sitting on a chair. The result is the number of alternate double hits.

**Fandrill (FAN)**

TASK: The subject runs with a racquet in his/her dominant hand, along a marked-out course of five directions of four meters. The subject must always step on the central marker and the other bases, or at least touch them with one foot. In addition, the racquet must touch the ground in front of the player at each of the outside bases. Leg number three must always be run backward, the other legs in any manner desired, as quickly as possible.

**Forward Bend on the Bench (FBB)**

TASK: The subject stands bare-footed on a bench. The legs are extended, feet are together and parallel. The toes are touching the tape measure. The subject bends forward and pushes the board which slides down the tape measure. The final position must be maintained for at least for 2 seconds.

**Hexagon (HEX)**

TASK: The subject stands in a hexagon with six sides 60 cm long. At the signal of the measurer the subject starts to jump with both legs in and out of the hexagon. Three rounds are made.

**Rebounding Tennis Ball with the Racquet (RTB)**

TASK: The subject holds the tennis racquet in one and the tennis ball in the other hand. At the signal of the measurer the subject starts rebounding the tennis ball alternately once with a string and once with the frame of the racquet. If the ball drops off, the subject picks it up and continues with the task. The task is done after 60 seconds.

**2400-m Run (R2400)**

TASK: The subjects are divided into groups of no more than 8 runners. The group of subjects stands behind the start line and at the signal, "Go!" starts to run. They run 6 laps (one lap is 400 m).

**TABLE 3**
Predictor variables of tennis motor tests

| Code | Name of test | Ability |
|---|---|---|
| **MBP** | Medicine Ball Put (cm) | Muscular power of arms and shoulders |
| **QJ** | Quarter Jump (cm) | Elastic power of the legs |
| **SU60** | Sit-ups in 60 s (freq.) | Repetitive strength of the trunk |
| **R5** | 5-m Run (.1 s) | Speed of movement |
| **TAP20H** | Tapping in 20 s with hand (freq.) | Speed of alternative movements with the hands |
| **TAP20L** | Tapping in 20 s with leg (freq.) | Speed of alternative movements with the leg |
| **FBB** | Forward Bend on the Bench (cm) | Flexibility of back |
| **HEX** | Hexagon (.1 s) | Agility |
| **FAN** | Fandrill (.1 s) | Agility |
| **RTBR** | Rebounding Tennis Ball with the Racquet | Hand-eye coordination |
| **R2400** | 2400-m Run (1 s) | Running Endurance |

In defining the criterion variable, all the competitions for female tennis players aged up to 12 which had taken place in the period of the last competitive season were taken into account. Since the players competed in a different number of tournaments, we selected the most suitable criterion variable (competition successfulness), which is the ratio between the number of points collected by an individual player in tournaments and the number of entered tournaments.

The number of collected points represents all the points received for ranking in a competition (depending on the competition's rank; from 1st to 3rd rank), while the points received for winning depend on the opponent's ranking – bonus points. Points received collectively are divided by the number of tournaments entered and on this basis the coefficient of competition successfulness is calculated.

**Data analysis**

The basic statistical parameters of all the variables were computed in the first phase of the data analysis. In the second part classic multiple regression analysis was used to asses the relation between tennis motor variables, anthropometric variables and competition successfulness of young female tennis players.

## RESULTS

Basic statistical parameters of anthropometric measures are shown in TABLE 4. The results of Kolmogorov-Smirnov test of distribution normality indicate that all anthropometric variables have normal distribution.

**TABLE 4**
Basic statistical parameters of anthropometric variables

| | Min. | Max. | Mean | SD | K–S | Sig. K–S |
|---|---|---|---|---|---|---|
| BH | 140.9 | 171.5 | 157.814 | 6.8941 | 1.043 | 0.227 |
| LL | 68.70 | 108.00 | 93.968 | 5.455 | 0.872 | 0.433 |
| AL | 53.70 | 91.50 | 69.471 | 4.480 | 0.864 | 0.444 |
| CG | 28.00 | 38.00 | 33.330 | 2.320 | 0.882 | 0.418 |
| CHG | 46.10 | 87.60 | 70.542 | 5.233 | 0.884 | 0.415 |
| KB | 5.00 | 8.50 | 6.607 | 0.440 | 1.007 | 0.262 |
| BW | 32.5 | 65.5 | 46.102 | 8.6037 | 0.509 | 0.958 |
| AS | 1.00 | 30.00 | 12.550 | 5.690 | 1.418 | 0.036 |
| BS | 4.00 | 28.20 | 11.251 | 5.221 | 1.507 | 0.021 |

Legend:
Min.: minimal result
Max.: maximal result
Mean: arithmetic mean
SD: standard deviation
K–S: Kolmogorov-Smirnov test of distribution normality
Sig. K–S: probability of K–S ($p < 0.05$)

Basic statistical parameters of tennis motor variables are shown in TABLE 5. The results of the Kolmogorov-Smirnov test of distribution normality indicate that all tennis motor variables have normal distribution.

**TABLE 5**
Basic statistical parameters of tennis motor variables

| | Min. | Max. | Mean | SD | K–S | Sig. KS |
|---|---|---|---|---|---|---|
| MBP | 350.00 | 1190.00 | 711.870 | 161.410 | 0.978 | 0.294 |
| QJ | 540.00 | 925.00 | 741.480 | 73.250 | 0.830 | 0.496 |
| SU60 | 24.00 | 71.00 | 48.940 | 9.040 | 0.880 | 0.421 |
| R5 | 1.15 | 1.65 | 1.324 | 0.106 | 1.186 | 0.120 |
| TAP20H | 20.00 | 36.00 | 29.980 | 2.420 | 1.189 | 0.118 |
| TAP20L | 30.00 | 55.00 | 43.710 | 4.290 | 1.113 | 0.168 |
| FBB | 36.00 | 65.00 | 51.540 | 5.870 | 1.047 | 0.223 |
| HEX | 7.70 | 14.80 | 10.256 | 1.286 | 1.057 | 0.214 |
| FAN | 11.90 | 20.70 | 15.717 | 1.835 | 0.689 | 0.730 |
| RTBR | 7.00 | 81.00 | 41.490 | 11.580 | 0.764 | 0.603 |
| R2400 | 438.00 | 879.00 | 676.280 | 75.990 | 0.632 | 0.819 |

Legend:
Min.: minimal result
Max.: maximal result
Mean: arithmetical mean
SD: standard deviation
K–S: Kolmogorov-Smirnov test of distribution normality
Sig. K–S: probability of K–S ($p < 0.05$)

Basic statistical parameters of the criterion variable (competition successfulness) are shown in TABLE 6. The results of Kolmogorov-Smirnov test of distribution normality indicate that the criterion variable has normal distribution.

**TABLE 6**
Basic statistical parameters of criterion variable

| | Min. | Max. | Mean | SD | K–S | Sig. KS |
|---|---|---|---|---|---|---|
| CS | 1.000 | 39.600 | 12.87727 | 10.756174 | 1.313 | .064 |

Legend:
Min: minimal result
Max: maximal result
Mean: arithmetical mean
SD: standard deviation
K–S: Kolmogorov-Smirnov test of distribution normality
Sig. K–S: probability of K–S ($p < 0.05$)

TABLE 7 shows that the predictor system of anthropometric variables and the criterion variable are correlated with statistical significance. The coefficient of determination ($R^2 = .132$) indicates that the predictor system of tennis motor variables explains 13% of the variance of the criterion variable. The coefficient of multiple correlation ($R = .364$) indicates that the relation of the system of predictor variables to the criterion variable is .36.

Among the selected variables, three variables, namely calf girth (CG), body weight (BW) and abdominal (suprailiac) skinfold (AS), have the largest Beta coefficients and are statistically significant. The Pearson correlation coefficients with predictor and criterion variables are higher for abdominal (suprailiac) skinfold (AS) and body weight (BW). The abdominal (suprailiac) skinfold (AS) has a negative correlation to the criterion variable.

**TABLE 7**
Regression analysis of anthropometric variables

| | **R** | **$R^2$** | **F** | **Sig. F** |
|---|---|---|---|---|
| | .364 | .132 | 2.187 | .027 |
| | **Correl** | **Beta** | **T** | **Sig. T** |
| BH | .106 | –.128 | –.565 | .573 |
| LL | .058 | –.080 | –.603 | .547 |
| AL | .066 | –.030 | –.226 | .821 |
| **CG** | **.027** | **–.447** | **–2.432** | **.016** |
| CHG | .053 | –.050 | –.358 | .721 |
| KB | .133 | .147 | 1.539 | .126 |
| **BW** | **.125** | **.796** | **2.878** | **.005** |
| **AS** | **–.161** | **–.290** | **–2.411** | **.017** |
| BS | –.075 | –.020 | –.146 | .884 |

Statistically significant correlations ($p < 0.05$) are shown in bold.
Legend:
R – coefficient of multiple correlation
$R^2$ – coefficient of determination
F – F test of H0: $R^2 = 0$
Sig. F – significance of F test
Beta – standardized beta coefficient
Correl – Pearson correlation coefficient
T – t value for H0: Beta = 0
Sig T – two-tailed significance level of T

TABLE 8 shows that the predictor system of tennis motor variables and the criterion variable are correlated with statistical significance. The coefficient of determination ($R^2$ = .411) shows that the predictor system of tennis motor variables explains 41% of the variance of the criterion variable. The coefficient of multiple correlation (R = .641) indicates that the relation of the system of predictor variables with the criterion variable is .64.

Among the selected variables two variables, namely the 5-m Run (R5) and the 2400-m Run (R2400) have the highest Beta coefficients and are statistically significant. Pearson correlation coefficients with predictor and criterion variables are higher for the 2400-m Run (R2400), Medicine Ball Put (MBP), Rebounding Tennis Ball with the Racquet (RTBR) and 5-m Run (R5).

**TABLE 8**
Regression analysis of tennis motor variables

| | R | $R^2$ | F | Sig. F |
|---|---|---|---|---|
| | .641 | .411 | 4.253 | .000 |
| | **Correl** | **Beta** | **T** | **Sig. T** |
| MBP | .412 | .095 | .612 | .543 |
| QJ | .273 | -.031 | -.179 | .859 |
| SU60 | .205 | -.075 | -599 | .551 |
| **R5** | **-.370** | **-.363** | **-2.718** | **.008** |
| TAP20H | .273 | -.042 | -.295 | .769 |
| TAP20L | .079 | -.143 | -1.076 | .286 |
| FBB | .207 | .124 | 1.129 | .263 |
| HEX | .014 | .008 | .067 | .946 |
| FAN | -146 | .077 | .535 | .594 |
| RTBR | .419 | .240 | 1.662 | .101 |
| **MT2400** | **-.469** | **-.361** | **-3.046** | **.003** |

Statistically significant correlations ($p < 0.05$) are shown in bold.
Legend:
R – coefficient of multiple correlation
$R^2$ – coefficient of determination
F – F test of H0: $R^2 = 0$
Sig. F – significance of F test
Beta – standardized beta coefficient
Correl – Pearson correlation coefficient
T – t value for H0: Beta = 0
Sig T – two-tailed significance level of T

## DISCUSSION

The results of regression analysis of anthropometric measures (TABLE 7) point to the statistically significant yet low connection of the anthropometric measure system with the criterion variable. The same applies to the explained variance, which equals 13%.

However, the results of regression with tennis motor variables show relatively high values of explained variance of the criterion variable (41%) and high correlation between the tennis motor and the criterion variable.

Filipčič (1996) made a regression analysis of male tennis players (aged 14) covering different abilities and characteristics. The following values of explained variance were obtained: in 15 morphological variables the explained variance was 51%, in 22 tennis motor variables 63%, while in 6 functional variables the explained variance was 53%. The criterion variable in the present research also included competition successfulness, estimated with a coefficient of successfulness.

**Anthropometric measures**

The most significant predictor of the criterion variable is body weight (BW), which measures body mass. The reason for this could originate from two sources. The first is that there are developmental differences among girls of this age, as it is known that in puberty the body weight of girls increases more than body height (Žlebnik, 1975). And second, the development of body height and weight to a high degree depends also on sexual development and the related increase in body weight and height. This is reflected also by the results of basic statistical parameters of anthropometric variables, which show considerable differences in body weight (BW) and body height (BH) between individual subjects. Higher body weight in addition to greater body mass can also mean greater muscle mass and indirectly also more speedy tennis strokes. In any case, puberty is characterised by intensive psychomotor development and thus the transition to a higher level of motor abilities.

The next variable which explains competition successfulness with statistical significance is calf girth (CG). From the functional point of view a more hypertrophied muscle (larger volume and number of muscle fibres) can apply greater force on the load, which may be consequentially related to the speed of contraction. Based on electromyography research (Guissard, Duchateau, & Hainaut, 1992) it has been established that sprint start performance is associated with the enhanced contribution of the MG during eccentric and concentric phases of calf muscles contraction. In tennis, a faster sprint start means that the ball is caught in time, which increases the possibility of an optimal tennis stroke.

Body fat is one of the sets of anthropometric variables within which the abdominal (suprailiac) skinfold (AS) explains the variance of the criterion variable with statistical significance. Greater body fat represents an obstacle for tennis players, namely ballast, which becomes apparent mainly in fast movements and jumps and is also an additional burden during long-term activities, i.e. long tennis matches. Filipčič (1996) discovered that due to high level of intensity and dynamic character of a tennis match fat tissue represents an additional burden for the player and to a certain extent slows down a player's movements.

The importance of body fat can be greater in girls, since the fat tissue values differ depending on the gen-

der. Average fat value in young men is about 12% and in women 20% of their body mass (Lasan, 1987).

**Tennis motor variables**

One of the two significant predictors of the criterion variable is 5-m Run (R5), which measures speed of movement. Among other things, within the scope of this research the speed was measured at a 5 meter distance. Since this is a very short running distance, it has to be stressed that the first step acceleration is extremely important. Namely, variables influence the movement of tennis players, since the start and the first meters of the run are crucial to the preparation and realisation of the stroke. In a tennis match many short sprints are no longer than 11 metres. Usually they are five metres long (Schönborn, 2000).

In most research studies the speed of movement test includes running at a distance of 20 metres. Therefore the variable 20-m Run (R20) was, a number of times, (Müller, 1989; Bunc, Dlouhá, Höhm, & Šafařík, 1990; Filipčič, 1996) recognised as the predictor that can explain successfulness in tennis with statistical significance. They also established that the speed of movement and start speed were very important in tennis. The importance of speed will continue to grow in modern tennis, since the speed of strokes is constantly increasing.

In their research Clark, Martin, Lee, Fornasiero and Quinn (1998) investigated the relations between individual speed tests and agility tests. They discovered that a ten metre sprint time was highly correlated with sprint times in the cases of both 5 and 20 m. Correlations were weak for males and females between sprint times and Acceleration/Deceleration (5 m), Back Slide, and Tball Forehand with the exception of Tball Forehand for males, which was shown to be significantly correlated with 10 m and 20 m sprint times. For the remaining agility tests correlations with sprint times were generally moderate in females and strong in males. Correlations between agility tests and sprint times became stronger in males and females as the sprint distance increased.

The second predictor variable that explains the competition successfulness of female tennis players with statistical significance is the 2400-m Run (R2400). This variable belongs to the field of the energy component of movement, or, more precisely, to the field of running endurance. The test is frequently used and known as the Cooper test of aerobic endurance. In the research on tennis games (Filipčič, 1993), a similar variable was used (R2000), which was also found to act as an individual predictor to explain competition successfulness with statistical significance. Završki (1997) also established that functional abilities of an organism are very important, pointing to the fact that a young tennis player is well prepared in terms of endurance. For successful performance in the test 2400-m Run (R2400), the following factors are important: functional ability of organic systems for $O_2$ transport (respiratory and cardiovascular system and the capacity of the blood), morphological and functional characteristics of the muscles, and the mechanism for the regulation and excitation of the nerve–muscular system.

The importance of the above-mentioned mechanisms in tennis is reflected particularly in time-consuming matches, where a player must retain a high level of abilities throughout the entire match or must perform at her best at the very end of the match.

To conclude, it can be established that the selection of variables included in regression analysis was adequate, both in terms of individual tennis motor abilities covered and the aspect of explaining tennis successfulness. It is above all important that some significant bases were developed for further research of girls' tennis and the importance of tennis motor abilities in explaining the competition successfulness of female tennis players.

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## VLIV MOTORICKÝCH SCHOPNOSTÍ A ANTROPOMETRICKÝCH MĚR NA ÚSPĚŠNOST V ZÁVODECH U 11 A 12LETÝCH HRÁČEK TENISU

(Souhrn anglického textu)

Soubor 75 mladých hráček tenisu ve věku 11 a 12 let byl zahrnut do výzkumného projektu s cílem zjistit vliv vybraných antropometrických údajů a tenisových motorických dovedností na úspěšnost v soutěžích mladých tenisových hráčů. Vybrané tenisové motorické proměnné zahrnují: sílu svalů paží a ramen, sílu nohou, opakovanou sílu trupu, rychlost pohybu, rychlost střídavého pohybu rukou, ohebnost zad, hbitost a koordinaci ruka – oko.

Výsledky regresní analýzy antropometrických měr odhalují statisticky významné spojení s kritérii proměnných (0,36). Skupina predikčních proměnných může vysvětlit 13% rozdílnost kritérií proměnných. To stejné se aplikuje na tenisové motorické proměnné, u kterých je důležitá hodnota poněkud bližší, dosahuje 0,64, zatímco systém prediktorů vysvětluje 41% rozdílnost kritérií proměnných.

Tři proměnné z antropometrických měr (obvod lýtka, tělesná váha, břišní kožní řasa) vysvětlují kritérium proměnné se statistickou významností. Mezi již výše zmíněné tenisové motorické proměnné patří běh na 2 400 metrů, který se používá pro měření vytrvalosti v běhu, a běh na 5 metrů, který se používá pro meření rychlosti pohybu.

*Klíčová slova: tenis, úspěšnost, antropometrická měření, motorické testy v tenisu.*

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