Hrvat. Športskomed. Vjesn. 2006; 21: 98-102

MORPHOLOGICAL ADVANTAGES AND DISADVANTAGES IN CROATIAN U-16 AND U-18 TENNIS PLAYERS

MORFOLOŠKE PREDNOSTI I NEDOSTACI HRVATSKIH TENISAČA KATEGORIJE U-16 I U-18

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SUMMARY

The main purpose of the study was to explore variations in the body constitution of Croatian tennis players (age categories under 16 and under 18), and to gain a better insight into advantages and disadvantages originating from morphological characteristics. Morphological differences between the dominant and non-dominant arm were also analyzed.

Forty-nine Croatian elite junior tennis players, all right-handed, participated in the study. The sample was divided into two groups: players under 16 and players under 18 years of age. As instructed by the International Biological Program, the following anthropometrical variables were measured: body height, body mass, leg length, arm length, biacromial and bicristal diameters, knee, elbow and wrist diameters, upper arm girth, forearm girth, chest girth, abdomen girth, thigh and calf girth. Upper arm girth was measured in the flexion and extension positions. Somatotypes were calculated using Heath-Carter equations. Differences between the dominant and non-dominant arm in elite Croatian tennis players were analyzed according to their age category using the Paired samples t-test and statistical significance was set at $p<0.05$.

According to their body constitution, under 16 and under 18 year old Croatian tennis players were found to be predominantly meso-ectomorf. The differences between the dominant and non-dominant arms (arm length, elbow diameter, wrist diameter, upper and lower arm girth and forearm girth) were statistically significant in both tested age groups.

As U16 and U18 Croatian tennis players are predominantly meso-ectomorf and being of that somatotype they should have an advantage while playing on the net, in addition to having powerful strokes and an ability to achieve high stroke speed. Also, they need a smaller number of steps when trying to position themselves in the desired spot on court. As expected, long-term exposure to training stimuli resulted in larger circumferences and diameters in the dominant arm. We can conclude that, in world class tennis, body constitution posses no limitations on maximal achievements for a vast majority of tested players.

Ključne riječi: tenis, građa tijela, morfološke karakteristike, somatotipi

SAŽETAK

Glavni cilj ovog istraživanja bio je istražiti varijacije u građi tijela hrvatskih tenisača (dobnih kategorija do 16 Ii do 18 godina), te steći bolji uvid u prednosti i nedostatke morfoloških karakteristika. Morfološke razlike između dominantne i nedominantne ruke su također bile promatrane.

U istraživanju je sudjelovalo četrdesetdevet vrhunskih hrvatskih tenisača juniora, dešnjaka. Uzorak je bio podijeljen u dvije grupe: igrači do 16 i igrači do 18 godina starosti. Upućeni međunarodnim biološkim programom, slijedeće antropometrijske varijable su bile izmjerene: visina tijela, tjelesna masa, dužina noge, dužina ruke, širina ramena i kukova, dijametar ručnog zgloba, lakta i koljena, opseg nadlaktice, opseg podlaktice, opseg grudi, opseg trbuha, te opseg natkoljenice i potkoljenice. Opseg nadlaktice se mjerio u pozicijama fleksije i ekstenzije. Somatotipi su izračunati korištenjem Heath-Carter-ovih jednadžbi. Razlike između dominantne i nedominantne ruke kod vrhunskih hrvatskih tenisača su analizirani u skladu s njihovom dobnom kategorijom koristeći t-test za značajne uzorke s statističkom značajnošću $p<0.05$.

U skladu s njihovim građom tijela otkriveno je da su hrvatski tenisači dobnih kategorija do 16 i do 18 godina pretežno mezo-ektomorfi. Razlike između dominantne i nedominantne ruke (dužina ruke, dijametar ručnog zgloba i lakta, opsezi nadlaktice i podlaktice) su statistički značajne u obje testirane dobne grupe.

Hrvatski tenisači dobnih skupina do 16 i do 18 godina su pretežno mezo-ektomorfi i postojanjem takvog somatotipa trebali bi stvoriti prednost u igri na mreži, te pored snažnih udaraca i sposobnost ostvarivanja velikih brzina udaraca. Također, trebaju manji broj koraka pri kretnju po na terenu. Kao što je očekivano, dugotrajno izlaganje stimulativnim podražajima treninga rezultat je većih opsega i dijametara kod dominantne ruke. Možemo zaključiti da, u vrhunskom tenisu, građa tijela ne stvara ograničenja pri maksimalnim dostignućima za veliku većinu testiranih igrača.

Key words: tennis, body constitution, morphological characteristics, somatotype

Primljeno 16. 05. 2006., prihvaćeno 01. 12. 2006.

INTRODUCTION

Tennis players are an interesting target group when studying the long-term influence of physical activity on morphological characteristics. Unilateral, usually intensive skeletal loading affects the development of the playing extremity when compared to the non-playing side (17). Previous studies involving tennis players have provided evidence that playing arm bone tissue is clearly affected by mechanical loading (3, 9, 10, 13, 16-19, 26). Modern rackets have facilitated a change in technique and playing style nowadays characterized by power and spin. The combination of increased stiffness in modern rackets and the tendency for harder tennis balls has led to increased shock transmission from the racket to the player, which is probably a major contributor to tennis elbow (4, 5). In many places along the upper extremity, playing to non-playing arm differences have been over 20% in favor of the playing arm, as compared to less than 5% dominant to non-dominant arm differences in non-players (18). This fact speaks of the positive effect of physical loading on morphological characteristics, especially on the musculoskeletal system (3, 9, 10, 13, 16-19, 26). According to the ATP championship race, the top ten ranked tennis players possess very similar morphological characteristics (average height 183.5 cm, average weight 80.5 kg (31)). However, among them there are several noticeably higher players among the first five. In tennis, athlete power is important because in modern professional tennis ball velocities over 200km/h are regularly recorded. In order to have an advantage during the serve, the tennis player needs to be very tall, at least 180cm (28). We can say that body constitution is not a limiting factor for effectiveness during the game, but it certainly does influence game style. For this reason, favorable body constitution provides an advantage for certain players. Tall above average height players have tendencies to play more offensive tennis with shorter points. On the contrary, players who are shorter and below average height tend to play more defensive tennis. Most top tennis players did compensate for constitution type related problems by adjusting style according to their morphological characteristics. However, it is impossible to know whether they would be even more successful if their body constitutions were more favorable.

Table 1. Descriptive statistics (mean±SD) parameters of morphological characteristics according to the player age
Tablica 1. Deskriptivni parametri (aritmetička sredina±SD) morfoloških karakteristika u skladu s dobi igrača

	16yrs(n=24)	18yrs(n=25)	p value
Body height (cm)	178,4±8,4	184,2±6,9	0,06
Body mass (kg)	65,6±8,2	75,5±8,3	0,00
Fat tissue (%)	8,5±2,9	8,7±3,8	0,73
Lean body mass (kg)	59,3±7,3	68,8±7,1	0,00
Body mass index	20,5±1,4	22,2±1,9	0,00
Left leg length (cm)	100,9±5,2	104,4±6,2	0,00
Right leg length(cm)	101,3±5,5	104,3±6,1	0,00
Left arm length (cm)	78,1±7,7	80,8±2,9	0,05
Right arm length(cm)	79,8±7,8	81,8±4,9	0,05
Left Elbow diameter (cm)	7,2±0,5	7,0±0,2	0,88
Right Elbow diameter (cm)	6,9±0,5	7,2±0,3	0,05
Left Knee diameter (cm)	9,7±0,4	9,7±0,3	0,45
Right Knee diameter (cm)	9,6±0,4	9,7±0,4	0,86
Left wrist diameter (cm)	5,7±0,4	5,7±0,3	0,75
Right wrist diameter (cm)	5,9±0,3	5,9±0,4	0,56
Left Upper arm girth extension(cm)	25,7±2,1	28,8±1,8	0,00
Right Upper arm girth extension(cm)	26,9±2,3	29,5±2,4	0,00
Left Upper arm girth flexion(cm)	30,6±2,2	30,1±1,8	0,00
Right Upper arm girth flexion(cm)	31,4±2,4	31,3±2,2	0,00
Left Forearm girth (cm)	24,3±1,9	26,4±2,1	0,00
Right Forearm girth (cm)	26,2±1,7	27,8±1,6	0,00
Left Thigh girth (cm)	53,5±3,7	57,1±3,1	0,00
Right Thigh girth (cm)	52,6±3,7	57,2±3,2	0,00
Left Calf girth (cm)	35,9±2,1	36,3±1,7	0,02
Left Calf girth (cm)	35,4±2,2	36,5±1,7	0,01

There are four different body types; body constitutions, present in tennis: Meso-ectomorf, Ecto-mesomorf, Mesomorf, Endomorph (28) each of which has its game advantages, as well as some common problems related to tactical demands, possible injuries and physical fitness limitations. The aim of this research was to explore variations in body constitution in elite Croatian tennis players (categories: under 16 and under 18 years of age) in order to gain better insight into advantages and disadvantages originating in morphological characteristics. The morphological differences between the dominant and non-dominant arm were also analyzed.

METHODS

The sample comprised Croatian tennis players (n=49) tested at the end of the 2005/06 competitive season. The sample was divided into two groups: players under 16 (U-16, N= 24, Age 15,42 0,45) and players under 18 years of age (U-18, N= 25 , Age 17,28 0,50) according to ITF age category regulations.

All of the players had more than 6 years of training and tournament experience. The players were fully informed of all experimental procedures before giving their consent to participate.

The percentage of body fat and relative body fat mass in tennis players was determined by Siri equations based on chest, triceps and subscapular skinfold measurements. According to the instructions of the International Biological Program (3), the following anthropometrical variables were measured: body height, body mass, leg length, arm length, biacromial and bicristal diameters, knee, elbow and wrist diameters, upper arm girth, forearm girth, chest girth, abdomen girth, thigh and calf girth. Upper arm girth was measured in the flexion and extension positions. Somatotypes were calculated using Heath-Carter equations.

The statistical Package for Social Sciences SPSS (v11.5, SPSS Inc., Chicago, IL) was used for statistical analysis. The descriptive statistics mean (X) and standard deviation (SD) were calculated for all experimental data. The Kolmogorov-Smirnov test was used to test if the data are normally distributed. The differences between the dominant and non-dominant arms were analyzed using the Paired samples t-test and statistical significance was set at $p<0,05$.

RESULTS

The average values presented in Table 1 indicate the differences in morphological characteristics according to player age.

The older group differed significantly from the younger group in most of the measured parameters, especially in variables depending on muscle mass (Table 1).

According to their body constitution, Croatian Tennis players under 16 and under 18 years of age are predominantly meso-ectomorfs (Table 2).

Table 2. Somatotype (mean ± SD) according to player age
Tablica 2. Somatotipi (aritmetička sredina±SD) u skladu s dobi igrača

	Endomorph	Mesomorf	Ectomorf
16yrs(n=24)	2,8±0,9	3,6±0,9	3,7±0,8
18yrs(n=25)	2,9±0,8	3,3±0,9	3,4±1,0

Significant differences were found in comparing the left and right side of the body (playing and non-playing arm), regardless of player age. The largest differences between the left and right side of the body were detected in the following variables: arm length, elbow diameter, wrist diameter, upper and lower arm girth and forearm girth.

Differences in morphological characteristics between the dominant and non-dominant arm (arm length, elbow diameter, wrist diameter, upper and lower arm girth and forearm girth) are statistically significant in all player categories (under 16 and under 18 years).

Table 3. Differences between the dominant and non-dominant (left vs. right) arm according to player age
Tablica 3. Razlike između dominantne i nedominantne (lijeva u odnosu na desnu) ruke u skladu s dobi igrača

	16yrs(n=24)	18yrs(n=25)
Length of the arm non-playing vs. playing (cm)	t=3,1*	t=3,5*
Elbow diameter non-playing vs. playing (cm)	t=4,7*	t=4,2*
Wrist diameter non-playing vs. playing (cm)	t=3,0*	t=3,5*
Upper arm girth extension non-playing vs. playing (cm)	t=5,6*	t=4,5*
Upper arm girth flexion non-playing vs. playing (cm)	t=6,7*	t=6,2*
Forearm girth non-playing vs. playing (cm)	t=8,0*	t=6,9*

* difference was considered significant at 5%

DISCUSSION

Croatian tennis players reach the average height of top international players, 184 cm, (29) when they enter the U-18 category but their weight is still lower, probably due to their very young age and uncompleted muscle mass development. The average knee, elbow diameter, bicristal and biacromial ranges, corresponded to the average values recorded from the general population. But thigh circumferences were greater in tennis players comparing to the results of the general population (24). This could be contributed to larger muscle mass and a smaller amount of fat than that of the general population as during the tennis match, each player performs many dynamic movements (cutting, sprints, serves) which require high strength (30). As a tennis match often lasts over an hour (8, 30) and in some cases more than five hours, players are exposed to a combination of maximal, or near maximal, workloads followed by longer periods of moderate and low intensity activity. Match intensity varies considerably depending on the player's level, style, and gender (and court surface and ball type) (8). In addition to this, playing style may be largely influenced by body constitution. Croatian U-16 and U-18 tennis players are mostly meso-ectomorfs pointing to above average height which certainly provides an advantage in the serve. As at that age growth has still not finalized for most of them, we could expect that, on average, they might reach a height above the mean height of the top ten best players on the list. Thanks to their arm and leg length, Croatian tennis players should have an advantage in developing good play on the net, powerful strokes, and the ability to achieve a high serve and smash velocity (courtesy of long arms representing long leverage). Also, their morphology enables them to use a smaller number of steps when trying to position themselves for the accurate stroke.

Speed when trying to play long rallies and running towards the net as well as a possible higher rate of shoulder and knee injuries, particularly, when playing on a quick surface (28) represent meager disadvantages of this constitution. For example, one of the major health concerns in Goran Ivanišević's career, also a successful meso-ectomorf tennis player, was shoulder injury.

The differences between the dominant and the non-dominant arm (playing vs. non-playing) in arm length, elbow diameter, wrist diameter, upper arm girth during the extension and flexion and forearm girth were found in both age categories (Table 3). This is an indication of the known unilateral influence of physical activity such as tennis. In some of the measured parameters differences became more apparent as the number of training years increased (see Table 1). This confirms previous findings on the effect of physical load on the musculoskeletal system (9, 13, 16-19, 26).

CONCLUSIONS

According to their body constitution, Croatian U-16 and U-18 tennis players are predominantly meso-ectomorfs and as such they possess an advantage while playing on the net. Their serve velocity might benefit from their height and arm length and from an energy expenditure point of view they should need a smaller number of steps in trying to reach a desirable on court position. However, their acceleration capacities when trying to play longer rallies and during the run towards the net may pose as meager disadvantages. Those disadvantages might be minimized by the involvement of footwork and leg coordination training in order to enable them to cover the tennis court more quickly. Attention should also be given to strength and flexibility training in order to reduce the chance of injuries. With this approach to the training process, coaches could increase the number competitive years the player has.

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