SOME MORPHOLOGICAL DIFFERENCES BETWEEN OPPOSITE SIDES OF THE BODY OF ELITE EUROPEAN JUNIOR BADMINTON PLAYERS

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Abstract

The aim of the study was to determine some morphological differences between sides of body (dominant versus non-dominant) of elite junior badminton players. The sample consisted of 85 high profile junior badminton players from Europe that have played on European Junior Circuit. They were gauged with 12 morphological measures aiming to gain some basic information regarding the players' morphological status and to establish relations between dominant and non-dominant side of the body, by comparing circumferences of limbs on both sides. The results obtained by the study have established significant (forearm and upper leg; p= 0,00) or non-significant (p=0,11), but nevertheless visible (30,49±16,96 opposed to 27,51±2,42) differences (upper arm) between circumferences of limbs of badminton players on opposite sides of their bodies, with higher values shown on the dominant side. The only exception of the rule has been shown on the lower leg circumference (36,58±2,58 opposed to 38,09±12,57). Badminton players, due to unilaterality of the sport, are predisposed to develop some morphological imbalances, which can both; increase potential risk of injuries and negatively influence players' performances in the game. Therefore, additional bilateral physical exercises that would help diminish some negative consequences of frequent and intensive badminton training and would enable symmetrical development of young badminton players', should be implemented in their training.

Key words: *anthropometry, unilaterality, dominant side, asymmetry*

Introduction

Anthropometric measurements are important tool for gathering information on characteristics of different sports or sports' disciplines. Each sporting activity has its own characteristic movement pattern, which very often requires some specific morphological features (Mahjoub, 2002). In numerous sports' studies it has been well established that in large number of sports or sports' disciplines a specific morphological profile is one of the main indicators of a player potential to compete at the highest level in a specific sport (Bourgois et al., 2000; Burgois et al., 2001; Claessens et al., 1999; Slater et al., 2005; Reilly et al., 2000). Therefore, the interest for establishing the role and importance of certain anthropometric characteristics or anthropometric profile as a whole, in different sports or sports disciplines, has increased dramatically over the years. Badminton is one of the most popular individual sport games in the world with 200 million participants (Kwan et al., 2010) actively involved in the sport, professionally or as recreational players. As one of racquet sport games badminton is unilateral and therefore structurally asymmetric sport. Because of its unilaterality, the movements of the dominant limb are more precise and quicker than those of the non-dominant limb (Boulinguez et al., 2001; Bagesteriro et al., 2002; Bryden, Kay, 2002). Studies on asymmetry in sport reveal the negative effects of unilaterality on competitive results and proper athletic development (Starosta, 2008; Rynkiewicz et al., 2007), but positive effects on technical skills of athletes who are actively involved in unilateral sports (Starosta, 2008; Dojla, 1979). An asymmetric technique may lead to an asymmetric distribution of muscle mass and unbalanced muscle tonus (Andreoli et al., 2001; Ilnicka, 2005; Sanchis-Moysi, 2004). For example, studies in tennis, which is also, like table tennis and badminton, asymmetric/unilateral sport, have shown that structural differences between dominant and non-dominant upper limbs were found in athletes (Colak et al., 2004; Lucky and Nickolay, 2007). Moreover, tennis players have shown markedly higher levels of muscle mass asymmetry in their upper limbs, as compared with athletes practicing other sports (Bass et al., 2002; Ducher et al., 2006; Ducher et al., 2009; Sanchis-Moysi, 2010). There are several studies in which asymmetries in racquet sports were enquired, primary in tennis (Yasin et al., 2010; Abrahão, Mello, 2008; Rynkiewicz et al., 2013), but only few studies (Raschka and Schmidt, 2013) in which morphological differences between dominant and non-dominant sides were determined among junior badminton players, what is the aim of the present study.

Methods

Sample of entities

This study was conducted on 85 elite European male junior badminton players, 14-17 years old (15,69±1,17), who have played tournaments on European Junior Circuit across Europe. The study was conducted in full compliance with the Declaration of Helsinki. Therefore, all the players participating in the study and their parents signed an informed consent.

Sample of variables

For the purpose of this study, 12 anthropometric measurements were included into the sample of variables. They are as follows: *height (cm), weight (kg), shoulder and crista iliaca width (cm) and circumferences of upper and lower right and left arm, such as circumferences of upper and lower right and left leg (cm)*. The variables have been selected with the aim to provide some basic information on morphological status of the examinees and to establish differences between sides of the body (dominant vs non-dominant side).

Procedure

The anthropometric measurements were conducted by two, in the field of morphological testing, experienced researchers from Faculty of kinesiology University of Zagreb. Measurements (12 of them) lasted approximately 5 minutes per each of the players and were conducted by following the 8 measuring procedures described below. *Height*: Height was measured with anthropometer. The subject stands flat on the ground; the weight is equally distributed on both legs. Shoulders are relaxed, heels put together and head is set up in the position of "Frankfurt Horizontal", which means that imaginary line connects the lower part of the left orbit and *tragus helix* of the left ear in horizontal position. Anthropometer is set in vertical position with the subject's back, touching them in the sacrum and interscapular area. Horizontal part of anthropometer descends to the crown of the head (*vertex* point) (Misigoj-Durakovic, 2008). *Weight*: Weight was measured with the digital scale with the maximum of 150 kg. Subject needed to stand still and after several seconds, we establish his/her weight. *Shoulder width* (biacrominal ratio): Both widths were measured with pelvimeter. Subject stands with relaxed shoulders. Measurer stands behind the subject and put two parts of the pelvimeter on the outer part of both *acromions,* touching soft tissue (Misigoj-Durakovic, 2008). *Crista iliaca width* (bicristal ratio): Subject stands with equally distributed weight on both legs, heels are put together. Measurer also stands behind the subject and puts pelvimeter parts on the reefs of pelvic bones (*crista iliaca - iliocristale* point), where the width is the biggest (Misigoj-Durakovic, 2008). *Upper arm circumference*: All circumferences were measured with centimetre tape. Subject stands with relaxed arms near the body. The tape sets up in horizontal position on the widest part of the upper arm, on its upper part (Misigoj-Durakovic, 2008). *Forearm circumference*: Subject stands with relaxed hands and shoulders. The tape sets on the widest part of the lower arm, on the upper third area (Misigoj-Durakovic, 2008). *Upper leg circumference:* Subject stands, and the weight is equally distributed on both legs. Feet are slightly apart in parallel position. The tape sets up horizontally under the gluteal furrow (Misigoj-Durakovic, 2008). *Lower leg circumference:* Subject stands and centimetre tape in horizontal position around the widest area on the upper third part of the lower leg (Misigoj-Durakovic, 2008).

Data analysis

The collected data were computed by the statistical software package Statistica 8.0 (Statsoft). Basic descriptive statistical parameters (mean, std. dev., min., max.) and distribution normalities were calculated for each variable. Single simple Student-t test was used to determine statistical differences within the group in height, weight, shoulder and iliocristale width and Student-dependent t-test was used to determine statistical differences between sides of the body. Significance level in this study was set up at 5% ($p<0,05$.)

Results

Results of Kolmogorov-Smirnov test has confirmed that the distribution of data on all the variables does not significantly differ from the values that characterise a normal distribution of data. Therefore, the distribution of the results can be considered as normal. The results presented in Table 1. have provided some general information regarding the most basic (height, weight) and some transversal morphological features of the examinees included in the sample. By using Student t-test for single sample, differences between badminton players within the sample have been established. The results (descriptive statistics and Student t-test) presented in Table 2. have provided some basic information regarding the relations between dominant and non-dominant side of the body of badminton players by comparing both arms and legs circumferences. The results have shown that statistical differences between opposite sides of the body exists between forearm and upper leg circumferences (25,59±1,99 opposed to 24,07±1,78; 55,53±4,01 opposed to 54,05±3,90) ($p<0,05$), but the statistical differences haven't been found between upper arm and lower leg circumferences of the opposite sides of the body (30,49±16,96 opposed to 27,51±2,42) ($p>0,05$).

Table 1. Descriptive statistics and the results of Student t-test for simple sample, establishing differences within the sample of badminton players by comparing their basic morphological features

VARIABLES	Mean	SD	Min	Max	t test	p value
Height	176,73	16,09	101,00	204,00	93,86	*0,00*
Weight	65,92	8,34	46,00	85,00	67,52	*0,00*
Shoulder width	34,96	2,93	21,20	43,00	109,83	*0,00*
Iliocristale width	26,65	1,61	22,50	31,50	152,59	*0,00*

Table 2. Descriptive statistics and the results of Student t-test for dependent samples

VARIABLES	Dominant side of the body	Non-dominant side of the body		
	Mean±SD	Mean±SD	t test	p value
Upper arm circumference	30,49±16,96	27,51±2,42	1,61	0,11
Forearm circumference	25,59±1,99	24,07±1,78	13,36	*0,00*
Upper leg circumference	55,53±4,01	54,05±3,90	7,82	*0,00*
Lower leg circumference	36,58±2,58	38,09±12,57	-1,13	0,26

Discussion

Badminton players due to unilaterality of the sport and its specific playing technique very often show an increased level of strength of the dominant hand (Berdejo-del-Fresno et al., 2010). Moreover, several studies have found asymmetry of the upper limbs (Andreoli et al., 2001; Ilnicka, 2005; Sanchis-Moysi et al., 2004; Colak et al., 2004; Lucky et al., 2007; Rogowski et al., 2008; Balius et al., 2012; Bass et al., 2002; Ducher et al., 2009; Ducher et al., 2006; Sanchis-Moysi et al., 2010; Sanchis-Moysi et al., 2010; Moreno et al., 2002). This study has been aiming to gain some basic information about morphological status of junior badminton players' and to establish relations between dominant and non-dominant sides of the players' bodies by comparing circumferences of their limbs on each side. The study has included 85 high profile badminton junior players who had played on European Junior Circuit. By analysing some of the basic morphological features *(height, weight, shoulder and iliocristale width)* the differences between badminton players within the sample have proved to be significant, as expected, since the age range of participants within the group is really substantial regarding the age period (puberty and adolescence) they belong to.

The results of the study (Table 1.) have shown to be comparable to results gained by Raschka and Schmidt (2013), who in their study included 40 competitive level badminton players (average age= 23,2±3,1; height= 175±5,2; 36,45±1,5; iliocristale width= 27,9±1,35). Regarding the relations between dominant and non-dominant side of the body (Table 2.) the results of the study have shown that statistical differences between opposite sides of the body of badminton players exists on forearm and upper leg circumferences *(25,59±1,99 opposed to 24,07 ±1,78; 55,53±4,01 opposed to 54,05±3,90) (p<0,05)*. The statistical differences haven't been shown on upper arm and lower leg circumferences between opposite sides of the body (30,49±16,96 opposed to 27,51±2,42) (p>0,05).

On the lower leg circumference, higher values (+ 1,51 cm more, p= 0,26) were determined on the leg opposite to the side of the dominant hand, probably because muscles of the lower leg are compensating when players perform vertical jump with one leg and perform smash shuttle-cook into the opponent's area. Raschka and Schmidt (2013) have presented similar results regarding relations between dominant and non-dominant side of badminton players' bodies. In their study average circumference of dominant versus non-dominant upper arm was 28±1,8 cm vs 27,35±1,9 cm and average circumference of dominant versus non-dominant forearm was 26,65±1,2 cm vs 25,3±1,75 cm. Comparing the results, it can be seen that in the study of Raschka and Schmidt (2013), the values of the dominant upper arm and forearm circumferences have been somewhat higher (0,65 cm and 1,35 cm respectively). Regarding the upper and lower leg circumferences, very similar results and relations have been obtained in both of the studies. In sport asymmetry between sides of body presents a negative phenomenon. It can lead to uneven distribution of muscle mass and lead to structural imbalances which can negatively influence overall players' development and increase potential risk of injuries. Therefore, exercises that would help to symmetrical development of players have to be implemented in young badminton players supervised training, with aim to diminish some negative consequences that frequent and intensive badminton training could have on their physical development. Moreover, several studies have confirmed a positive influence of symmetrical training of motor tasks on the improvement of technical skills and motor coordination. According to Starosta (2008), symmetrical training of motor tasks is associated with a bilateral transfer of motor skills, enabling improvement of motor coordination and the technique of movement in both dominant and non-dominant limb.

Conclusion

The results obtained by the study have established significant (forearm and upper leg) or non-significant, but nevertheless visible differences (upper arm) between circumferences of limbs of badminton players on opposite sides of their bodies, with higher values shown on the dominant side. The only exception of the rule has been shown on the lower leg circumference probably due to the fact muscles of the lower leg on non-dominant side are much more involved when players perform vertical jump with one leg and perform smash into the opponent's area, and therefore are more developed. In badminton asymmetry between sides of body can increase potential risk of injuries and negatively influence players' performances in the game. As badminton players, due to unilaterality of the sport, are predisposed to develop some morphological imbalances, some additional physical exercises enabling symmetrical morphological development, should be implemented in their supervised training. Such an approach would help diminishing some of the negative consequences that a frequent and intensive badminton training could have on young badminton players' physical development.

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NEKE MORFOLOŠKE RAZLIKE IZMEĐU SUPROTNIH STRANA TIJELA EUROPSKIH ELITNIH JUNIORSKIH IGRAČA BADMINTONA

Sažetak

Cilj ovog rada bio je utvrditi postojanje određenih morfoloških razlika između dominantne i nedominantne strane tijela kod vrhunskih juniorskih igrača badmintona. Na uzorku od 85 igrača koji su sudjelovali na seriji europskih juniorskih badminton turnira provedena su neka najosnovnija antropometrijska mjerenja. Uzeto je 12 morfoloških mjera s ciljem dobivanja informacija o osnovnim morfološkim karakteristikama igrača i utvrđivanja odnosa između dominantne i nedominantne strane tijela usporedbom opsega udova na svakoj od strana. Na osnovi dobivenih rezultata utvrđene su značajne (na podlaktici i potkoljenici; p= ,00) i ne značajne (p= ,11) ali vidljive (30.49±16.96 prema 27.51±2.42) razlike (nadlaktica) između opsega udova u korist dominantne strane tijela, a jedina iznimka od tog pravila uočena je na potkoljenici, gdje su veće vrijednosti opsega ostvarene na nedominantnoj strani (36.58±2.58 prema 38.09±12.57). Kako je badminton u svojoj naravi unilateralan sport, igrači su predisponirani razvijanju nekih morfoloških disbalansa, što u konačnici povećava rizik od ozljeda i negativno utječe na igračke performanse. Stoga je u trening mladih igrača preporučljivo uvesti dodatne bilateralne vježbe koje će pozitivno utjecati na simetričan razvoj mladih igrača te na taj način umanjiti moguće negativne efekte koje učestali i intenzivni badminton trening može uzrokovati.

***Ključne riječi**: antropometrija, unilateralnost, dominantna strana, asimetrija.*

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