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THE INFLUENCE OF SOMATOTYPE ON YOUNG TABLE TENNIS PLAYERS' COMPETITIVE SUCCESS

VPLIV SOMATOTIPA NA TEKMOVALNO USPEŠNOST MLADIH IGRALCEV NAMIZNEGA TENISA

ABSTRACT

The main objectives of this research were to determine the somatotype of the best young male Croatian table tennis players using the Carter and Heath (1990) method and to establish whether the subjects classified in three groups of physique, according to similarities in their somatotype component values, differ in terms of their age, years of training, and especially competitive success.

The results reveal the predominance of the mesomorphic somatotype component, which is evident and emphasised in almost half the subjects. The ectomorphic somatotype component is also significant since it was established as a dominant component of more than one-third of the subjects while, as expected, the least dominant component is the endomorphic component.

The results of an analysis of variance reveal that the subjects in each group dominated by a different somatotype component are the same age and possess the same playing experience, and that the groups do not differ in their competitive success. It is thus possible to conclude that the somatotype of players at this age is not a crucial factor in achieving competitive success in table tennis.

The predominance of a physique dominated by the mesomorphic and ectomorphic somatotype components only reveals the potential advantage of these body constitution types, one that increases the probability of success but is not a factor that directly influences the competitive success of young table tennis players.

Key words: anthropometry, racket sports, table tennis, athletes, success

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IZVLEČEK

Glavna cilja raziskave sta bila opredeliti somatotip najboljših mladih hrvaških igralcev namiznega tenisa s pomočjo metode Carterja in Heatha (1990) ter ugotoviti, ali se merjenci, ki so bili glede na telesne značilnosti oz. podobne vrednosti komponent somatotipa razdeljeni v tri skupine, med seboj razlikujejo glede na starost, staž treniranja in zlasti tekmovalni uspeh.

Rezultati so pokazali prevlado mezomorfne komponente somatotipa, ki je očitna in poudarjena pri skoraj polovici merjencev. Ektomorfna komponenta somatotipa je tudi pomembna, saj je prevladovala pri več kot tretjini merjencev, medtem ko je bila endomorfna komponenta v skladu s pričakovanji najmanj izstopajoča.

Rezultati analize variance so pokazali, da so merjenci v vsaki skupini, v kateri je prevladala ena od komponent somatotipa, enake starosti in z enakimi igralskimi izkušnjami ter da se skupine ne razlikujejo med seboj glede na tekmovalni uspeh. Tako lahko zaključimo, da somatotip igralca pri teh letih ni glavni dejavnik doseganja tekmovalne uspešnosti v namiznem tenisu.

Prevladujoč odstotek merjencev s telesno konstitucijo, za katero sta najznačilnejši mezomorfna in ektomorfna komponenta somatotipa, samo nakazuje potencialno prednost tega tipa telesne konstitucije, ki lahko poveča možnosti za uspeh, vendar ni dejavnik, ki bi neposredno vplival na tekmovalno uspešnost mladih namiznoteniških igralcev.

Ključne besede: antropometrija, igre z loparji, namizni tenis, igralci, uspeh

INTRODUCTION

There is a long tradition in sports sciences of researching physiques and determining somatotypes. Attempts to categorise and describe human beings according to different somatotypes date back to Hippocrates and throughout history many have attempted to establish the connection between somatotypes and different anthropological determinants. Today, the most frequently used model for determining somatotypes is the Heath and Carter method (1967) that was developed on the basis of Sheldon's type classification (1940). This method uses 10 anthropometrical measurements to establish the value characteristics of the three somatotype components; *endomorphy* (a high degree of subcutaneous fat tissue), *mesomorphy* (a highly developed musculoskeletal system) and *ectomorphy* (the linearity of the body is emphasised).

Since 1940 numerous studies of body composition have influenced the development of somatotyping (Carter & Heath, 1990) and, in the last 20 years, many studies have defined the somatotype profile of athletes in different sport disciplines (Orvanova, 1990; Charjewski, 1991; Claessens et al. 1991; Leake & Carter, 1991; Gualdi-Russo & Graziani, 1993; Hawes & Sovak, 1994; Travill, 1995) and games (Popichev, 1992; Casagrande & Viviani, 1993; Viviani, 1994; Carter, Ackland, Kerr & Stapff, 2005; Bayios et al., 2006; Čanaki, Sporiš & Leko, 2006; Malousaris et al., 2008; Pradas et al. 2007; Pradas et al. 2009; Carrasco, Pradas & Martinez, 2010).

According to Carter (1984), successful athletes competing in different sports within different competitive classes show similarities (which become more and more evident in higher competitive classes) in their body dimension and body constitution, although this similarity varies greatly among sports.

Within specific sports, sport disciplines or playing positions in team sport games, it is evident that an almost identical somatotype profile dominates, characterised by certain anthropometric features that are crucial or at least extremely important for achieving top competitive results. At the same time, this similarity in physique is less common among some other sports, that is, an athlete's morphological constitution does not play such an important role in achieving good competitive results. Table tennis is an acyclic sport in which playing time and rest time periods alternate continuously. The players' most important physical capacities are endurance and velocity. Although it is clear that physical preparation is an important factor in reaching the top, several studies have demonstrated that, at the same training level, the best performances are achieved by players with more compatible anatomic conditions (Faccini et al., 1989; Yu Zhang et al., 2010).

Many authors have attempted to establish the connection between somatotypes and competitive success or performance levels in different sports (Siders, 1993; Sullivan, 1994; Gualdi-Russo & Zaccagni, 2001; Slater et al., 2005; Sanchez-Munoz, Sanz & Zabala, 2007; de Hojo, Sanudo & Paris, 2009), and it would be interesting to establish whether and to what extent the different somatotypes themselves affect the competitive success of juvenile table tennis players and to determine the importance of physique in achieving good competitive results in table tennis (Carrasco, Pradas & Martinez, 2010; Pradas, Carrasco, Martinez & Herrero, 2007; Pradas et al., 2009).

The **main objectives** of this research are to determine the somatotype of the best young Croatian table tennis players (young cadets and cadets), to establish whether a certain somatotype is dominant in this age group and to establish whether the subjects, who are classified in three types

of physique according to similarities in their somatotype component values, differ in terms of their age, years of training, or competitive success.

METHODS

Sample of cases

The participant sample included 62 male table tennis players participating in the Croatian national championship for young cadets and cadets in the 2007/2008 season. The Croatian national championship is a closed competition; that is, competitors have to earn the right to be invited through regional qualifications or by being placed within the top 16 on the national ranking list. Accordingly, all of them are high-level players within their age group (YC, C; age10-14), can be found on the CTTA (Croatian Table Tennis Association) ranking lists for the 2007/2008 season, and have been playing for 3 to 8.5 years. The study was approved by the Ethics Committee of the Croatian Table Tennis Association.

Sample of variables

We employed the Carter and Heath method (1990). The anthropometric measurements needed to determine somatotype using this method are as follows:

1. *body height (cm)*
2. *knee diameter (femur breadth) (cm)*
3. *elbow diameter (humerus breadth) (cm)*
4. *body mass (kg)*
5. *lower leg span in a standing posture (calf girth) (cm)*
6. *upper arm span during flexion and contraction (biceps girth-tensed) (cm)*
7. *upper arm skinfold (triceps skinfold) (cm)*
8. *skinfold of the back (subscapular skinfold) (cm)*
9. *abdominal skinfold (suprailiac skinfold) (cm)*
10. *lower leg skinfold (calf skinfold) (cm)*

All of these variables are described in detail in Carter and Heath (1990).

For each measurement, the whole measuring procedure was repeated three times so as to produce a measuring instrument of a composite type.

On the basis of the 10 anthropometric measurements, three variables describing individual somatotype component values were selected from the sample of variables:

- endomorphic somatotype component
- mesomorphic somatotype component
- ectomorphic somatotype component

The following variables were selected as **criteria variables:**

- age of the participants
- years of training
- competitive success – based on points won and registered on the CTTA ranking lists for each category (cadets and young cadets) for the 2007/2008 season

Procedure

The anthropometric measurements were conducted during the Croatian national championship for young cadets and cadets held at Dugo Selo in April 2008 and were performed by the same experienced researcher.

The data obtained using anthropometric measurements were entered into the "Somatotype" computer program (Sweat Technologies) which calculates the somatotype using the 10 anthropometric measurements and is based on the Carter and Heath method (1990). Numerical values obtained on the basis of the 10 anthropometrical measurements using this program determine the level of correspondence with a certain somatotype component (endomorphic, mesomorphic, ectomorphic) for each subject individually, using the numbers 1-7 in such a way that an extreme endomorph would be defined as somatotype 7-1-1, an extreme mesomorph 1-7-1, and an extreme ectomorph 1-1-7. The majority of subjects do not belong to any of the extreme somatotypes; in fact, they possess a mixture of mild characteristics belonging to all of these somatotypes. Each mixture is individual and determines the somatotype of a specific subject. The "Somatotype" computer program recognises different combinations of the individual components of a somatotype and places subjects in different groups and sub-groups depending on the influence of each component.
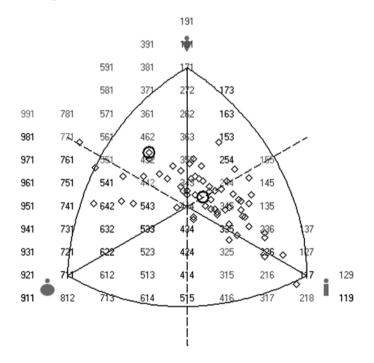

Figure1: Graphic display of somatochart values for each subject

Data Analysis

The numerical values obtained for each of the three somatotype components (endomorphic, mesomorphic, ectomorphic) by the "Somatotype" computer program and the results of the three criteria variables were processed using the statistical package Statistics 7 (StatSoft, USA).

Basic descriptive statistical parameters and distribution normalities were calculated for each variable.

The participants were classified in three groups using a taxonomic analysis: the K- means method (by selecting the three clusters) according to similarities in their physique based on the somatotype component values. Differences between the three groups based on the criteria variables were determined using an analysis of variance (breakdown & one-way).

RESULTS

The aim of this study was to determine the influence of somatotype on the competitive success of young table tennis players. Although we do not have clear information on the influence of anthropometric characteristics on table tennis performance, it seems obvious that a mesomorphic predominance can play a decisive role in any sport, including table tennis (Pradas et al., 2007). The basic descriptive statistical parameters show the results are normally distributed (K-S test) for all the variables and that an average subject (table tennis player) is almost 13 years old, has been playing table tennis for more than 5 years, and that the average values of the mesomorphic and ectomorphic somatotype components predominate over the values of the endomorphic component (Table 1).

Table 1: Basic descriptive and distribution statistical parameters for all variables for all subjects

	Mean	N	SD	Min.	Max.	max D	K-S
Endomorphic component	2.82	62	1.19	1.3	6.2	0.171	p < .10
Mesomorphic component	3.65	62	0.91	1.3	6.3	0.063	p > .20
Ectomorphic component	3.54	62	1.25	0.8	7.4	0.081	p > .20
Age	12.83	62	1.7	10.07	14.9	0.124	p > .20
Years of training	5.23	62	1.53	3.00	8.5	0.171	p < .10
Competitive success points	535.12	62	450.35	2.1	1580	0.135	p > .20

Limit max D = 0.175

Based on the numerical values calculated for each somatotype component, the subjects were classified in three different physique groups *(using a taxonomic analysis – the K-means method – by selecting three clusters)* established on the somatotype similarities *(Table 2)*.

Table 2: The division of subjects into three physique groups *(Predominant endomorphs, Predominant mesomorphs and Predominant ectomorphs)*

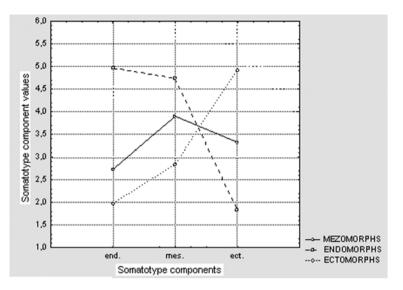| *Groups*	Predominant ENDOMORPHS group (n=10)		Predominant MESOMORPHS group (n=30)		Predominant ECTOMORPHS group (n=22)		ANOVA	
Components	Mean	SD	Mean	SD	Mean	SD	F	p
Endomorph comp. values	4.96	0.94	2.73	0.66	1.98	0.41	74.56	**0.000**
Mesomorph comp. values	4.74	0.69	3.90	0.57	2.84	0.66	36.30	**0.000**
Ectomorph comp. values	1.83	0.60	3.32	0.41	4.90	0.87	85.56	**0.000**

Figure 2: Graphic display of somatotype component values for each of the three basic physique groups

According to the results gained using the taxonomic analysis *(Tables 2 and 3),* the majority of subjects (48.39%) belong to the group *(Predominant mesomorphs)* dominated by the **mesomorphic somatotype component.**

Table 3: The frequencies (F) and percentage (%) of subjects belonging to each particular physique group dominated by individual somatotype components

Groups	F	%
Predominant ENDOMORPHS	10	16.13
Predominant MESOMORPHS	30	48.39
Predominant ECTOMORPHS	22	35.48
TOTAL	62	100.00

A little over one-third of the subjects (35.48%) form the second group (Predominant ectomorphs) consisting of 22 players dominated by the **ectomorphic somatotype component.**

The third group *(Predominant endomorphs)* is the smallest (16.3%) and comprises 10 subjects with an accentuated influence of the **endomorph somatotype component** but also a highly emphasised mesomorphic component.

The results obtained by the analysis of variance (breakdown & one-way) reveal a lack of significant differences for each of the criteria variables among the three individual physique groups dominated by a specific somatotype component. This can be confirmed by looking at the descriptive statistical parameters (Table 4).

Table 4: Descriptive statistical parameters for each of the three physique groups, with a variance analysis to determine the significance of differences between the groups based on the three criteria variables.

	Predominant ENDOMORPHS group (n=10)		Predominant MESOMORPHS group (n=30)		Predominant ECTOMORPHS group (n=22)		ANOVA	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	**p**
Age	13.24	1.84	13.09	1.44	12.44	1.63	1.573	0.216
Years of training	5.41	1.65	5.90	1.47	4.88	1.41	1.929	0.154
Competitive success points	474.95	413.03	536.58	486.49	578.76	474.25	0.330	0.720

DISCUSSION

The variable sample is based on the 10 anthropometric parameters needed to determine somatotype using the Carter and Heath method (1990). The growth and development differences among participants at this age (the subjects were aged 10-14) are too significant to compare them directly via anthropometric measurements, but when determining the somatotype using the Carter and Heath method the only relevant interrelation is that between the 10 anthropometric measurements and the chronological age of the participants. This fact nullifies the age difference and enables further comparisons. The majority of subjects (48.39%) belong to the group *(Predominant mesomorphs)* dominated by the **mesomorphic somatotype component.** This group (n = 30) is made up of subjects with high numerical values for the mesomorphic component compared to the other two somatotype components *(endomorphic and ectomorphic).* Based on the values of those two less emphasised components, it is possible to further divide the subjects of this group into those dominated by the endomorphic component of the mesomorphic somatotype *(endomorphic mesomorphs),* those dominated by the ectomorphic component *(ectomorphic mesomorphs),* and those with a balance of the two components *(balanced mesomorphs).*

A little over one-third of the subjects (35.48%) form the second group *(Predominant ectomorphs)* consisting of 22 players dominated by the **ectomorphic somatotype component.** The values of the other two components *(endomorphic and mesomorphic)* are much less emphasised and subdivide this group into two ectomorphic subtypes *(mesomorphic ectomorphs and balanced ectomorphs).*

The group with an accentuated influence of the **endomorphic somatotype component** but also a highly emphasised mesomorphic component is characterised by high levels of subcutaneous fat tissue. It includes endomorphs, the majority of whom have an accentuated mesomorphic component (mesomorphic endomorphs), followed by those with a balance of the two components (mesomorphic-endomorphic); there are also a few mesomorphs with an accentuated endomorphic component.

Subjects in all three groups do not differ significantly in their age or in years of training (Table 4); therefore, these two variables were not relevant for differentiating the subjects; their ages are similar and so are their years of training.

These results enable a quality comparison of the subjects based on the third variable – their competitive success – which also reveals the lack of significant differences between the groups as regards the players' competitive success (points won during the competitive season). As a result, it becomes obvious that no kind of somatotype domination has a crucial influence on the competitive success of young table tennis players in this specific age group. Similar results were found by Carrasco et al. (2010) and Pradas et al. (2009). Fleck's (1983) study of body composition data for various groups of elite American athletes concluded that extremely low fat values were not a necessity for success in many sports.

In a structurally complex game such as table tennis, competitive success is primarily a result of the quality and degree of technical and tactical knowledge. Accordingly, the differences in the competitive success of the young table tennis players are mostly the result of differing levels of technical/tactical skills. Those differences are much more salient at this competitive level than among top senior players where a high level of technical/tactical knowledge can be assumed.

Although the existence of suitable morphological features certainly represents an advantage and plays a role in achieving competitive success (especially among top players), in a technically complex game like table tennis it is just one of many factors that influence competitive success. At this age and competitive level, as an integral part of a player's basic anthropological status body constitution is an important yet far from crucial factor in achieving top competitive results.

The predominance of a physique dominated by the mesomorphic and ectomorphic somatotype components only reveals the potential advantage of these types of body constitution in increasing the likelihood of success, but it is not a decisive factor that directly influences competitive success among young table tennis players.

CONCLUSION

The results of this research reveal that none of the three somatotype components is sufficiently dominant to be named the model somatotype for table tennis players in this specific age group, but the predominance of a physique dominated by the mesomorphic somatotype component among these top young Croatian table tennis players (young cadets and cadets) is evident in almost half the subjects. The influence of a physique dominated by the ectomorphic somatotype component is also significant since it emerged as the dominant somatotype in more than one-third of the subjects; as expected, the least dominant type of physique is the one dominated by the endomorphic somatotype component.

The results also show that there are no significant differences among the three groups dominated by different somatotype components, or in terms of the competitive success of the players in each group. Since differences were not established, this leads to the conclusion that, at this age, body constitution is not a crucial factor in achieving top results in table tennis.

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