Coll. Antropol. **38** (2014) 1: 241–245
Original scientific paper

The Relationship of Morphology and Motor Abilities to Specific Table Tennis Tasks in Youngsters

Ivana Nikolić[1], Gordana Furjan-Mandić[2] and Miran Kondrič[3]

[1] University of Zagreb, Faculty of Teacher Education, Zagreb, Croatia
[2] University of Zagreb, Faculty of Kinesiology, Zagreb, Croatia
[3] University of Ljubljana, Faculty of Sport, Ljubljana, Slovenia

A B S T R A C T

The aim of this research was to establish the relationship of certain basic motor abilities and morphological characteristics and efficacy in specific table tennis tasks. The research sample consisted of cadet category table tennis players (N=101; aged 10.52±0.78 years, training experience 2.8±0.93 years). The participants were measured as they performed 24 motor tasks,along with 15 anthropometric measures and 3 specific table tennis tests. Indicators of the relationship between morphological characteristics and motor abilities, coupled with the results of the specific table tennis tests indicate that: a) subcutaneous fatty tissue on the lower extremities significantly limits the test results where movements involving fast changes in direction are required; b)subcutaneous abdominal adipose tissues have a positive influence on tasks demanding controlled and precise alternate bouncing of the ball; c) in general, a positive influence can be seen in the results of specific tests concerning the following motor abilities: arm coordination, agility, explosive arm power, movement frequency speed and repetitive leg power. The test used for a coordination assessment of the whole body revealed a negative influence on the success of performing specific tasks.

Key words: *table tennis, motor abilities, morphology, tests, racquet sports*

Introduction

An important research trend in kinesiology forms part of research which by its subject, aims and methodology belongs to a group that seeks to shed light on relations between indicators of anthropological status and sport success, and to understand relations among sets of variables that belong to various dimensions of basic, specific and situational readiness. Based on the acquired data, aims to be achieved in certain periods and sets of practical training for general and basic physical preparation focused on improving efficacy can be clearly and operationally defined.

Several authors[1–3] have studied the relationship between various anthropological, functional, motor, cognitive, conative, sociological and other dimensions, as well as differently defined variables for success in a particular sport. Such table tennis research[4] states that, between the ages 10 to 14, there is no distinct anthropometric player profile, i.e. the mesomorph somatotype is the most common, then there is ectomorph and finally endomorph which is emphasised among females, and that somatotypes have no influence on how successful a table tennis player is likely to be.

According to Limoochi[5], there is no relationship between the three anthropometric factors of height, weight and body mass index among the 32 top women table tennis players at the Athens 2004 Olympic Games and their world ranking. Research on relations between sets of variables among younger players is conducted in order to effectively identify talent. The same author proves that height and weight are the most important characteristics when identifying talent in table tennis, whereas preliminary research[6] has shown that motor ability »speed while dribbling«, »aiming at a target«, »ball skills« and »eye-hand coordination« seem promising ways to discrimi-

Received for publication September 20, 2013

nate between talented and less talented young players. However, Schmidt and Wrisberg[7] claim that practitioners should avoid making predictions about an individual's future performance during their initial practice for the following reasons: a) the patterns of abilities required for a successful performance change with practice; therefore, individuals who do well early in practice may not be those who do well later; and b) even when the majority of relevant abilities are known, it may be difficult to measure them accurately.

The practitioner can design a learning experience that allows individuals to capitalise on their stronger abilities and practise activities to compensate for their weaker abilities. Many table tennis experts[8–10] have pointed out that motor skills and physical fitness are important traits in table tennis. From the aspect of the individual motor abilities required, one can assert that table tennis demands a balance of coordination, precision, agility, balance, strength, speed and flexibility. In terms of the shot learning technique, coordination is definitely the most important since its influence grows with the complexity of motor activities[11].

Coordination abilities are mainly expressed in situations when a previously learned motor stereotype movement cannot be relied on. This has a great significance in table tennis since it involves fast exchanges of shots, anticipation, a choice, a decision and another shot so a player only has a short amount of time to choose the appropriate type of shot and execute it at the exact time in relation to the ball (timing of the shot).

The aim of this research was to determine which motor abilities and morphological characteristics influence the results of specific table tennis tests of table tennis players who have been involved in the practical training process for at least two years.

Methods

The sample of subjects consisted of 101 table tennis players (61 male and 40 female), aged 10.52±0.78 years, training experience 2.8±0.93 years. The measurements took place at ten table tennis clubs in the north-west region of Croatia. The project was introduced to all the players and their parents and they all voluntarily took part in the research.

The set of variables for assessing morphological characteristics encompassed 15 standard anthropometric variables that were measured according to the International Biological Programme (IBP) which represents a unique measuring methodology[12]. All of the anthropometric measurements were taken by a single measurer.

A set of standard motor measuring instruments[13] was chosen to assess the subjects' basic motor abilities. Twenty-four motor tests were used. Based on previous research, it was assumed that those tests cover the area of latent abilities that depend on moving regulation and also those that depend on energetic regulation[14].

The sample of criteria variables present the results the subjects attained in three specific tests to assess basic table tennis elements[14]. The tests applied were: ball balance on the racquet (BALLR), alternate shots using forehand and backhand strokes (ODBLR), and dribbling of the ball using a racquet (VODLR). Regression analyses were conducted in SPSS. Considering the minimal ratio of subjects and variables[15], a corrected determinacy coefficient was used as an explained variance indicator.

Results

The results of a regression analysis of predictor sets and all three criteria variables showed a significant statistical relationship.

The final model (Table 1) explains 29% of the variance in the results. Bearing age in mind, the largest influence on the result of ball balance on the racquet (BALLR) was exerted by the side to side agility test (BETA=–0.372; t=–3.37; p=0.001). Running in alternate directions had approximately the same influence (BETA=0.373; t=3.31; p=0.001), while juggling with matches and skinfold shank had a slightly smaller influence on the explanation of the criteria. The negative algebraic sign of certain coefficients suggests inverse relations of the mentioned variables.

TABLE 1
RELATIONSHIP OF MORPHOLOGICAL AND MOTOR VARIABLES TO THE TEST BALL BALANCE ON THE RACQUET (BALLR)

$R=0.57$; $R^2=0.328$; Adj. $R^2=0.292$ $F(5.93)=9.088$;$p=0.00$; SEE=0.945 D-W=1.858	B	SE	Beta	t	p
(Constant)	14.00	1.694		8.269	0.000
Age	–0.374	0.233	–0.167	–1.609	0.111
Side to side agility	–0.112	0.033	–0.372	–3.372	0.001
Running in alternate directions	0.344	0.104	0.373	3.308	0.001
Juggling with matches	–0.045	0.017	–0.297	–2.609	0.011
Skinfold shank	0.025	0.012	0.189	2.081	0.040

R – multiple correlation; R^2 – coefficient of determination; Adj. R^2 – adjusted coefficient of determination; F – value of F-test; p – value of significance threshold of F-test; SEE – standard error of estimation; D-W – Durbin-Watson coefficient; BETA – partial standard coefficient of regression; SE. BETA – standard error of partial coefficient of regression; t – degree of freedom; p – significance level

Based on seven independent variables (Table 2), the final model explains 59% of the variance in the results. The biggest partial influence on the criteria variable alternate shots using forehand and backhand strokes came from the variables juggling with matches (BETA=0.317; t=3.739; p=0.000), arm plate tapping (BETA=0.285; t=3.419; p=0.001) and running around parallel racks (BETA=–0.287; t=–3.405; p=0.001). The boomerang, squats in 30 seconds, hip extension using both legs while laying face up and skinfold abdomen tests also contribute to the prediction, although their influence is slightly smaller.

The predictor set (Table 3) explains 28% of the variance in the results for dribbling of the ball using a racquet and juggling with matches (BETA=–0.400; t=–4,028; p=0.000) and medicine ball throw (BETA=–0.317; t= –3.143; p=0.002).

Discussion and Conclusion

The results of the regression analyses show various contributions of morphological and motor variables to the specific test results. Thus, a significant influence of arm coordination is noted in specific tests whose aim is to rapidly carry out motor tasks with ball and racquet control. It has been argued that ball-control skills hold practical applications in a game situation because they develop the proper racquet control and hand-to-eye coordination needed to effectively perform table tennis strokes[16]. This suggests that oculomotor coordination is particularly significant in the process of learning basic table tennis techniques because it helps a player properly position the racquet as well as control their arm velocity and the direction of the hit[10].

The efficacy of the ball balance on the racquet test is considerably conditioned by footwork, especially when there are rapid changes in direction over short distances, which is confirmed by the positive influence of the side to side agility and running in alternate directions tests (Table 1). In table tennis, agility means a type of footwork which enables a player to rapidly position their body for a particular stroke. Movements around the table are even more complex and consist of five types based on the technique executed: one step, chasse, slide step, crossover and pivot[17] and thus preparing for changes in direction, speed and agility must involve highly specific training

TABLE 2
RELATIONSHIP OF MORPHOLOGICAL AND MOTOR VARIABLES TO THE TESTS ALTERNATE SHOTS USING FOREHAND AND BACKHAND STROKES (ODBLR)

$R=0.79$; $R^2=0.619$; $Adj.R^2=0.586$ $F(8.91)=18.516$; p=0.00; SEE=4.928 D-W=1.926	B	SE	Beta	t	p
(Constant)	–2.190	10.35		–0.212	0.833
Age	1.809	1.189	0.118	1.522	0.131
Juggling with matches	0.328	0.088	0.317	3.739	0.000
parArm plate tapping	0.586	0.171	0.285	3.419	0.001
Running around parallel racks	–2.043	0.600	–0.278	–3.405	0.001
Boomerang test	0.437	0.229	0.148	1.909	0.053
Squats in 30 seconds	0.308	0.108	0.191	2.846	0.005
Hip extension using both legs while lying face up	0.058	0.031	0.124	1.860	0.066
Skinfold abdomen	0.111	0.050	0.170	2.210	0.030

R – multiple correlation; R^2 – coefficient of determination; Adj. R^2 – adjusted coefficient of determination; F – value of F-test; p – value of significance threshold of F-test; SEE – standard error of estimation; D-W – Durbin-Watson coefficient; BETA – partial standard coefficient of regression; SE. BETA – standard error of partial coefficient of regression; t – degree of freedom; p – significance level

TABLE 3
RELATIONSHIP OF MORPHOLOGICAL AND MOTOR VARIABLES TO THE TEST DRIBBLING OF THE BALL USING A RACQUET (VODLR)

$R=.550$; $R^2=0.303$; $Adj.R^2=0.281$ $F(3.96)=13.90$; p=0.00; SEE=1.751 D-W=1.781	B	SE	Beta	t	p
(Constant)	13.543	0.846		15.999	0.000
Age	0.141	0.429	0.034	0.328	0.744
Juggling with matches	–0.113	0.029	–0.400	–4.028	0.000
Medicine ball throw	–0.005	0.002	–0.317	–3.143	0.002

R – multiple correlation; R^2 – coefficient of determination; Adj. R^2 – adjusted coefficient of determination; F – value of F-test; p – value of significance threshold of F-test; SEE – standard error of estimation; D-W – Durbin-Watson coefficient; BETA – partial standard coefficient of regression; SE. BETA – standard error of partial coefficient of regression; t – degree of freedom; p – significance level

that recognises the specific demands of the sport[18], especially in pre-puberty because speed tasks (e.g. running speed and agility) attain maximal gain before the peak height velocity is reached[19]. The results showed that larger quantities of subcutaneous fatty tissue positioned on the lower extremities act as a restrictive factor when performing rapid changes in direction. It is known that body mass may be an aggravating factor in the speed at which a change in direction takes place since a table tennis player needs to overcome their inertial characteristic. They have to produce a rapid increase in work effort to get started, as well as reduce the moment of inertia of the body in the deceleration phase. Accordingly, one could say that a fatter player will have a greater mass of excess fatty tissue (not lean body mass) and inertia, thereby requiring greater force production per unit of lean mass to produce a given change in velocity or direction[20].

The relationship between the juggling with matches and alternate shots using forehand and backhand strokes tests (Table 2) is logical since both tasks consist of finely structured movements of the upper extremities, with minimal variations of body movement. Task completion demands rapid successive hand movements that seem the same from the motor structure aspect. However, they demand a change, i.e. the regulation of effector musculature tonus. A significant relationship between the arm plate tapping test results and the efficacy of performing this specific test, in which efficacy depends on the ability to consciously control the upper extremities' alternative muscle innervation, can be equally explained. Due to high sensitivity of this activity, i.e. even small deviations from an ideal movement trajectory can significantly disrupt the course of action, corrections are necessary and their efficacy chiefly depends on a fast analysis in the perceptive area and quick motor reactions.

The relationship with the running around parallel racks test can be interpreted in a similar way. The good result in the squats in 30 seconds test represents a significant positive contribution to the alternate shots using forehand and backhand strokes test results. The most intense strain in this motor task is on the leg muscles, specifically the »quadriceps femoris muscle« of the femur which is the most important muscle in the kinetic chain of each stroke in table tennis. It can be assumed that the movement efficacy of a table tennis player in points that last longer depends significantly on repetitive leg strength. Interestingly, the values of the abdomen skinfold variable showed that subjects with more abdomen fatty tissue would achieve better results in the alternate strokes test. The obtained values can be interpreted using the results of previous research[3] which suggest that adipose, voluminous and burly persons will still achieve better results in motor activities that call for a fine and sensitive tonus movement regulation because the kinetic programmes that need to be carried out with precise but rapid hand movements require the rest of the body, especially the torso, to be stable. They also require a synchronised relaxation of the antagonistic musculature.

The results of the juggling with matches test contributed to the success of the dribbling of the ball using a racquet test (Table 3), which means that the success of this task also depends on the ability of a fine movement structure of the upper extremities and the medicine ball throw. The relationship in the explosive component can be found in the activation of the fist in the final phase of the medicine ball throw test. Although each stroke in table tennis is a kinetic chain in which the initial impulse comes from the leg muscles, then the torso, the shoulders, the upper arm, the lower arm and finally the wrist, there is an exception in situations with smaller spaces and less time at hand so the impulse only comes from the lower arm and the fist[21–23].

To sum up the results of the specific tests in the area of morphological characteristics and motor abilities, the following conclusions can be drawn: a) subcutaneous lower extremities fatty tissue indicators significantly limit achievement in tests which consist of rapid changes in direction; b) subcutaneous abdomen fatty tissue has a positive influence on the task which demands controlled and precise alternate bouncing of the ball; c) in general, a positive influence can be seen in the results of specific tests regarding the following motor abilities: arm coordination, agility, explosive arm power, movement frequency speed and repetitive leg power; d) the boomerang test, which evaluates whole body coordination, revealed a negative influence on the results in all specific tests, and should not be conducted during training practice; e) arm coordination assessment tests (juggling with matches), agility tests (side to side agility, running in alternate directions, running around parallel racks), explosive power test (medicine ball throw), frequency speed test (arm plate tapping) and repetitive power test (squats in 30 seconds) proved to be significant and can be conducted during efficacy control of the training process.

REFERENCES

1. KATIĆ R, BLAŽEVIĆ S, KRSTULOVIĆ S, MULIĆ R, Coll Antropol, 29 (2005) 79. — 2. SRHOJ V, ROGULJ V, ZAGORAC N, KATIĆ R, Coll Antropol, 30 (2006) 601. — 3. GRGANTOV Z, NEDOVIĆ D, KATIĆ R, Coll Antropol, 31 (2007) 267. — 4. MUNIVRANA G, PAUŠIĆ J, KONDRIČ M, Kinesiologia Slovenica, 17 (2011) 42. — 5. LIMOOCHI S, The effects of some anthropometrics elements on the world ranking of 32 top women table tennis players in Athens 2004 Olympic Games. In Proceedings (The 10th Anniversary ITTF Sports Science Congress, Zagreb, 2007). — 6. FABER I, OOSTERVELD F, NIJHIUS VAN DER SANDEN R, A first step to an evidence-based talent identification program in the Netherlands; a research proposal. In Proceedings(The 12th ITTF Sport Science Congress, Rotterdam, 2011). — 7. SCHMIDT RA, WRISBERG CA, Motor Learning and Performance (2nd Edition Champaign, IL: Human Kinetics, 2004). — 8. BANKOSZ Z, Human movement, 13 (2012) 16. — 9. LEES A, Journal of Sport Sciences, 21 (2003) 707. — 10. RODRIGUES ST, VICKERS JN, WILLIAMS AM, Journal of Sport Science, 20 (2002) 187. — 11. KONDRIČ M, HUDETZ R, FURJAN-MANDIĆ G, The Basics of Table Tennis (Faculty of Kinesiology University of Zagreb, Zagreb, 2010). — 12. WEINER JS, LOURIE JA, Human biology. A Guide to Field Methods (Burgers and Son, London, 1969). — 13. METIKOŠ D, PROT F, HOFMAN E,

PINTAR Ž, OREB G, Measurement of basic motor characteristics of athletes. In Croatian (Faculty of Kinesiology, Zagreb, 1989). — 14. KONDRIČ M, A Test Bank for Basic and Specialized Table Tennis Motorics and Morphology (Faculty of Sport, Ljubljana, 1995). — 15. GREEN SB, Multivariate Behavioral Research, 26 (1991) 499. — 16. TORIOLA A, TORIOLA O, Perceptual and Motor Skills, 98 (2004) 584. — 17. MALAGOLI LANZONI I, LOBIETTI R, MERNI F, Footwork techniques used in table tennis: a qualitative analysis. In Proceedings (The 10th Anniversary ITTF Sports Science Congress, Zagreb, Faculty of Kinesiology University of Zagreb, 2007). — 18. SHEPPARD JM, YOUNG WB, Journal of Sport Sciences, 24 (2006) 919. — 19. BEUNEN GP, MALINA RM, Exercise and Sport Sciences Reviews, 16 (1988) 503. — 20. ENOKA R, Neuromechanics of human movement (Champaign, IL: Human Kinetics, 2002). — 21. HUDETZR, Technique with Vladimir Samsonov (Huno Sport, Zagreb, 2000). — 22. KONDRIČ M, MATKOVIĆ B, FURJAN MANDIĆ G, HADŽIĆ V, DERVIŠEVIĆ E, Coll Antropol, 35 (2011) 413. — 23. KONDRIČ M, ULJEVIĆ O, GABRILO G, KONTIĆ D, SEKULIĆ D, Journal of Human Kinetics, 32 (2012) 157.

I. Nikolić

University of Zagreb, Faculty of Teacher Education, Savska 77, 10 000 Zagreb, Croatia
e-mail: ivana.nikolic@ufzg.hr

POVEZANOST MORFOLOŠKIH I MOTORIČKIH OBILJEŽJA SA SPECIFIČNIM STOLNOTENISKIM TESTOVIMA U MLAĐIM KATEGORIJAMA

S A Ž E T A K

Cilj istraživanja bio je utvrđivanje povezanosti između nekih bazičnih motoričkih sposobnosti, morfoloških obilježja i uspješnosti u specifičnim testovima u stolnom tenisu. Uzorak su sačinjavali stolnotenisači (N=101) kadetske kategorije, (prosječne dobi 10,52±0,78 godina i trenažnog iskustva 2,8±0,93 godine). Ispitanici bili su izmjereni sa 24 bazična motorička testa i 15 standardnih antropometrijskih mjera te 3 specifična testa iz stolnog tenisa. Pokazatelji relacija između morfoloških i motoričkih obilježja, i rezultata u specifičnim testovima ukazuju da: a) potkožno masno tkivo na donjim ekstremitetima značajno limitira rezultatska dostignuća u testovima kod kojih su izražene brze promjene smjera kretanja; b) potkožno masno tkivo na trbuhu pozitivno utječe na zadatak koji zahtijeva kontrolirano i precizno naizmjenično odbijanje loptice; c) generalno se može uočiti pozitivan utjecaj na rezultate u specifičnim testovima, u slijedećim motoričkim sposobnostima: koordinacija ruku, agilnost, eksplozivna snaga ruku, brzina frekvencije pokreta i repetitivna snaga nogu. Negativan utjecaj na uspješnost izvođenja specifičnih testova pokazao je test za procjenu koordinacije cijelog tijela.