STRUCTURE OF BIO MOTOR ABILITIES OF TABLE TENNIS PLAYERS IN THE REPUBLIC OF MACEDONIA WHO COMPETE IN THE SUPER LEAGUE AND FIRST LEAGUE

(Research note)

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Abstract

The research is conducted on 54 table tennis players who compete in the Super League and the First League of Macedonia during the competition season 2008/2009. 12 bio motor variables were applied, 4 of which (MPT30, MSKDM, MDPKL, MTLRA) were measured following the recommendations of Kurelić et al., (1975). Due to the research objective (determining asymmetry) MTDRA variable is measured by the same methodology as MTLRA while variables: MPONA, MCHEST, MONLS and MONDS are measured according to the recommendations of Metikoš, Prot, Hoffman, Pintar, Oreb (1989). Variables MDLRA and MDDRA are measured using mechanical dynamometer type "Tideman" with accuracy of 1.14 kg. In order to determine the structure of the bio motor abilities, the factor analysis component is applied. From the results analysis, in the latent bio motor space, three latent factors are obtained: factor of coordination, i.e. the factor responsible for rapid assessment of the method and direction of movement, speed of movement in an unusual way, a quick change of direction of movement, simultaneously responsible for the efficiency of the explosive strength of leg muscles as well as the flexibility of the body. The second factor is defined as a factor of strength of the muscles on the left and right hand and the repetitive strength of the belly muscles, while the third factor is defined as the speed factor, incorporating the speed of frequency movements of the hands and legs.

Keywords: *inter correlation coefficients, factor analysis, general bio motor factor, varimax factor, coordination factor, factor of strength muscles, factor of speed*

INTRODUCTION

Table tennis is a sport that is played individually and in pairs, and belongs to the group of poly-structural sports with variable structure where automation of movements reaches up to 40%. The game itself and the activity of the players is determined by: the space of the game, the speed of flight of the ball, speed of the strokes movement and the required response time. The game development, in parallel with the equipment development, have contributed to the present situation in the contemporary table tennis where the players exchange strokes where the ball reaches the speed of 140 km / h, while the speed of the hand paddle is about 60/70 km / h, while during the impact/ hit with rotation (spin) - the ball spins around its axis 170 times per second, or more than 10000 turns per minute.

During the hit/ impact, the ball is kept in the paddle only 1/1000 second, and the distance spend together is from 0.2 to 1 cm. When all this adds to the energy requirements, particularly where maximum aerobic capacity is important, undoubtedly table tennis is placed in the category of difficult sports with complex structure. The success of the game depends on many factors, including the bio motor abilities. Analyzing and exploring the

structure of bio motor abilities and dimensions at table tennis players along with other factors and features, can greatly contribute to the development and improvement of the table tennis play in the direction of achieving top sports scores. Therefore, as the aim of this and many other studies are the bio motor abilities, as in the manifest, so as in the latent space.

METHODS

In this research, the sample of respondents is comprised of 54 active table tennis players (male) who with their teams compete in the Super League and First league in the Republic of Macedonia during the competition season 2008 / 09 The respondents are members of teams: TTC Rabotnicki, TTC Vlae- Farmahem, TTC Vardar, TTC Floraskop and TTC Gorce Petrov from Skopje, TTC Kriva Palanka and TTC Kriva Palanka 2007 from Kriva Palanka, TTC Bregalnica and TTC Filip Vtori from Shtip, TTC Strumica from Strumica, TTC Mladost and TTC Mladost 96 from Prilep and TTC Ohrid from Ohrid. Age is defined as chronological age with the age range from 17 to 37 years.

The age range in this study is determined by the actual state of active competitors in our country. 12 bio mo-

tor variables were applied, 4 of which (MPT30, MSK-DM, MDPKL, MTLRA) were measured following the recommendations of Kurelič, Momirovič, Stojanovič, Šturm, Radojevič, Viskič - Štalec (1975). Due to the research objective (determining asymmetry) MTDRA variable is measured by the same methodology as MTL-RA while variables: MPONA, MCHEST, MONLS and MONDS are measured according to the recommendations of Metikoš, Prot, Hoffman, Pintar, Oreb (1989). Variables MDLRA and MDDRA are measured using mechanical dynamometer type Tideman with accuracy of 1.14 kg.

Measurements were carried, during the break between fall and spring competition season in the sports halls where the clubs train. They are realized in one day per table tennis club, with pre-determined program that was identical for all clubs where the order of realization of bio motor tests is set according to their weight and complexity, and in order to neutralize the tiredness of the respondents. All members of the team that performed the measurements are graduated professors of Physical Education, who were previously guided and trained regarding the methodology of measuring necessary for the bio motor test as well as the evaluation and marking of the results. The same test for all respondents was measured by the same examiner.

For the needs of this research, basic descriptive analysis was applied, whereas the correlation among all the applied bio motor variables is determined with matrix of inter-correlation. The factorization of the inter-correlation matrixes of the bio motor variables is conducted by using Hotelling's method of the main component. The number of the significant main components whose values of the characteristic roots (lambda) possess values which are equal or larger than 1.00 is determined by using the Kaiser- Guttman criteria. The transformation into orthogonal factors is determined by applying the normal- varimax method.

RESULTS AND DISCUSSION

The obtained results from the inter-correlation of the bio motor variables, shown in table 1 indicate that from all the obtained coefficients of correlation, 32 results demonstrate the statistical significance on various levels and with various prefixes. The variables for assessment of the repetitive force of the belly muscles (MPT30), assessment of the speed of movement in an unusual way - coordination (MPONA), assessment of the direction and method of movement- coordination (MONDS), assessment of the speed of movement of direction change- coordination (MCEST) and the test for assessment of the speed of frequency movement of the left hand (MTLRA) are characterized with the largest number (with 7) significant statistical correlation connections on the level of R< 0.05 with various prefix. The variable for rapid assessment of the method and direction of movement- coordination (MONLS) has six significant statistical correlation connections on the level R< 0 .05 .

The variables for estimation of the explosive strength of leg muscles (MSKDM) and the variable to assess the strength of the muscles of the right palm (MD-DRA) show four results that are on a significant statistical level (from 31 to 47). With three results above the limit of statistical significance are the variables MDLRA MTDRA (from 27 to 76). The variable for assessing the flexibility of the corpus-MDPKL, there are no results above the limit of statistical significance (from 00 to 23). In the zone of very high correlation is the result of 92 derived between the variables for estimating the speed of change of the direction of movement present in the right and left side (MONDS and MONLS).

When analyzing Table 2, which according to the Hotelling method shows a factor matrix of variables to estimate the bio motor space (facmat), communalities (h2), the significant characteristic roots (lambda) and the percentage of total explained variance (targ%), it is

Table 1. Correlation between the bio motor tests

Variables	MPT30	MCKDM	MDPRA	MDDPA	MPONA	MONLS	MONDS	MCEST	MTLRA	MTDRA	MTNO3	MDPKL
MTP30	1.00											
MCKDM	.25	1.00										
MDLRA	-.41	-.03	1.00									
MDDRA	-.41	-.01	.76	1.00								
MPONA	-.61	-.39	.17	.39	1.00							
MONLS	-.45	-.47	.28	.35	.71	1.00						
MONDS	-.49	-.36	.30	.44	.72	.92	1.00					
MCEST	-.27	-.31	.21	.25	.53	.73	.73	1.00				
MTLRA	.15	.24	.14	-.11	-.27	-.24	-.30	-.26	1.00			
MTDRA	.21	.19	.08	.10	-.12	-.08	-.05	-.28	.57	1.00		
MTNO3	.56	.23	-.26	-.22	-.37	-.38	-.42	-.32	.34	.27	1.00	
MDPKL	.01	.22	.11	.00	-.19	-.26	-.21	-.12	.21	.18	.23	1.00

noted that the applied system of 12 variables has formed three significant main components which explain the total variance percentage by 65.71%.

Table 2. Un-rotated matrix – Hotelling's procedure

Variables	H1	H2	H3	h²
MTP30	.69	-.20	.34	.62
MSKDM	.50	.32	-.26	.42
MDLRA	-.43	.71	-.31	.79
MDDRA	-.54	.62	-.26	.74
MPONA	-.81	.00	.17	.69
MONLS	-.88	.00	.37	.91
MONDS	-.89	.06	.28	.88
MCEST	-.74	-.11	.25	.62
MTLRA	.42	.58	.38	.66
MTDRA	.28	.62	.53	.75
MTNO3	.61	.11	.41	.56
MDPKL	.27	.42	-.13	.27
Lambda	4,66	1,96	1,26	
Cum %	38,86	16,32	10,53	
Lambda	4,66	6,62	7,89	
Cum %	38,86	55,18	65,71	

Of all the major components, most partial participation is present at the first because of the total variability, it explains 38.86% with significant characteristic root lambda = 4.66. The second component in the explanation accounts for 16.32% and lambda = 1.96. Smallest share in explaining the variance has a third component with 10:56% and lambda = 1.26, and such value is close to the zone of acceptance.

From the un-rotated factor matrix of the analyzed bio motor space, it is found that the first main component is a general bio motor factor, where of the 12 applied variables, 10 variables participate in its formation, with saturation ranging from 42 to 88, but with a different prefix, with the exception of the variables MTDRA and MDPKL which have higher projections in the second factor. The MTLRA variable is complex factor due to the higher saturation in the other two components.

Upon the orthogonal varimax rotation of the initial coordinative system of the twelve bio motor variables (Table 3), for the purpose of reaching a simpler structure in the latent space (factors), three factors are also obtained. At the first factor (**V1**), the variables with high saturations are: MONLS (- 92), MONDS (- 87), MCEST (- 75), MPONA (-75) and MCKDM (60). Starting from the structure of the variables which participate in its formation with their projections, the same is defined as the coordination factor, i.e. the factor responsible for rapid assessment of the method and direction of movement, speed of movement in unusual way, rapid change of the movement direction, at the same time responsible for the efficiency of the explosive force of the leg muscles so as the flexibility of the body.

Table 3. Rotated varimax procedure

Variables	V1	V2	V3
MPT30	0,33	-0,64	0,32
MSKDM	0,60	0,11	0,21
MDLRA	-0,04	0,88	0,12
MDDRA	-0,18	0,84	0,06
MPONA	-0,75	0,32	-0,15
MONLS	-0,92	0,26	-0,04
MONDS	-0,87	0,35	-0,07
MCEST	-0,75	0,17	-0,15
MTLRA	0,22	0,03	0,78
MTDRA	0,03	0,06	0,86
MTNO3	0,28	-0,42	0,55
MDPKL	0,37	0,23	0,28
Lambda	3,48	2,46	1,95
Cum %	28,99	20,46	16,26
Lambda	3,48	5,94	7,89
Cum %	28,99	49,45	65,71

On the second factor (**V2**) the following variables maintained significant projections: MDLRA (88), MDDRA (84) and MPT30 (-64). Based on the variables which participate with higher projections during the formation of this factor, the same is defined as the factor of strength of the left and right palm muscles and the repetitive strength of the belly muscles.

On the third factor (**V3**) three variables maintained high projections: MTDRA (86), MTLRA (78) and MTNO3 (55). Starting from the structure of variables from which it is formed, it is defined as the factor of speed, including the speed of frequent movements of the hands and legs. The greater participants in the definition of the bio motor space are the variables MONLS and MONDS with a communality of 0.91 and 0.88, respectively. At the other variables, the projections of their communalities range from 0.62 to 0.79 and the variables with the lowest communalities are: MDPKL, MSKDM, MTN03 with communalities of 0.27, 0.42 and 0.56.

CONCLUSION

In this research in the latent bio motor space, three latent dimensions are obtained. The first factor (V1) is defined as the coordination factor, i.e. the factor responsible for the rapid assessment of the method and direction of movement, speed of movement in unusual way, rapid change of the movement direction, at the same time responsible for the efficiency of the explosive force of the leg muscles as well as the flexibility of the body. The second factor (V2) is defined as the factor of strength of the left and right palm muscles and the repetitive strength of the belly muscles. The third factor (V3) is defined as the factor of speed, including the speed of frequent movements of the hands and legs.

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