DIFFERENCES IN MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES BETWEEN SLOVENIAN AND SERBIAN MALE GYMNASTS

ROZDÍLY MEZI SLOVINSKÝMI A SRBSKÝM GYMNASTY V TĚLESNÝCH PROPORCÍCH, POHYBOVÝCH SCHOPNOSTECH A DOVEDNOSTECH

Miha Marinsek¹, Sasa Velickovic², Edvard Kolar¹

¹ Faculty of Education Maribor, Slovenia, ² Faculty for Sports and Physical Education Nis, Serbia

ABSTRACT

The purpose of this present research was to find out the differences in morphological characteristics and motor abilities between slovenian and serbian gymnasts. We tested 100 male gymnasts from slovenia and serbia who were seven to fourteen years of age and were at the time of testing competing for at least two years. We classified gymnasts into four different age groups according to the competition system. Gymnasts who were 7 years of age (3 from each country), 9 – 10 years of age (20 from each country), 11 – 12 years of age (17 from each country), 13 – 14 years of age (10 from each country). All gymnasts agreed on performing the tests. We found out that statistically significant differences between slovenian and serbian gymnasts exist in 19 out of 35 variables and are mostly in favour of slovenian gymnasts. We think that slovenian gymnasts performed most of the tests better mainly because of the longer tradition of top-level gymnastics. Serbian experts should consider to incorporate expert and research advanced study courses for serbian coaches into their training system.

Key words: gymnastics, morphological characteristics, motor abilities, Slovenia, Serbia

SOUHRN

Cílem studie bylo zjistit rozdíly mezi slovinskými a srbskými gymnasty v tělesném stavbě, v pohybových schopnostech a dovednostech. Testování se zúčastnilo 100 slovinských a srbských gymnastů mužského pohlaví ve věku od sedmi do čtrnácti let, kteří v době měření se nejméně dva roky účastnili soutěží. V souladu se soutěžním systémem byli závodníci rozděleni do čtyř kategorií (kategorie sedmiletých 3 osoby z každé země, kategorie 9 – 10-ti letých 20 osob z každé země, kategorie 11 – 12-ti letých 17 osob z každé země a kategorie 13 – 14-ti letých 10 osob z každé země). Zúčastněnou souhlasili s prováděným měřením. Zjistili jsme statisticky významné rozdíly v 19-ti z 35-ti proměnných, většinou ve prospěch slovinských gymnastů. Domníváme se, že lepší výsledky dosažené slovinskými gymnasty jsou podmíněny hlavně delší tradicí vrcholové gymnastiky v této zemi. Srbskí odborníci by měli zvážit začlenění odborníků a výsledků výzkumu do nadstavbových kurzů srbských trenérů a tím i do jejich tréninkového systému.

Klíčová slova: gymnastika, tělesná stavba, pohybové schopnosti, Slovinsko, Srbsko

For the competitive sport the selection process is highly important. It is important that we select children for the certain sport discipline who have all the necessary predispositions for achieving their competitive goal. Every sport discipline has its own demands in morphologic characteristics, motor, functional and other abilities. For every sport discipline, a perfect type of competitor exists, who can represent the model for selection – the model of a champion. The process of selection in gymnastics is based on assessment of the model's characteristics which are dominant and have a significant influence on gymnast's outcome. Slovenian gymnastics school has developed a battery of tests for young gymnasts which enables a successful assessment of gymnast's perspectiveness. The battery has been developed upon practical knowledge, long lasting observations and
longitudinal studies.

Cuk, Kolar and Piletic (1997) started to develop the project for the new competition system for young slovenian gymnasts. The competition system consists of:
- compulsory exercises for each age group
- assessment of technical knowledge
- assessment of morphological characteristics
- assessment of motor abilities

The gymnasts are divided into four age groups:
- first category from 6 to 8 years
- second category from 9 to 10 years
- third category from 11 to 12 years
- fourth category from 13 to 14 years

The potential efficiency of the gymnast is assessed on the basis of results for the single test (Cuk, Kolar, Crnjac and Piletic, 1997; Crnjac, 1998). The potential efficiency helps coaches with their planning and to compare their gymnasts with others.

The goal of this research is to find differences in morphological characteristics and motor abilities between young slovenian and serbian gymnasts.

Method

Subject
We tested young serbian and slovenian male gymnasts who were seven to fourteen years of age and who were at the time of testing competing for at least two years. The following number of gymnasts was tested: 6 gymnasts 7 years of age (3 from each country), 40 gymnasts 9 – 10 years of age (20 from each country), 34 gymnasts 11 – 12 years of age (17 from each country), 20 gymnasts 13 – 14 years of age (10 from each country). All together we assessed 100 gymnasts (50 from each country).

Slovenian gymnasts represented six different clubs and serbian gymnasts five different clubs in their country. These are all the clubs that are involved in top-level male gymnastics in both countries. Thus our subjects represent characteristics of the whole countries.

Measures
For the assessment of morphological characteristics and motor abilities we used different number of tests for each age group (Table 1).

For the assessment of morphological characteristics we used the following variables:
- ATV – body height
- ATT – body weight
- AKGN – upper arm skin fold

For the assessment of motor abilities we used the following general tests:
- PON – obstacle course backwards
- TAP – hand tapping
- SDM – standing broad jump
- PRE – forward bench fold
- DT – 60-second sit-ups
- VES – bent arm hang

For the assessment of specific motor abilities we used the following specific tests:
- PLEZN – rope climbing 5m with help of the legs (6-8 years)
- PLEZBN – rope climbing 5m without help of the legs (9-14 years)
- OPOKR – support on the rings (6-8 years)
- PREKR – L sit on the rings (9-10 years)
- VAGZ – back lever on the rings (9-10 years)
- VAGS – front lever on the rings (11-14 years)
- NAUTEZ – vertical pull up with bent arms to support on the rings (9-10 years)
- VZN – V sit on parallel bars (9-10 years)
- KOLJU – double leg circles on the mushroom (6-8 years)
- KOLOK – double leg circles in cross-support on the horse without pommels facing to the other end of the horse (9-10 years)
- KOLOR – double leg circles on the pommels (11-12 years)
- CKOL – double leg circles in cross-support on the pommel horse facing away from the pommels (13-14 years)
- STOJAST – handstand with stomach to the wall (6-8 years)
- STOJABR – handstand on the parallel bars (9-10 years)
- STOJ – handstand on the floor (11-12 years)
- STOJKR – handstand on the rings (13-14 years)
- SPIBRA – press to handstand on the parallel bars (9-12 years)
- SPIKR – press to handstand on the rings (13-14)
- SKLEBR – push-ups in support on the parallel bars (6-8 years)

Table 1. Number of tests for each age group (Cuk and Kolar, 1999)
Tabulka 1. Počet testů v každé věkové skupině (Cuk and Kolar, 1999)

| age groupe     | morphological ch. | general tests | special strength | special flexibility |
|---------------|-------------------|---------------|------------------|---------------------|
| first category| 3                 | 5             | 5                | 5                   |
| second category| 3               | 5             | 8                | 5                   |
| third category | 3               | 5             | 8                | 5                   |
| fourth category| 3               | 5             | 7                | 5                   |
Table 2. Descriptive statistics and t test between Slovenian and Serbian gymnasts 6 – 8 years of age

| TEST | COUNTRY | MEAN | STD  | STD ERROR | T VALUE | SIG. T |
|------|---------|------|------|-----------|---------|--------|
| ATV  | Slovenia| 1284.33 | 91.00 | 52.54 | 1.818 | .143 |
|      | Serbia  | 1180.00 | 40.00 | 23.09 |         |        |
| ATT  | Slovenia| 256.67 | 43.39 | 25.05 | 1.74  | .157 |
|      | Serbia  | 203.33 | 30.55 | 17.64 |         |        |
| AKGN | Slovenia| 57.33 | 11.37 | 6.57  | 1.77  | .151 |
|      | Serbia  | 43.33 | 7.57  | 4.37  |         |        |
| PON  | Slovenia| 97.33 | 13.50 | 7.80  | -1.07 | .342 |
|      | Serbia  | 115.33 | 25.58 | 14.77 |         |        |
| TAP  | Slovenia| 27.33 | 2.52  | 1.45  | -1.13 | .900 |
|      | Serbia  | 27.67 | 3.51  | 2.03  |         |        |
| SDM  | Slovenia| 175.33 | 6.11  | 3.53  | 8.58  | .001 |
|      | Serbia  | 143.33 | 2.08  | 1.20  |         |        |
| PRE  | Slovenia| 56.00 | 5.29  | 3.06  | .00   | 1.00 |
|      | Serbia  | 56.00 | 4.58  | 2.65  |         |        |
| DT   | Slovenia| 48.67 | 3.51  | 2.03  | 3.39  | .027 |
|      | Serbia  | 39.00 | 3.46  | 2.00  |         |        |
| VES  | Slovenia| 61.00 | 9.54  | 5.51  | -3.78 | .019 |
|      | Serbia  | 85.67 | 6.03  | 3.48  |         |        |
| PLEZN| Slovenia| 140.33 | 44.81 | 25.87 | .04   | .964 |
|      | Serbia  | 139.00 | 19.08 | 11.02 |         |        |
| OPOKR| Slovenia| 49.33 | 1.15  | .67   | 10.34 | .000 |
|      | Serbia  | 13.67 | 5.86  | 3.38  |         |        |
| KOLJU| Slovenia| 38.33 | 12.01 | 6.94  | 1.60  | .184 |
|      | Serbia  | 19.00 | 17.06 | 9.85  |         |        |
| STOJAST| Slovenia| 100.00 | .00   | .00   | a     | a     |
|      | Serbia  | 100.00 | .00   | .00   |         |        |
| SKLEBR| Slovenia| 20.00 | .00   | .00   | .68   | .532 |
|      | Serbia  | 16.33 | 9.29  | 5.36  |         |        |
| MOST | Slovenia| 98.33 | 10.41 | 6.01  | -2.0  | .851 |
|      | Serbia  | 100.00 | 10.00 | 5.77  |         |        |
| MSP  | Slovenia| 1.00  | 1.00  | .58   | -1.68 | .168 |
|      | Serbia  | 5.00  | 4.00  | 2.31  |         |        |
| ZSPL | Slovenia| .33   | .58   | .33   | -1.48 | .213 |
|      | Serbia  | 4.67  | 5.03  | 2.91  |         |        |
| ZSPD | Slovenia| .67   | 1.15  | .67   | -1.06 | .346 |
|      | Serbia  | 4.00  | 5.29  | 3.06  |         |        |

a… t cannot be computed because the standard deviations of both groups are 0.

From the table 1 we can confirm statistically significant differences between mean values for the test SDM and OPOKR (p<0.01) and for the test DT and VES (p<0.05). Slovenian gymnasts are better in leg power (SDM), statical power of arms and shoulders (OPOKR) and muscular endurance of the torso (DT). Serbian gymnasts are better in muscular endurance of shoulder girdle and arms (VES) (Table 2).

Procedure

All gymnasts agreed on performing the tests and they warmed up before they proceeded to the measurements. They were all assessed on the same day. The execution of the tests was performed according to the predetermined rules (Cuk and Kolar, 1999).

The data were analysed using the SPSS 12.0 statistical package. We calculated the descriptive and comparative statistics.

For the descriptive statistics we used the following measures:
- mean value – MEAN
- standard deviation – STD
- standard error – STD ERROR

For the comparative statistics we used T test for small independent samples:
- value of the T test – T VALUE
- significance of the T test – SIG. T
Table 3. Descriptive statistics and t test between Slovenian and Serbian gymnasts 9 – 10 years of age

| TEST   | COUNTRY  | MEAN   | STD    | STD ERROR | T VALUE | SIG. T |
|--------|----------|--------|--------|-----------|---------|--------|
| ATV    | Slovenia | 1342.20| 55.88  | 12.50     | 1.516   | .138   |
|        | Serbia   | 1317.20| 48.09  | 10.75     |         |        |
| ATT    | Slovenia | 282.00 | 75.75  | 16.94     | -.218   | .829   |
|        | Serbia   | 285.95 | 29.18  | 6.52      |         |        |
| AKGN   | Slovenia | 55.70  | 14.08  | 3.15      | 1.395   | .171   |
|        | Serbia   | 49.50  | 14.03  | 3.14      |         |        |
| POL    | Slovenia | 75.50  | 18.35  | 4.10      | -4.105  | .000   |
|        | Serbia   | 97.40  | 15.24  | 3.41      |         |        |
| TAP    | Slovenia | 36.05  | 3.39   | .76       | 1.455   | .154   |
|        | Serbia   | 34.05  | 5.12   | 1.15      |         |        |
| SDM    | Slovenia | 185.80 | 13.19  | 2.95      | 3.093   | .004   |
|        | Serbia   | 171.10 | 16.66  | 3.73      |         |        |
| PRE    | Slovenia | 58.40  | 2.87   | .64       | 1.737   | .091   |
|        | Serbia   | 55.75  | 6.19   | 1.38      |         |        |
| DT     | Slovenia | 56.10  | 5.83   | 1.30      | 2.321   | .026   |
|        | Serbia   | 51.40  | 6.93   | 1.55      |         |        |
| VES    | Slovenia | 72.90  | 25.17  | 5.63      | .287    | .776   |
|        | Serbia   | 70.50  | 27.66  | 6.19      |         |        |
| PLEZBR | Slovenia | 141.80 | 87.10  | 19.48     | 1.239   | .223   |
|        | Serbia   | 104.75 | 101.49 | 22.69     |         |        |
| PREKR  | Slovenia | 23.75  | 5.95   | 1.33      | -1.704  | .097   |
|        | Serbia   | 30.60  | 16.97  | 3.79      |         |        |
| VAGZ   | Slovenia | 25.70  | 31.96  | 7.15      | 3.194   | .003   |
|        | Serbia   | 2.20   | 7.81   | 1.75      |         |        |
| NAUTEZ | Slovenia | 3.55   | 2.89   | .65       | 3.579   | .001   |
|        | Serbia   | 1.00   | 1.34   | .30       |         |        |
| VZN    | Slovenia | 104.00 | 28.49  | 6.37      | .745    | .461   |
|        | Serbia   | 80.80  | 136.31 | 30.48     |         |        |
| SPIBR  | Slovenia | 5.40   | 3.20   | .72       | 2.766   | .009   |
|        | Serbia   | 2.50   | 3.43   | .77       |         |        |
| KOLKBR | Slovenia | 30.05  | 12.22  | 2.73      | 4.577   | .000   |
|        | Serbia   | 13.40  | 10.74  | 2.40      |         |        |
| STOJABR| Slovenia | 63.82  | 113.00 | 27.41     | .821    | .417   |
|        | Serbia   | 40.20  | 57.01  | 12.75     |         |        |
| MOST   | Slovenia | 95.00  | 10.39  | 2.32      | 1.008   | .320   |
|        | Serbia   | 90.00  | 19.60  | 4.38      |         |        |
| MSP    | Slovenia | 1.35   | 1.69   | .38       | -1.130  | .266   |
|        | Serbia   | 2.80   | 5.48   | 1.23      |         |        |
| ZSPL   | Slovenia | 2.85   | 3.38   | .75       | .000    | 1.000  |
|        | Serbia   | 2.85   | 4.49   | 1.00      |         |        |
| ZSPD   | Slovenia | 3.15   | 3.73   | .83       | -3.42   | .734   |
|        | Serbia   | 3.60   | 4.55   | 1.02      |         |        |

In the age group 9 – 10 years we can determine statistically significant differences between both groups in following tests: POL, SDM, VAGZ, NAUTEZ, SPIBR, KOLKBR (p<0.01) and DT (p<0.05). In all mentioned tests Slovenian gymnasts were better than Serbian. Thus, Slovenian gymnasts are better in coordination of the whole body movement (POL), leg power (SDM), repetitive power of arms and shoulders (NAUTEZ, SPIBR), muscular endurance of the torso (DT), specific endurance (KOLKBR) and statical power of shoulder girdle and back (VAGZ) (Table 3).
Results

Table 4. Descriptive statistics and t test between Slovenian and Serbian gymnasts 11 – 12 years of age

| TEST  | COUNTRY | MEAN | STD  | STD ERROR | T VALUE | SIG. T |
|-------|---------|------|------|-----------|---------|--------|
| ATV   | Slovenia| 1437.41 | 68.05 | 16.30 | 1.356 | .185 |
|       | Serbia  | 1405.12 | 70.84 | 17.18 |         |        |
| ATT   | Slovenia| 359.12 | 55.22 | 13.39 | .971 | .339 |
|       | Serbia  | 341.82 | 48.37 | 11.73 |         |        |
| AKGN  | Slovenia| 59.24 | 14.56 | 3.53 | 2.230 | .033 |
|       | Serbia  | 47.00 | 17.32 | 4.20 |         |        |
| PON   | Slovenia| 71.94 | 8.05  | 1.95 | -3.975 | .000 |
|       | Serbia  | 83.88 | 9.41  | 2.28 |         |        |
| TAP   | Slovenia| 41.94 | 3.17  | .77 | 3.809 | .001 |
|       | Serbia  | 36.41 | 5.08  | 1.23 |         |        |
| SDM   | Slovenia| 202.06 | 16.32 | 3.96 | 1.911 | .065 |
|       | Serbia  | 190.59 | 18.60 | 4.51 |         |        |
| PRE   | Slovenia| 59.65 | 3.08  | .75 | 1.292 | .205 |
|       | Serbia  | 58.06 | 4.02  | .98 |         |        |
| DT    | Slovenia| 62.35 | 7.34  | 1.78 | 4.375 | .000 |
|       | Serbia  | 52.47 | 5.73  | 1.39 |         |        |
| VES   | Slovenia| 60.12 | 25.40 | 6.16 | -2.226 | .033 |
|       | Serbia  | 78.71 | 23.25 | 5.64 |         |        |
| PLEG  | Slovenia| 99.35 | 18.40 | 4.46 | -1.856 | .073 |
|       | Serbia  | 128.71 | 62.55 | 15.17 |         |        |
| VAGS  | Slovenia| 5.41 | 11.99 | 2.91 | 1.246 | .222 |
|       | Serbia  | 1.47 | 5.12  | 1.24 |         |        |
| STO   | Slovenia| 44.12 | 11.25 | 2.73 | .741 | .464 |
|       | Serbia  | 37.24 | 36.60 | 8.88 |         |        |
| KOLR  | Slovenia| 17.35 | 11.99 | 2.91 | -2.56 | .800 |
|       | Serbia  | 18.29 | 9.29  | 2.25 |         |        |
| DN    | Slovenia| 14.59 | 7.93  | 1.92 | .538 | .594 |
|       | Serbia  | 13.18 | 7.36  | 1.78 |         |        |
| PUMP  | Slovenia| 6.53 | 3.76  | .91 | .573 | .571 |
|       | Serbia  | 5.76 | 4.02  | .98 |         |        |
| SALTO | Slovenia| 8.88 | 3.76  | .91 | 3.423 | .002 |
|       | Serbia  | 4.18 | 4.25  | 1.03 |         |        |
| SPBR  | Slovenia| 6.24 | 3.11  | .76 | 2.779 | .009 |
|       | Serbia  | 3.47 | 2.67  | .65 |         |        |
| MOST  | Slovenia| 95.29 | 12.68 | 3.08 | .900 | .375 |
|       | Serbia  | 90.29 | 19.08 | 4.63 |         |        |
| MSP   | Slovenia| 2.59 | 2.32  | .56 | -.098 | .923 |
|       | Serbia  | 2.71 | 4.37  | 1.06 |         |        |
| ZSPL  | Slovenia| 4.71 | 3.69  | .89 | .454 | .653 |
|       | Serbia  | 4.06 | 4.58  | 1.11 |         |        |
| ZSPD  | Slovenia| 5.06 | 4.32  | 1.03 | .361 | .721 |
|       | Serbia  | 4.53 | 4.32  | 1.05 |         |        |

Statistically significant differences between serbian and slovenian gymnasts 11 – 12 years of age are in the tests: PON, TAP, DT, SALTO, SPIBR (p<0.01) and AKG and VES (p<0.05). The best slovenian gymnasts in this age group are achieving better results than their serbian contemporaries in the tests of coordination of the whole body movement (PON), speed of alternate movement (TAP), leg power and coordination (SALTO), repetitive power of shoulder girdle and arms (SPIBR) and also muscular endurance of the torso (DT). The best serbian gymnasts have in compare to the slovenian gymnasts lower amount of body fat (AKGN) and higher muscular endurance of shoulder girdle and arms (VES) (Table 4).
In this age group (13 – 14 years) we found out the most of the differences between Serbian and Slovenian groups of gymnasts (Table 5). All the differences were significant at the very high level (p<0.01). Slovenian gymnasts had better results in all of those tests. These are: coordination of the whole body movement (PON), speed of alternate movement (TAP), leg power and coordination (SDM, SALTO), flexibility of legs and torso (PRE), arm power (PLEZ), equilibrium and muscular endurance of shoulder girdle and arms (VAGS, STOJKR), repetitive power of shoulder girdle and arms (PUMP, SPIKR), muscular endurance of the torso (DT) and specific endurance (CKOL). Slovenian gymnasts in this age group are also taller, weigh more and have higher amount of body fat but without significant differences. Serbian gymnasts are better in muscular endurance of shoulder girdle and arms (VES) (p<0.01).
Discussion

While helping to develop young gymnasts, coaches have to be very systematical. They have to be aware that development of motor abilities is one of the most important issues in coaching young children. Only well physically prepared gymnasts will be able to perform gymnastic elements and routines technically correct and without any unnecessary injuries. Therefore, it is highly important to dedicate enough time to the development of motor abilities.

Apart from motor abilities there are also physical characteristics that have an important effect on motor efficiency. Coaches can change these characteristics with suitable practice.

In order to find out which physical characteristics and motor abilities Serbian gymnasts differ from Slovenian gymnasts we made this research. From the results we can conclude:

1. Statistically significant differences between Serbian and Slovenian gymnasts exist in 19 out of 35 variables.
2. Statistically significant differences are mostly in favour of Slovenian gymnasts. Serbian gymnasts achieved significantly better results only in two tests (VES and AKGN).
3. Slovenian gymnasts achieved better results in most of the tests:
   - fast power of legs and arms (SDM, PLEZBN, SALTO)
   - (continuous) muscular endurance of the torso (DT) and the shoulder girdle and arms (SPIBK, SPIKR, PUMP, NAUTEZ)
   - (static) muscular endurance (OPORKR, VAGZ, VAGS, STOJKR)
   - specific endurance (KOLKBR, CKOL)
   - coordination of the whole body movement (PON) and speed of alternate movement (TAP)
4. In flexibility there is just one significant difference between the mean values of the groups (PRE; 13 – 14 years). We can conclude that for this subsistem of motor abilities gymnasts from both groups are prepared at the same level.

The reason for the difference between nations is probably due to the longer tradition of top-level gymnastics in Slovenia. As the sport systems develop through a longer period of time, tradition in sport plays a very important role.

In order to take advantage of young gymnasts’ potential we have to make it possible that every coach in the country gets the opportunity to develop his/her knowledge of sport science and coaching. Expert and research advanced study courses are one of the ways to spread knowledge. Only in such case we will truly help all gymnasts in the country to develop their sport (not only motor) potential.

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MSc Miha Marinsek
Gregorciceva 33
2000 Maribor
Slovenia
Telephon number: +38641 955 103
e-mail: miha.marinsek@gmail.com