INFLUENCE OF MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES FOR THE SELECTION IN THE BALLET

Abstract
Technical selection for sports activities is based on the adopted specific contents upgraded on the general abilities and characteristics of the individual. Factors in the ballet and dance selection are different from sports according to the expressivity of motion and flexibility (Liederbach, 2000). According to the physiological requirements and ranges of motion, ballet has similar characteristics as sports such as artistic and rhythmic gymnastics. The survey was conducted with 84 girls in primary ballet school „Lujo Davico“ from Belgrade, the mean ages of 12.84 (± 1.14) years, and values of body height 157.0 (± 9.0) cm and body mass 43.1 (± 7.6) kg. Data for motor abilities were obtained by applying EUROFIT test battery, which determined the order of implementation of general guidelines, recommended to standardized use in countries of the European Council (Kukolj et al. 1993). The success of the ballet score was evaluated according to the marks derived at the ballet school. The results were analyzed using descriptive (mean and standard deviation) and comparative (Pearson’s correlation) statistic procedures. The results showed a correlation of body height, body weight and percentage of body fat with success at school (p<0.01), with the range of $r = -0.33 - r = -0.36$, while correlation results of BMI with success at school were $r = -0.27$ (p<0.05). Results of motor abilities revealed a significant correlation with success at the ballet school only in two tests of EUROFIT test battery. The results obtained from the 20-meter Shuttle run test (SRUN) and the test for assessing flexibility (PUSE) showed a significant correlation with success in teaching ballet, $r = 0.30$ (p<0.01) and $r = 0.25$ (p<0.05), respectively.

**Key words:** BALLET / MORPHOLOGY / EUROFIT / SUCCESS

INTRODUCTION

The sport selection is applied since the beginning to the senior age. The special attention should be given to the initial selection. The sport selection in most sports usually starts very early, at the age of 5 or 6 years in sport schools, or at the beginning of sports trainings. Sports selection could be spontaneous, when the selection is made based on the expression of certain general and specific expression of children during exercise or competition, based on professional observations, or organized (planned or laboratory) selection based on inspection of children abilities and analysis of the psycho-physical characteristics that are relevant for success in a given sport discipline. The selection approach could be observed as an action, based on the currently abilities, or as a process, if a definitive expected abilities of athletes is based on actual results of current testing, according to the time when the selection is made. The sport selection included the evaluation of morphological characteristics (longitudinal and transversal body dimensions,
ties of elementary school students, showed a significant influence on the results of programs of physical education (Milenkovic, 2009).

The technical selection of sporting activity is based on the specific adopted contents upgraded to the general individual capabilities and characteristics. Factors for selection in ballet and dance are different from the sports on the basis of expressive movement and flexibility (Liederbach, 2000). Physiological requirements of dance are similar to the requirements in some sports, based on which classical ballet can be defined as a predominantly intermittent type of activity (Schantz, & Astrand, 1984), similar to soccer and tennis, in which parts are shifting large loads and elements of precision and skill. Based on that dancers should have the benefit of aerobic capacity (Allen, & Wyon, 2008) and a high anaerobic threshold to the state of fatigue and lactic acid build-up of less impact on the balance, poise and coordination (Baldari, & Guidetti, 2001). In previous studies it was found that the dancers and ballet dancers, to the achieved level of aerobic capacity, are similar to athletes in sports in which endurance is not dominant and that dancers activities have little impact on their cardiovascular system (Cohen, et al., 1982, Schantz, & Astrand 1984, Wyon, et al., 2004). Some studies have shown that solo ballet dancers have 5% greater oxygen consumption than group dancers, although the difference was not statistically significant (Schantz, & Astrand, 1984). According to the physiological requirements and range of motion ballet has similar characteristics with sports such as rhythmic and sports gymnastics.

The physical abilities of children were assessed by EUROFIT test battery, which is designed to assess physical fitness in healthy children and adults. EUROFIT for children is designed to be practical and applicable in everyday environments. Testing of children covered four areas: body composition, cardiorespiratory function, motor ability and musculoskeletal capacity (Ozdirenc, et al., 2005).

A battery of tests of the Institute of Physical Education and Sports Medicine (SIPESM) used in the physical education curriculum of the Republic of Serbia was replaced by EUROFIT test battery, recommended by the European Union countries. EUROFIT test battery consists of two sets of data, the morphological characteristics and motor abilities of subjects. It was used since 1993 for the estimation in the school population, as well as in other similar studies (Macura, et al., 2007) and takes into account the following information: body height, body mass, percent of body fat, Flamingo balance test, plate tapping, sit and reach, standing broad jump, handgrip test, sit-ups in 30 seconds, bent arm hang, 10 × 5m shuttle run and 20m endurance shuttle run with a progressive acceleration of the tempo (Kukolj, et al., 1993).

Research conducted on a sample of ballet dancers revealed certain deficiency. They usually included a sample of professional ballet dancers, with administering the assessment of their morphological characteristics and motor abilities in order to analyze the expression and prevention of injuries during practice or performance. Based on this it can be concluded that the population of students involved in ballet is under-researched. Considering that this is not a sport, the relation of morphological characteristics and motor abilities with success in teaching ballet, and the final exam at the end of the school year, have been considered as possible parameters for the selection of the ballet, which gain access to the basic problem of this research.

**METHOD**

In this paper was used empirical transverse testing protocols for the measurement of morphological features and protocols of EUROFIT test battery to assess the motor abilities. Measurements were applied during the regular curriculum classes in primary ballet school at the subject of Applied Gymnastics. Data for motor abilities were obtained using EUROFIT - test battery, which determined the order of implementation of general guidelines, recommended to use standardized at countries of the European Council (Kukolj, et al., 1993). Success in ballet grade was evaluated by the marks at ballet teaching. The results were analyzed using descriptive (mean and standard deviation) and comparative statistics (Pearson’s correlation coefficient).
Subjects

The study was conducted on 84 girls in primary ballet school „Lujo Davico” from Belgrade, the average age of 12.84 (± 1.14) years, body height 157 (± 9.0) cm and weight 43.1 (± 7, 6) kg.

Variables

Variables were divided according to their methodological nature into the two groups. The first group consists of five independent variables of the morphological status: body height, body mass, body mass index, percentage of muscle tissue and percentage of body fat. The second group consists of eight variables of motor abilities that belong to the EUROFIT- test battery.

The technique of measurement of anthropometric variables

Evaluation of the morphological status was performed on the basis of data obtained by measuring the height (BH) and body mass (BM). During all the anthropometric measurements the subjects were only in ballet tights, which are take-off during measuring body mass and body composition. The body height was measured using anthropometry by Martin with an accuracy of measuring 0.1 cm. The body mass of the subjects was measured by the medical decimal scale (Omron BF 509) with the possibility of reading the body mass index and body composition of subjects, percentage of muscle and adipose tissue. The reading accuracy was 0.1 kg. Body mass index, as a measure of voluminous of subjects (Heyward, & Stolarczyk, 1996), was calculated by the formula:

\[ \text{BMI} = \frac{\text{BM (kg)}}{\text{BH (m2)}}. \]

Description of tests and measurements in order EUROFIT – Battery

Flamingo balance test (BAL)

The subjects were standing balancing on the preferred leg on the wooden beam, length 50 cm, height 4cm and 3cm wide. The instructions to the subjects were that when standing on one leg on a beam, holding the other leg with hand on the same side of the body, and to stay as long as they could at this position. The balance position is maintained for as long as the time within a minute. Time spent on the beams was measured by a stopwatch.

Plate tapping (TAP)

The subjects were seated at a table with a board with two metal plates diameter of 20 cm, the distance between centers of 80 cm (60 cm between the closer edges). A hand of free arm was placed on a rectangular plate dimensions 10 x 20 cm mounted on the center of a board. Subjects were asked to perform 25 contacts with the dominant (selected) hand at the circular plate as fast as they could. The first movement was abduction at the shoulder joint of dominant arm. The measurement was performed twice, and better result was used for further analysis.

Sit and reach (SITR)

The subjects were seated on the mat, stretched legs, so that their feet were placed flat on the side of the box. They tried to seated forward bend with outstretched arms and hands placed one over another to reach as far as possible mark on the ruler. The result was reading when they reached the end position. Label of 20 cm was located at the feet height.

Standing broad jump (JUMP)

The subjects stood barefoot, feet and normally spaced swinging the arms and trying to jump as long as they could. They were jump both feet bound with both feet landing on the mat. The score was the distance from the line to the last toe prints on the mat. The achieved result is inscribed in centimeters. Subjects were entitled to two successful attempts and a better result was used for further analysis.

Sit ups in 30 seconds (SU30)

The subjects were placed in a laying position on the mat with both legs flexed at the angle of 90°, hands clasped behind his head and forearms positioned on the head. While the foot was fixed by the other respondents, the subject raised the trunk to a sitting position, trying to touch the knees with the elbows as many times as it is possible for 30 seconds. The number of correctly performed repetitions was used for further analysis.

Bent arm hang (BAH)

The subjects were placed into position, the body lifted to a height so that the chin is level with the horizontal bar. The bar is grasped using an over-
hand grip, with the hands shoulder width apart. They should attempt to hold this position for as long as possible. Timing stops when the person’s chin falls below the level of the bar or the head is tilted backward to enable the chin to stay level with the bar. The result was a time expressed in tenths of seconds.

**10x5 m shuttle run (10x5)**

When instructed by the timer, the subject were running as quickly as possible distance of 5m and back for 10 times in a row. Every time they have crossed the line at both ends of distance with both feet. The result of the test was the time required for 10 reps, with an accuracy of 1/100 of a second.

**20m endurance shuttle run (SRUN)**

The subjects were running between two lines 20m apart in time to recorded beeps, constantly changing its direction. The pace was dictated by a beep sound signal from the CD drive. The speed at the start is quite slow. The subjects last completed level was recorded as indication of cardio-respiratory and muscular endurance.

**Success in ballet**

The success in ballet, as the dependent variable, was used for the estimation of dance expression and range of motion (Liederbach, 2000) based on which the ballet is different from sports. Rating of success was obtained as an average value from the marks during the regular curriculum and final exam grades in the ballet.

**Data Processing**

The results were analyzed using statistical software SPSS 12.0. All data were process using descriptive and comparative statistical procedures.

**RESULTS AND DISCUSSION**

The aim of this study was to test the ability of selection in the ballet based on the correlation between the morphological characteristics and tests for motor abilities of elementary ballet school and their achievements in the expression of ballet technique. The study included 84 female students basic ballet school „Lujo Davico” from Belgrade, the average age of 12.84 (± 1.13) years, body height 157 (± 9.0) cm and weight 43.1 (± 7.6) kg. Average values of components of body composition were 16.24 (± 5.23)% fat, and 33.29 (± 2.85)% of muscle tissue. The values of body mass index, as a measure for the observed voluminosity of subjects, was 17.33 (± 1.59). Table 1 shows the results of descriptive statistics for all the morphological characteristics and motor abilities.

<table>
<thead>
<tr>
<th>BH (cm)</th>
<th>BM (kg)</th>
<th>FAT (%)</th>
<th>MUS (%)</th>
<th>BMI</th>
<th>BAL (pon)</th>
<th>SU30 (pon)</th>
<th>TAP (s)</th>
<th>SITR (cm)</th>
<th>JUMP (cm)</th>
<th>BAH (s)</th>
<th>10x5m (s)</th>
<th>SRUN (min)</th>
<th>SUCCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>157.01</td>
<td>43.14</td>
<td>16.24</td>
<td>17.33</td>
<td>2.32</td>
<td>23.65</td>
<td>6.58</td>
<td>34.98</td>
<td>164.58</td>
<td>8.61</td>
<td>21.90</td>
<td>3.59</td>
<td>4.05</td>
</tr>
<tr>
<td>(SD)</td>
<td>8.99</td>
<td>7.62</td>
<td>5.23</td>
<td>1.59</td>
<td>2.65</td>
<td>3.08</td>
<td>0.85</td>
<td>6.17</td>
<td>22.75</td>
<td>6.95</td>
<td>1.65</td>
<td>1.28</td>
<td>0.85</td>
</tr>
<tr>
<td>Min</td>
<td>137</td>
<td>29.4</td>
<td>2.85</td>
<td>1.59</td>
<td>0</td>
<td>17</td>
<td>4.72</td>
<td>20</td>
<td>120</td>
<td>6</td>
<td>1</td>
<td>18</td>
<td>0.47</td>
</tr>
<tr>
<td>Max</td>
<td>173</td>
<td>57.8</td>
<td>47.7</td>
<td>22</td>
<td>31</td>
<td>8.41</td>
<td>49</td>
<td>232</td>
<td>30.63</td>
<td>28.48</td>
<td>6.59</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>cV (%)</td>
<td>5.73</td>
<td>17.66</td>
<td>32.20</td>
<td>8.56</td>
<td>9.17</td>
<td>114.22</td>
<td>13.02</td>
<td>12.92</td>
<td>17.64</td>
<td>13.82</td>
<td>80.72</td>
<td>7.53</td>
<td>35.65</td>
</tr>
</tbody>
</table>

Results of descriptive statistics for all subjects are very close to those obtained in previous studies conducted on a similar sample by the age (Gajević, 2009). Although the mean with relatively small standard deviations may indicate the homogeneity of the observed sample, values of the coefficient of
variation, which are in most of the observed variables higher than 10%, provide an easier statistically significant correlation between the observed variables.

Results of descriptive statistics indicate that the morphological characteristics of the body height and body mass close to those obtained in previous studies on the population of subjects from the fifth to eighth grade, which corresponds to the age of first to fourth grade of elementary ballet school. The values of the morphological characteristics increase with the age of the subjects in line of the trend of maturation. The structure of body components of the subjects does not show great variation at the values of percentage body fat (FAT = 16.24 ± 5.23%), while the values of muscular components were something more homogenized (MUS = 33.29 ± 2.85%). Body mass index was determined based on data obtained by the measurement of body height and weight, so the values were also consistent (BMI = 17.33 ± 1.5) and close to the values obtained in previous studies.

The correlation with the success achieved at the ballet was calculated for the morphological characteristics, as the aesthetic factor, which plays an important role in the expression, as well as motor abilities, which have a great importance for the accuracy and quality of movement performance.

The results of motor variables were obtained using EUROFIT battery of tests, while the score for assessing the performance of the ballet expressing obtained as the average of marks during the regular curriculum and final exam grades in the ballet.

Correlation between Motor abilities and the success in ballet revealed a quiet different situation (Table 3). Significant correlation was obtained with only two EUROFIT battery tests. The results obtained in the test 20m endurance shuttle run (SRUN) revealed correlation with success in the ballet at the level of significance p <0.01 (r = 0.30), while the results obtained in the test to assess flexibility, Sit and reach (SITR) revealed correlation with the success in ballet, (r = 0.25) at the significance level of p <0.05.

Table 2. Results of the comparative statistics of morphological characteristics and success in ballet for all subjects

<table>
<thead>
<tr>
<th></th>
<th>BH</th>
<th>BM</th>
<th>FAT</th>
<th>MUS</th>
<th>BMI</th>
<th>SUCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH</td>
<td>1</td>
<td>.90**</td>
<td>.44**</td>
<td>.32**</td>
<td>.54**</td>
<td>-.33**</td>
</tr>
<tr>
<td>BM</td>
<td></td>
<td>1</td>
<td>.71**</td>
<td>.22*</td>
<td>.85**</td>
<td>-.36**</td>
</tr>
<tr>
<td>FAT</td>
<td></td>
<td></td>
<td></td>
<td>-.36**</td>
<td>.86**</td>
<td>-.33**</td>
</tr>
<tr>
<td>MUS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.05</td>
<td>.10</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.27*</td>
</tr>
<tr>
<td>SUCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

**p <0.01, * p <0.05
Based on the relations with the success at the ballet it could be considered two separate components that determine the performance (Liederbach, 2000). The first component is expressive and aesthetic impression, based on which ballet is different from a sports.

Negative correlation score among the teaching of ballet and the body height, body weight, body mass index and percentage of body fat suggests that morphological factors could be important at the selection of students for the ballet school.

Correlation between motor skills and the results of success in ballet of the students of primary ballet school was obtained for the two tests, while one test (balance) is close to statistical significance \((r = -0.21)\). These results suggest that motor skills could partially affect the performance of the ballet. The component that is essential for success in the performing ballet is performing movements of large amplitude, which is associated with flexibility, what was measured using Sit and rich test. Although it was noted that ballet dancers have a similar level of aerobic fitness as athletes from "non-endurance" sports (Cohen, et al., 1982, Schantz, & Astrand 1984, Wyon, et al., 2004), they should take a benefit of aerobic fitness. The positive correlation of test of the flexibility and the 20m endurance shuttle run (SRUN) with grades in the classroom suggests that these motor skills could be an important factor in selecting students for ballet.

A negative correlation of the balance test (Flamingo balance test) indicates that subjects with multiple disturbances and a worse balance in this test have a lower mark at the ballet performance. The values of the quotient of variation applied the balancing test are greater than 100%, which may indicate a lack of confidence, and therefore weak validity for this test.

**CONCLUSION**

Based on these results it can be concluded that, at this age, the negative correlation of the success in ballet with the body height, body weight, body mass index and body fat percentage suggests to the influence of morphological characteristics that could be important components for ballet school selection. Correlation between motor skills with the success in ballet was found only at two tests, basis on what could be established a limited impact of motor skills on the efficiency in ballet. The positive correlation between the flexibility test and the 20m endurance shuttle run with grades in the classroom suggests that these motor skills could be an important factor in selecting students for ballet.

The obtained results could be applied to the subscription in the elementary ballet school, where the ones that have less height and weight, as well as those that achieve better results in tests for the assessment of flexibility and aerobic fitness could have an advantage in the selection for ballet (Wyon, et al., 2004). However, based on the observed age it can
be suspected that subjects with higher body weight and height of those previously entered puberty. It is generally known that during puberty there is a disturbance of fine coordination, which can have a negative impact on the performance of ballet elements, and thus the derived estimation.

Regular testing of ballet school student would provide a better inspection into the changes in motor skills and the impact of teaching on the realized changes. Following the morphological characteristics and motor abilities of students during the three years of teaching, the duration of applied gymnastics classes and in fourth grade could check the validity to reduce classes of applied gymnastics in fourth grade. Testing the students of secondary ballet school could indicate the state of motor skills, as well as the need for additional training which would enable the achievement of better results and better performance on stage.

The application of a flexibility tests battery, which proved to be one of the most important skills for dealing with the ballet, would provide better and more detailed inspection into the flexibility of the student. It could also, by applying various programs to improve flexibility, establish a model that would be applied in regular applied gymnastics classes.

Further research would be focused on the analysis of motor skills and their changes by applying a longitudinal study on a sample of male and female primary and secondary ballet school.

REFERENCES


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