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MOTOR AND MORPHOLOGICAL CONDITIONALITY FOR PERFORMING *ARABESQUE* AND *PASSE* PIVOTS

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Abstract. *The aim of the present study was to establish the probable influence of characteristic motor abilities and morphological characteristics on the arabesque and passé pivots performance in a sample of 53 girls (mean age 7.1 ± 0.3 years), who had three months of training experience. The sample of variables consisted of 10 tests of basic motor abilities, eight standard tests for assessing morphological characteristics and two specific-pivot performance tests, in which five judges evaluated performance. The regression analysis was utilized to establish relations between the scores of motor and morphological tests and the pivots performance marks. The results obtained showed statistically significant multiple correlations between motor–morphological variables and both tests applied for assessing pivot performance. The test for assessing agility (side steps), flexibility (shoulder flex) and adipose tissue (calf skinfold) have a significant predictive value (Beta coefficient) for the performance of the arabesque pivot. According to the study results, a training process with the special goal of learning pivots intended for different aesthetic sport novices should be programmed to include the preset objectives for the development of agility, flexibility and adipose tissue reduction.*

Key words: *aesthetic movements, anthropologic features, regression analysis, seven-year old girls*

1. INTRODUCTION

The performance of pivots is an important training element in various sport disciplines with aesthetic components (rhythmic gymnastics, dance, figure scatting, gymnastics etc.). It is already known that successful movement performance in some sports disciplines with aesthetics components could be predicted by motor abilities and the morphological characteristics of athletes (Kostić 1997; Kostić and Dimova, 1997; Claessens

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et al., 1999; Mišigoj – Duraković et al., 2001; Kostić, Zagorc, Uzunović, 2004; Uzunović & Kostić, 2005). The body build plays a significant role in the performance of elite artistic (Claessens & Lefevre, 1998) as well as elite rhythmic gymnasts (Alexander, 1991). However, relevant scientific information on aesthetic sports novices is particularly limited. Therefore, the need to determine the characteristic influence of certain motor abilities and skills, as well as the one of morphological characteristics on the performance of pivots is an important research issue. The level of expertise to which the novices in aesthetic sport disciplines are expected to master pivots is not very high at the beginning - the intention is to achieve an approximate, "rough form of the elements' execution". A more accurate and skilful performance is a goal of the training phases that are yet to come.

The authors also presumed it would be very interesting and useful, especially from the aspect of motor teaching and learning practice, to determine the probable influence of certain basic motor abilities and morphological characteristics on the performance of basic pivots of beginners. The establishment of such correlations may be very helpful in the early stages of the training process in different sports with aesthetic components, as well as in the sport selection process. However, certain problems should be solved first. The first problem is to objectively identify and assess the quality of the element execution as performed by novices. Namely, the characteristic "rough-form execution" of elements, as required in the beginning of the teaching-learning process in aesthetic movement, does not make rigorous evaluation suitable. And, yet, the differences in performance quality among the evaluated subjects exist and must somehow be estimated.

Ackerman (1998) suggested that basic motor abilities and skills have a crucial importance in the early phases of the motor learning process. In this statement the second main problem of the present investigation can be recognized: which combination of motor skills best describes the performance of pivots in novices? We have tried to give an answer to this question in the present paper.

The aim of the study was to establish the quality of arabesque and passé pivot performance, and to determine any probable influence of characteristic motor abilities and morphological characteristics on the arabesque and passé pivot performance on a sample of seven-year-old girls.

2. METHODS

The subject sample

The sample of subjects consisted of 53 girls, mean age 7.1 ± 0.3 years. All of the participants were in good health, with no obvious physical or mental aberrations. The girls were selected from a population of 337 age-paired volunteer participants in the sport-school programs. An attempt was made to recruit female pupils (from the population of 337 peers who had voluntarily joined sport-school programs) that were interested in training sports with aesthetic components.

The sample of variables

Three test batteries were used.

The sample of variables used to assess motor abilities consisted of 10 motor standard tests as proposed by Katić et al. (2002) and Miletić et al. (2004): tests assessing coordina-

tion (Polygon backwards – s); agility (Side steps – s); frequency of movement (Tapping against a wall – taps/15s); power tests (Standing jump/cm), strength tests (Bent arm hang/s and Sit-ups/per minute); tests assessing flexibility (Shoulder flex/cm and Sit-and-reach/cm) and coordination in rhythm test (Hand-drumming and Hand–foot drumming – f/per 20 s).

All of the tests used to assess the frequency of movement, power, flexibility and coordination in rhythm, the subjects performed three times and only the best results were taken for analysis. The tests assessing strength were performing only once.

The sample of variables used for the assessment of morphological characteristics consisted of eight standard morphological tests (suggested by Miletić et al., 2004): weight (kg); height (cm); foot length (cm), bicristal diameter (cm); foot diameter (cm); upper leg circumference (cm); triceps skinfold (mm); calf skinfold (mm). All of the tests were performed three times and only the average results were taken for analysis.

The sample of variables used for assessment of basic pivots consisted of two standard pivots used in aesthetic sports disciplines:

1. Arabesque pivot- stand upright, leg in rear horizontally, a 360 degree rotation;
2. Passé pivot- stand upright, upper leg angled with shin, toes touches the knee of the supporting leg, a 360 degree rotation.

In rhythmic gymnastics, for example, the arabesque pivot is considered as having a B level of difficulty, and the passé pivot is considered as having an A level of difficulty when rotated a full 360 degrees (according to the FIG code of points 2005). The authors have tried to select the elements which were adequate for beginners. After a three-month training process (basic ballet, dance and rhythmic gymnastics elements) with a special goal of learning pivots, fifty three study subjects had to perform the arabesque and passé pivots. Five independent judges evaluated the performances on the Likert scale (1-5) by watching videotaped material. The judges had previously been educated to evaluate the specific rank of five motor assessment levels. Basically, they evaluated the amplitudes and the explicit forms and rotations of the pivots.

A description of the experiment

The experiment design had two phases. In the first phase of the experiment, the motor and morphological tests were implemented. After three months of the training program involving basic rhythmic gymnastics, basic ballet elements and dance structures, which had been implemented three times a week (four hours per week), the performance was tested. The 53 participants were obliged to perform the arabesque and passé pivots.

In order to avoid any subjective assessment (Popović, 2004), all the participants were videotaped first. Five independent judges later evaluated the performances on the Likert scale (1-5) by watching the videotaped material. The judges evaluated form, amplitude and rotation.

The method of data processing

The descriptive statistics for each of the variables were calculated, and the resulting means and standard deviations are presented here. For assessing some of the metric characteristics of the used tests the Cronbach Alpha, Kolomogorov-Smirnov test and inter item correlations were calculated. To determine the correlation between the predictor motor and morphological variables and every single criterion variable (arabesque and passé pivots), four standard regression analyses were applied (separately for motor and morphological predictor sets). All of the data were calculated in STATISTICA 6.0 program.

3. RESULTS

Table 1. The basic statistics of the motor variables (χ, Mean; SD, Standard deviation)

Variable	χ ± SD
Polygon backwards (s)	21.4 ± 5.2
Side steps (s)	14.9 ± 1.3
Tapping against a wall (taps/15s)	15.3 ± 2.0
Standing jump (m)	1.1 ± 0.1
Bent arm hang (s)	8.3 ± 6.9
Sit-ups (per minute)	24.2 ± 8.6
Shoulder flex (cm)	54.4 ± 8.3
Sit-and-reach (cm)	54.6 ± 7.5
Hand drumming (taps/20s)	5.5 ± 1.9
Hand-foot drumming (taps/20s)	4.3 ± 2.1

Table 2. The basic statistics of the morphological variables (χ, Mean; SD, Standard deviation)

Variable	χ ± SD
Weight	27.3 ± 4.7
Height	130.6 ± 5.6
Foot length	20.3 ± 1.6
Bicristal diameter	21.4 ± 1.6
Foot diameter	7.4 ± 0.4
Upper leg circumference	40.6 ± 4.07
Triceps skinfold	10.5 ± 3.1
Calf skinfold	12.8 ± 4.4

Table 3. The descriptive statistics of the pivot-performance variables (χ, mean, Min, Max, SD); Kolmogorov-Smirnov test (KS d); reliability and item analysis (Cronbach Alpha Coefficient – Cronbach Alpha, Average Inter Item Correlation Coefficient – Average Inter Item r)

Vars	Calculated as the Mean of all 5 judges					Cronbach Alpha	Average Inter Item r
	χ	Min	Max	SD	KS d		
1. ARABESQUE	2,65	1,00	5,00	1,19	0,12	0,96	0,83
2. PASSE	3,08	1,00	5,00	1,10	0,08	0,96	0,85

Note: The KS test is considered significant for the d >0,20

The descriptive statistical parameters of the results of the participants achieved in the applied motor and morphological tests are presented in Table 1 and Table 2. If compared to the standardized values presented by Findak et al. (1996), the present sample of participants was dominant over the age-paired average school female population in the dimensions of flexibility and coordination (which was a selection criterion for the sample drawing), whereas it was comparable to the peers in the dimensions of strength and power. Namely, in the first phase of the experiment, the initial level of the observed motor abilities (flexibility, coordination and strength) made the selection of participants possible by focusing on the dimensions of flexibility and coordination. The intention of the initial selection was to distinguish between the above-average flexible and coordinated girls from the rest of the female population of the first graders. In the background of the

experiment concept was the assumption that these motor abilities, which were highly developed, might have a potentially positive influence on the faster progress and better motor learning in aesthetic movements. The descriptive statistic of the morphological characteristics is summarized in Table 2. The results of the descriptive parameters of weight, height and adipose tissue for subjects' in this study are generally consisted with those of European seven-year-olds (Mota et al., 2002; Falk et al., 2001). The descriptive statistical parameters, the results of the objectivity (reliability) and item analyses of the criterion variables (the arabesque and passé pivot performance quality) are presented in Table 3. The Cronbach-alpha coefficients and the average inter-item correlation coefficients, as the indicators of the objectivity of the five judges, were calculated. The alpha coefficients for both criterion variables (pivots) exceed the value of 0.95, which confirms a high level of objectivity of the instrument. The normality of distribution, estimated by the Kolmogorov-Smirnov test, was satisfactory for both of the variables. No significant differences were observed between the studied distribution parameters and the expected normal distributions ($p > 0.05$).

Table 4. The regression analysis of the motor variables and pivot – performing variables

Motor variables	ARABESQUE BETA	PASSE BETA
Polygon backwards (s)	–0,24	–0,17
Side steps (s)	–0,30 *	–0,24
Tapping against wall(taps/15s)	–0,08	–0,04
Standing jump (m)	0,06	0,04
Bent arm hang (s)	0,27	0,00
Sit-ups (per minute)	–0,20	0,06
Shoulder flex (cm)	–0,30 *	–0,14
Sit-and-reach (cm)	0,02	0,12
Hand drumming (taps/20s)	0,08	0,23
Hand-foot drumming (taps/20s)	0,04	–0,01
RO	0.66 **	0.62 *

BETA = regression coefficient; RO = multiple correlation; *P< 0.05; **P<0.01; ***P<0.001.

Table 5. The regression analysis of the morphological variables and pivot – performing variables

Morphological variables	ARABESQUE BETA	PASSE BETA
Weight	–0,07	–0,09
Height	–0,05	–0,06
Foot length	–0,02	0,21
Bicristal diameter	0,00	0,02
Foot diameter	–0,19	–0,26
Upper leg circumference	0,39	0,55
Triceps skinfold	–0,03	–0,48
Calf skinfold	**–0,57** *	–0,26
RO	0.53 *	0.56 *

BETA = regression coefficient; RO = multiple correlation; *P< 0.05; **P<0.01; ***P<0.001.

From the regression analyses (Table 4), the multiple correlation between the motor variables and both criterion variables indicates statistically significant relations with arabesque and passé pivots. The variables of agility, BETA = -.30, and flexibility, BETA =-.30, in the arabesque pivot, give a statistically significant contribution, explaining the correlation with the criterion. The negative correlations of the *side–steps* and *shoulder flex* variables with the criterion variable are a logical consequence of the measuring procedure used for certain variables (the time variables are measured in seconds, so they are the reverse scaled variables).

The significant correlation between the morphological status of the independent motor variables and the dependent pivot performing variables are noted in both the arabesque and passé pivots. The influence of each predictor variable on the criterion indicates the fact that, during the performance of the arabesque pivot, the above-average adipose tissue (BETA = -.57) had the greatest influence.

4. DISCUSSION

The *side-steps* and *shoulder flex* variables can be considered the most dominant in the arabesque pivot performance. Consequently, the connection between the assessed motor abilities and the quality of performing the observed arabesque pivot can be described as follows: coordination, that complex motor ability, can be conversely named as *motor-intelligence* (Sekulić, 2002). The New Zealand authors (Hume et al., 1993) used the term *visuo–motor proficiency* for the factor-composition of several coordination variables. So, if we accept the given definitions, there is no doubt about the established positive influence of coordination on the arabesque pivot performance. In fact, the named "simplified" definitions of coordination present the true logic of the obtained correlation.

The present investigation was conducted using seven–year–old girls who were novices in the aesthetic movement school training programme. Naturally, the participants characterized with a higher level of coordination are expected to be more apt for any kind of motor learning, pivot learning included.

Consequently, the characteristics of the pivot performance are very logical from the aspect of proficiency in aesthetic movements. Several authors so far have determined the positive influence of coordination (Miletić et al., 1998; Kioumourtzoglou et al., 1997) and flexibility (Hume et al., 1993) on the performance efficiency in some movements with aesthetic components. The investigation of Hume et al. (1993), in which the significant prediction value of flexibility for the rhythmic gymnastics efficiency criteria was established, dealt with elite, or at least, national level (senior) athletes, whereas the sample of participants in our investigation consisted of beginners. Therefore, the efficacy or expertise level of the novice athletes has to be determined by inspecting the level of their sport-specific knowledge (pivot performance, in this case). In the later stages of the training process or sports career, the quality differences between athletes have to be observed according to exactness, accuracy and skilfulness with which particular elements are performed. Accuracy here unquestionably includes the desired execution range of motion. So, a more advanced training flexibility is probably one of the most important motor factors that highly influences the performance of pivots (not only shoulder flexibility), as some authors have already demonstrated.

Morphological characteristics are closely related to motor performance in children (Classenes et al., 1999; Georgopoulos et al., 1999). It has already been reported that a specific somatotype, characterized by under-average adipose tissue, is desirable in rhythmic gymnasts (Alexander, 1991) where pivots are one of the basic body elements. In our study sample consisting of seven-year-old girls, the somatotype characteristic had not yet been defined. The variable for assessing adipose tissue had a significant negative predictive value (BETA coefficient) on performing the arabesque pivot. The higher percentage of adipose tissue exerted an unfavorable effect on the pivot performance already acquired by the novices, thus the girls with a pronounced endomorphic somatotype would be less successful in acquiring and performing pivots.

5. CONCLUSION

The influence of the measured motor abilities and morphological characteristics on the performance of the arabesque and passé pivot performance in the sample of the novices was the main scope of the investigation. According to the regression analysis results, there is an evident correlation between the motor–morphological variables and arabesque and passé pivot performance. Especially in the case of the arabesque pivot, we can suppose that their application in aesthetic movement training processes will cause qualitative stimuli to the motor (dominantly agility and flexibility) and morphological status (dominantly adipose tissue reduction) of the seven–year–old girls.

Although a high level of coordination facilitates acquisition of motor-learning programmes at any training and quality level in any sport, it is particularly valid for the first stages of motor learning of novice athletes. Although expected, the influence of flexibility (*sit and reach test*) on the pivot performance was not found as a significantly predictable variable. The novices were probably considerably better in some other strongly appreciated components of performance than in the range of motion, which is highly affected by flexibility. For any aesthetic element, as well as for pivots, movement has to be efficient, it has to be nice and harmonious, which means that it should be properly graded and leveled in terms of strength, speed, amplitude, muscle tonus, rotation and above–average adipose tissue which are important elements of aesthetic movement appearance.

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MOTORIČKA I MORFOLOŠKA USLOVLJENOST IZVOĐENJA "ARABESQUE" I "PASSE" OKRETA

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Cilj istraživanja bio je na uzorku 53 djevojčice (prosečne starosti 7,1 ± 0,3 godina), nakon tromjesečnog trenažnog procesa učenja,utvrditi mogući utjecaj motoričkih sposobnosti i morfoloških karakteristika na izvođenje arabesque i passé okreta. Uzorak varijabli činilo je 10 standardnih testova za procenu motoričkih sposobnosti, osam standardnih testova za procenu morfoloških karakteristika i dva specifična testa za procenu stepena izvođenja okreta, čije je izvođenje procenjivalo pet nezavisnih sutkinja. Za utvrđivanje relacija između morfološko – motoričkog prostora i ocena postignutih u izvođenju okreta, primenjena je regresiona analiza. Dobivene su statistički značajne multiple korelacije između motoričko–morfoloških varijabli i oba testa za procenu količine izvođenja okreta. Testovi za procenu agilnosti (koraci u stranu), fleksibilnosti (iskret) i potkožnog masnog tkiva (kožni nabor potkolenice) indukuju značajnu prediktivnu povezanost (Beta koeficijent) sa izvođenjem arabesque okreta. Prema rezultatima ovog istraživanja, trenažni proces za početnice u sportskim disciplinama s estetskom komponentom, posebno kod učenja okreta, mora se programirati, s istaknutim ciljevima razvoja agilnosti i fleksibilnosti i smanjenja postotka masnog tkiva.

Ključne reči: *estetska kretanja, antropološka obeležja, regresiona analiza, sedmogodišnjakinje*