THE LEAPING PERFORMANCE OF 7-YEAR-OLD NOVICE RHYTHMIC GYMNASTS IS HIGHLY INFLUENCED BY THE CONDITION OF THEIR MOTOR ABILITIES

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Abstract:

The aim of this study was to establish the probable influence of the characteristic motor ability and skill factors on the jumping/leaping performance in a sample of 55 novice female gymnasts (mean age 7.1 ± 0.3 years), who had participated in a year of training. The sample of variables consisted of 12 tests of the basic motor abilities and 9 RG (rhythmic gymnastics) specific leaping performance tests, in which 5 experienced RG-judges evaluated their performance. Canonical correlation analysis was utilized to establish the relations between the scores of the motor tests and the leaping/jumping performance marks. According to the linear correlation and canonical correlation results, coordination (coordination in rhythm, primarily) and strength (leg power, in the first place), contributed mostly to the performance evaluation marks assigned for the RG leaping elements (65% variance explained). Although being expected, the influence of flexibility on the leaping performance of novices in RG was not evident.

Key words: *rhythmic gymnastics, 7-year-old novices, leaping performance, motor abilities*

SPRUNGLEISTUNG DER 7-JÄHRIGEN ANFÄNGERINNEN IN RHYTHMISCHER GYMNASTIK IST STARK VON DEM ZUSTAND DEREN MOTORISCHEN FÄHIGKEITEN BEEINFLUSST

Zusammenfassung:

Die Absicht dieser Studie war, den wahrscheinlichen Einfluss von Faktoren der charakteristischen motorischen Fähigkeit und Fertigkeit festzustellen auf die Sprungleistung von 55 Anfängerinnen in rhythmischen Gymnastik (das Durchschnittsalter 7,1 ± 0,3), die ein Jahr trainiert haben. Die Auswahl von Variablen umfasste 12 Tests der basischen motorischen Fähigkeiten und 9 Tests der Sprungleistung, die für die rhythmische Gymnastik spezifisch sind, bei denen 5 erfahrene Schiedsrichter die Leistungen bewerteten. Die Analyse der kanonischen Korrelation wurde gemacht, um den Zusammenhang zwischen den Ergebnissen der motorischen Tests und den Noten für die gymnastische Ausführung festzustellen. Die Ergebnisse der linearen und kanonischen Korrelation zeigten, dass die Koordination (insbesondere die rhythmische Koordination) und die Kraft (in erster Linie die Beinkraft) die Noten für die Sprungelemente der rhythmischen Gymnastik beeinflussen, was den 65% des Unterschieds erklärt. Obwohl erwartet, war der Einfluss der Flexibilität auf die Sprungleistung der Turnerinnen nicht festzustellen.

Schlüsselwörter: *rhythmische Gymnastik, 7-Jährige Anfängerinnen, Sprungleistung, motorische Fähigkeiten*

Introduction

Leaps are fundamental, highly estimated elements of rhythmic gymnastics (RG). The quality of the performance of the leaps has almost a direct influence on the sports outcome, i.e. on the number of points earned and, consequently, on the final ranking at competitions. In experienced, highly skilled RG athletes (of international and elite level), the performance of leaps and jumps is strongly influenced by strength, power and flexibility (Wolf – Cvitak, 1984; Srhoj, 1989), and general efficiency in RG is strongly influenced by coordination (Furjan, 1990; Kioumourtzoglou et al., 1997) and rhythmic coordination (Wolf – Cvitak, 1984; Persicshini et al., 1998; Miletić, Srhoj, Lj., & Bonacin, 1998). From the aspect of anthropometry, rhythmic gymnasts are characterized by an under-average percentage of subcutaneous fat and above-average body height and body mass (Dimova, 1983, 1998; Miletić, Srhoj, Lj., & Bonacin, 1998). Alexander, Boreskie and Law (1987) described the physical characteristics of a group of four elite rhythmic gymnasts, in conjunction with a time – motion analysis of the sport. They found that the mean age was 14 years, the mean height was 1.58 m, the mean weight was 42.7 kg, the mean VO_2max 47.7 ml/kg/min, and their mean body fat percentage was found to be 13.6%. Alexander (1991) used a standardized battery of tests, which included height, weight, sum of five skinfolds, body fat percentage, aerobic power, anaerobic power, ten flexibility tests, and six strength tests. A comparison was conducted between the physiological characteristics of the three groups of elite rhythmic gymnasts in Canada. The results indicated that the mean height (1.64 m), weight (48 kg), the sum of five skinfolds (35 mm), body fat percentage (12%), aerobic power (50 ml/kg/min) and anaerobic power were relatively constant, whereas generally significant decreases were obtained in the flexibility and strength test scores over the three-year period of the research. Georgopoulos and associates (1999) concluded that in the elite rhythmic gymnasts psychological and somatic efforts have profound effects on growth and sexual development, but despite these aberrations, adult height is not expected to be affected. Bercades, Pieter and Angisco (1999) compared the morphological characteristics of Filipino and American rhythmic gymnasts. They found that the Filipino gymnasts were more endomorph (0.215) and more mesomorph (0.375), but less ectomorph (0.383) than the American gymnasts.

The majority of the abovementioned authors and studies, however, dealt with experienced, skilled athletes. Therefore, the need to determine the characteristic influence of certain motor abilities and skills, as well as the morphological characteristics on the performance specific skills of novice RG gymnasts is still a research issue. This issue has become even more intriguing in the last few years, due to the obvious trends in RG. This is particularly so with regards to the training of novices in RG, which is characterized by an enormous amount of motor knowledge that they are expected to attain. Novice gymnasts have to learn as many RG elements as possible at the commencement of the systematic training. The expertise level to which they are expected to master these skills is not very high at the beginning - the general intention is to achieve an approximate, rough form of the elements' execution. A more accurate and skilful performance is the goal of the training phases that are yet to come. The authors of the present study, therefore, assumed that RG novices could be a more appropriate sample for investigation and differential determination of the influence of certain motor skill factors on performance of jumps/leaps than experienced rhythmic gymnasts.

The authors also presumed that 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 on the performance of certain elements in RG novices. The established correlation may be very helpful in the early stages of the RG training process, as well as in the sport-selection process. However, certain problems should be solved first. The first problem is how to identify objectively and assess the quality of the element execution as performed by novice rhythmic gymnasts. Namely, the characteristic "rough-form execution" of elements, as required in the beginning of the teaching-learning process in RG, does not make rigorous evaluation suitable. And, yet, the differences in performance quality among the evaluated gymnasts exist and must be estimated somehow. So, the performing quality of novice gymnasts has to be established on a basis quite different from the procedures and criteria prescribed by the FIG's (Fédération Internationale de Gymnastique) *Code of Points in RG* (2001), which are used for assessing the performance quality in experienced, skilled athletes**.** 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. The "basic motor abilities and skills" is a very wide definition. If we ignore the variety of the basic-motor-skill interpretation models, several questions still remain, among which the major one is: Which combination of motor skills describes best the performance of RG novices? We have tried to give an answer to this question in this paper.

The aim of the study was to establish the quality of leaping/jumping performance, and to determine any probable influence of characteristic motor skill factors on the leaping/jumping performance in a sample of novice rhythmic gymnasts.

Methods

The sample of subjects consisted of 55 female novice rhythmic gymnasts, mean age 7.1 ± 0.3 years. All 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 novice (sports-school) programmes. An attempt was made to recruit female pupils (from the population of 337 peers who joined sports-school programmes for novice voluntarily) that were above-average in flexibility and coordination dimensions as compared to the data presented in NORMS by Findak, Metikoš, Mraković and Neljak, (1996).

The sample of variables consisted of 12 motor variables that were suggested by Metikoš and associates (1989) and Katić, Bonacin and Blažević (2001): coordination tests (POLYGON, AGILITY), of coordination in rhythm test (HAND-DRUMMING), tests assessing frequency of movement (HAND-TAPPING and FOOT-TAPPING), strength tests (SIT-UPS and SQUATS), power tests (VERTICAL JUMP, i.e. Sargent and MED-BALL-THROW), and tests assessing flexibility (SIT-AND-REACH, LEFT SPLIT and RIGHT SPLIT – the latter two according to Hume and associates, 1993). The first day the subjects were tested for coordination, rhythm coordination, frequency of movement and flexibility. The next day they participated in power and strength tests.

Data processing methods. The descriptive statistics for each of the variables were calculated and the resulting means, minima, maxima and standard deviations are presented.

To assess some metric characteristics of the tests used, the Kolmogorov-Smirnov test was employed and the Cronbach's alpha and the inter-item correlation were calculated.

To determine the relations between the set of motor variables (left set) and leaping performance variables (right set), linear correlation and canonical correlation analyses were performed.

All coefficients were considered significant at $p \leq 0.05$.

The experimental design had two phases. In the first phase of the experiment, the motor tests were implemented. After the one school-year period (nine months) of the standard RG training programme for novices, implemented three times a week (4 hours per week), the performance was tested. The 55 participants were obliged to perform the following nine leaping routines with and without an apparatus:

1. COSSACK – Cossack leap
2. STAG – stag leap
3. SPLIT – split leap
4. SCISSORS – skips and scissors leap through an open rope, rotated forwards by both hands
5. COSS-ROPE – rotation of the rope in one hand and Cossack leap
6. STAG-BALL – throwing and catching the ball and stag leap (either the standard or the two-handed one)
7. COSS-HOOP – Cossack leap through a hoop
8. STAG-CLUBS – large circles with clubs and stag leap
9. SPLIT-RIBBON – large circles with ribbon and split leap.

All the tests consisted of basic body elements and some basic techniques with various apparatus es (A difficulty – according to FIG's Code of Points, 2001). The authors tried to select elements which they considered to be adequate for beginners.

In order to avoid any subjective assessment (Sekulić, 2002), performances of all the participants were firstly videotaped. Five independent expert (national level) RG judges evaluated afterwards the performances on the Likert scale (1-5) by watching the videotaped material. The authors tried to simplify the judging procedure. Therefore, the standard RG judging score was avoided, since it was more suitable for assessing compositions than for evaluating single elements. The judges evaluated form, amplitude and height of the leaps/jumps executed, as well as the basic movement pattern of the apparatus in question.

Results

Table 1. Descriptive statistics of scores achieved in the motor variables (Mean, Min = minimum, Max = maximum, SD = standard deviation)

	Mean	Min	Max	SD
POLYGON (s)	24.73	11.74	53.53	7.59
AGILITY (s)	15.09	11.95	20.00	1.43
HAND-TAPPING (f)*	17.72	12.00	24.33	2.45
FOOT-TAPPING (f)	15.32	10.66	20.00	1.95
SARGENT (cm)	21.19	13.00	31.66	4.37
MED-BALL (m)	2.52	1.81	3.91	0.47
SIT-UPS (f)	22.70	0.00	43.00	8.60
SQUATS (f)	39.49	9.00	59.00	9.80
SIT-REACH (cm)	53.16	30.66	72.33	7.79
SPLIT R (°)	78.21	62.66	106.00	8.26
SPLIT L (°)	91.17	68.00	132.66	11.34
HAND-DRUMMING (f)	5.17	1.66	9.66	1.86

*f = frequency

Table 2. Descriptive statistics of the leaping-performance variables (Mean, Min, Max, SD); Kolmogorov-Smirnov test (KS d); reliability and item analysis (Cronbach's alpha coefficient – Cronbach's alpha, average inter item correlation coefficient – Aver R)

VARIABLES	Calculated as Mean of all five judges					Cronbach's alpha	Aver R
	Mean	Min	Max	SD	KS d		
COSSACK	2.86	1.00	5.00	1.08	0.09	0.95	0.79
STAG	3.05	1.00	5.00	1.16	0.09	0.96	0.84
SPLIT	2.42	1.00	4.60	1.10	0.11	0.96	0.83
SCISSORS	2.90	1.00	5.00	1.03	0.12	0.96	0.81
COSS-ROPE	2.78	1.00	5.00	1.11	0.09	0.96	0.83
STAG-BALL	2.58	1.00	4.80	1.23	0.10	0.97	0.87
COSS-HOOP	2.71	1.00	5.00	1.09	0.10	0.96	0.83
STAG-CLUBS	2.87	1.40	5.00	0.97	0.09	0.93	0.73
SPLIT-RIBBON	2.62	1.00	5.00	1.09	0.12	0.96	0.84

Note: The KS test is considered significant for d > 0.18

Table 3. Cross-correlations (the coefficients in bold are significant at $p \leq 0.05$)

	COSSACK	STAG	SPLIT	SCISSORS	COSS-ROPE	STAG-BALL	COSS-HOOP	STAG-CLUBS	SPLIT-RIBBON
POLYGON	**-0.42**	**-0.36**	**-0.45**	**-0.36**	**-0.36**	**-0.52**	-0.20	**-0.27**	**-0.30**
AGILITY	**-0.36**	**-0.40**	**-0.41**	**-0.54**	**-0.40**	**-0.52**	**-0.34**	**-0.36**	**-0.41**
HAND-TAPPING	**0.36**	**0.30**	**0.42**	**0.39**	0.25	**0.44**	**0.41**	**0.40**	**0.35**
FOOT-TAPPING	**0.40**	**0.37**	**0.43**	**0.48**	0.21	**0.34**	**0.34**	**0.30**	**0.37**
VERTICAL JUMP	**0.49**	**0.56**	**0.51**	**0.53**	**0.47**	**0.58**	**0.33**	**0.44**	**0.34**
MED-BALL	**0.31**	**0.50**	**0.44**	**0.42**	**0.37**	**0.46**	**0.30**	0.26	**0.34**
SIT-UPS	**0.45**	**0.50**	**0.44**	**0.53**	0.26	**0.49**	**0.35**	**0.49**	**0.36**
SQUATS	**0.35**	**0.39**	**0.38**	**0.56**	**0.32**	**0.36**	**0.33**	**0.42**	**0.46**
SIT-REACH	0.25	0.16	0.23	**0.28**	**0.30**	0.20	**0.28**	0.18	**0.33**
SPLIT R	0.23	0.17	**0.30**	0.22	0.19	0.20	0.23	0.18	0.25
SPLIT L	**0.31**	**0.27**	**0.30**	**0.33**	**0.37**	**0.31**	**0.31**	0.19	**0.28**
HAND-DRUMMING	**0.46**	**0.50**	**0.45**	**0.54**	**0.32**	**0.46**	**0.43**	**0.44**	**0.52**

Table 4. Canonical correlation – successful roots (canonical correlation coefficient – Can R; coefficient of canonical determination – Can Rsq; canonical root's structure - F; level of significance – p)

	F		F
POLYGON	-0.61	COSSACK	0.75
AGILITY	-0.65	STAG	0.82
HAND-TAPPING	0.53	SPLIT	0.69
FOOT-TAPPING	0.42	SCISSORS	0.79
VERTICAL JUMP	0.71	COSS-ROPE	0.71
MED-BALL	0.54	STAG-BALL	0.96
SIT-UPS	0.64	COSS-HOOP	0.60
SQUATS	0.48	STAG-CLUBS	0.65
SIT-REACH	0.28	SPLIT-RIBBON	0.58
SPLIT R	0.21		
SPLIT L	0.39		
HAND-DRUMMING	0.62		
Variance Extracted	*0.28*		*0.54*
Can R		*0.805*	
Can Rsq		*0.648*	
p		*0.016*	

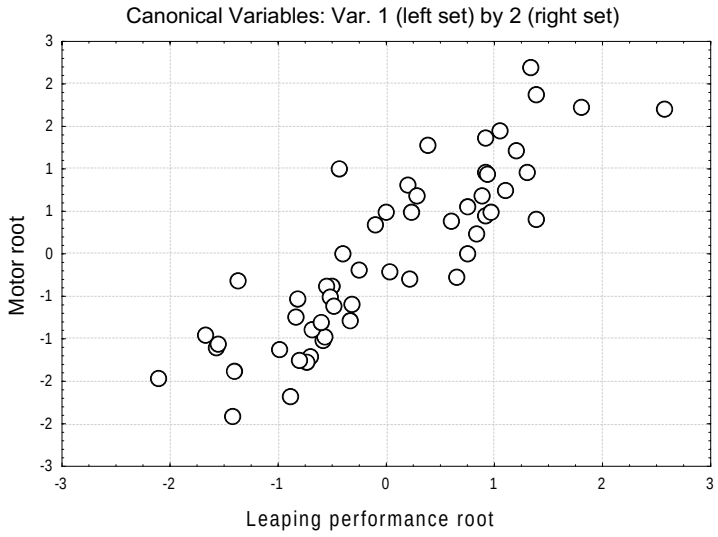

Figure 1. Graphic presentation of the canonical root's correlation.

The descriptive statistical parameters of the results the participants achieved in the antecedent motor tests are presented in Table 1. When compared to the standardized values presented by Findak and associates (1996), the observed 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 its 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, power and strength) made the selection of subjects possible by focusing on the dimensions of flexibility and coordination. The intention of the initial selection was to distinguish the above-average flexible and coordinated girls from the rest of the female population of first graders. In the background of the experiment concept was the assumption that these motor abilities, highly developed, might have a potentially positive influence on the faster progress and better motor learning in rhythmic gymnastics.

The descriptive statistical parameters, the results of objectivity (reliability) and item analyses of the criterion variables (the RG leaps/jumps performance quality) are presented in Table 2. The Cronbach's alpha coefficients and the average inter-item correlation coefficients, as the indicators of objectivity of the five judges, were calculated. The alpha coefficients for all the nine criterion variables (RG leaps) exceed the value of 0.90, which confirms a high level of objectivity of the instrument. The normality of distribution, estimated by the Kolmogorov-Smirnov test, was satisfactory for all the variables. No significant differences were observed between the observed distribution parameters and the expected normal distributions ($p > 0.05$).

In Tables 3 and 4 the results of the linear and canonical correlation analyses between the set of predictors (the motor ability variables) and the set of criteria (the RG leaps performance marks) are presented. The linear cross-correlation matrix (Table 3) presents the partial-correlation coefficients between the two sets. Even at first glance a large number of significant correlation coefficients are obvious, among which the connections between coordination and explosive strength (power) with the criterion variables excel.

By means of canonical correlation analysis (Table 4) one significant pair of canonical roots was extracted, which described 65% of common variance of the two sets (Can Rsq = 0.648). As seen in Figure 1, the better results on the left motor root determined the better results on the leaping performance root.

Discussion and conclusions

Although the canonical analysis does not recognize the sets of predictors and criteria, in this text the motor set was named as "predictors" and the set of the leaping performance variables was named as "criteria", for better understanding. The numerically high relation between specific motor learning of RG elements (or the RG elements attainment speed), on the one hand, and the analysed motor abilities, determined by the 65% of the common variance explained by the applied canonical correlation analysis, on the other, yields that successfulness or quality of performance in RG, like in most sports events, can be strongly predicted by the level to which the sport-specific, therefore relevant, motor abilities are developed. Since not all the motor tests contributed equally to the explanation of the motor canonical factor set, it would be useful to establish their hierarchy. As can be inferred from the results of linear correlation analysis, which indicated that certain variables shared most of the significant correlation coefficients, the main part of the motor-ability root was explained by projections of the coordination and strength variables. Projections of the variables determining the frequency of movement followed. The correlation with the canonical root was observed for the flexibility measures as well. The negative correlations of the coordination variables with the corresponding canonical root are a logical consequence of the measuring procedure used for certain coordination variables (POLYGON and AGILITY - the time variables measured in seconds, so, they are the reverse scaled variables).

All the analysed leaping elements of rhythmic gymnastics shared almost an equal contribution to the leaping performance root variance, with projections ranging from moderate (0.58 – SPLIT-RIBBON) to high (0.96 – STAG-BALL). Although coherent correlation has been established, for the sake of further discussion, a particular explanation of the leaping performance will be appropriate. The variable STAG-BALL can be considered as the most dominant of the leaping performance ($r = 0.96$), followed, in descending order by the variables STAG and SCISSORS (0.82 and 0.79, respectively). A relatively small part of the variability is under the influence of the variables STAG-HOOP and SPLIT-RIBBON.

Consequently, the connection between the assessed motor abilities and the quality of performing the observed RG leaps can be described as follows. Coordination, that complex motor ability, can conversely be 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 RG leaping performance. In fact, the named "simplified" definitions of coordination present the true-logic of the obtained canonical correlation. The present investigation was conducted with novices in rhythmic gymnastics. Naturally, the participants characterized by a higher level of coordination are expected to be more apt for any kind of motor learning, including RG motor learning. Consequently, the characteristics of the leaping performance are very logical from the aspect of proficiency in RG. The variable STAG-BALL is among the most complicated elements in the novice RG training programme. A gymnast has to execute a very complex element, consisting of manipulation with the ball, then simultaneous leaping and throwing, which are followed by soft landing and synchronized ball catching. The coordination or visuo-motor proficiency demands of the performance are more than obvious. But it is not only coordination that is involved in the performance of the described element. The highly pondered component in the performance evaluation of the named element (STAG-BALL), but also of the rest of the highly projected variables (STAG and SCISSORS), is related to the height of the leap/jump executed. Thus, the correlation with the dimension of explosive strength is embodied. The same explanation of the connections between coordination and strength, on the one hand, and the elements performance efficiency, on the other, can be applied to all the other analysed RG elements.

As mentioned before, several authors have so far determined the positive influence of coordination (Furjan – Mandić, 1990; Kioumourtzoglou et al., 1997) and selected muscular endurance and power dimensions (Wolf – Cvitak, 1984; Hume et al., 1993) on the performance efficiency in rhythmic gymnastics. Meanwhile, some authors have suggested a strong correlation between the measures of flexibility and RG performance scores (Hume et al., 1993). As could be seen in Table 4, and in Table 3 also, the dimension of flexibility, both absolutely and relatively, explained only a small part of the motor control canonical root set in our case (a lower number of significant linear cross-correlation coefficients and fewer projections on the canonical root of the left set). Thus, as compared to the other observed motor variables, the measures of flexibility are partially and globally the least significant for an explanation of the relations between the motor abilities and leaping

performance in the present study. This finding contradicts the aforementioned conclusions of several authors, but it could be explained by the differences in the samples of subjects. The investigation of Hume and associates (1993), in which the significant prediction value of flexibility for the RG efficiency criteria was established, dealt with elite, or at least, national level (senior) RG athletes, whereas the sample of participants in our investigation consisted of beginners in rhythmic gymnastics. In the last few years, due to the official rule changes, the main goal of the early-stage RG training has been an attainment of a great number of RG elements. Therefore, the efficacy or expertise level in the novice RG athletes has to be determined by inspecting the level of the sport-specific knowledge (RG leaping/jumping performance, in this case). In 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 of range of motion. So, at more advanced training and competition levels, flexibility is probably one of the most important motor factors that highly influences the performance score in RG routine performances, as some authors have already demonstrated.

The main scope of the contemporary RG training in the first active period is a comprehensive motor learning, that means attainment of as many RG elements, or completely new RG motor programmes, as possible. According to the results obtained in our study, the motor learning capacity of the RG novices is mostly influenced by coordination. 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. It is not exclusively coordination that has been found to be a significant predictor of the RG leaping efficiency. According to the results of linear correlation and canonical correlation analyses, power (leg power, in the first place) also contributes to a better performance evaluation (grades) of the leaping elements. Its positive influence is manifested as increased height and length of leaps, and as improved speed with which routines are executed.

Although expected, the influence of flexibility on the RG leaping performance was not found to be significant. Probably, the novices were considerably better in some other strongly appreciated components of performance than in the range of motion, which is highly affected by flexibility.

The influence of the measured motor abilities on the performance of RG leaps/jumps in the sample of the novices in rhythmic gymnastics was the main scope of the investigation. Further studies have to establish such relations for the rest of the RG routines.

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RAZINA MOTORIČKIH SPOSOBNOSTI SEDMOGODIŠNJIH POČETNICA IZRAVNO UTJEČE NA KVALITETU IZVEDBE SKOKOVA U RITMIČKOJ GIMNASTICI

Sažetak

Uvod

Skokovi su osnovna skupina elemenata tijelom u ritmičkoj gimnastici. Može se pretpostaviti da je dobro izvođenje skokova na svim težinskim razinama preduvjet za postizanje dobrih rezultata ritmičarki. Ackerman (1988) pretpostavlja da su opće motoričke sposobnosti presudne za izvedbu skokova na prvom stupnju usvajanja znanja iz ritmičke gimnastike (RG).

Osnovni cilj ovog istraživanja je kanoničkom korelacijskom analizom utvrditi utjecaj motoričkih sposobnosti na uspjeh u izvođenju skokova kod početnica u RG.

Metode

Istraživanje je provedeno na uzorku od 55 sedmogodišnjih početnica u ritmičkoj gimnastici (prva godina vježbanja). Primijenjeno je 12 motoričkih testova koji pokrivaju područje latentnih kretnih i energetskih dimenzija za koje se pretpostavlja da su nazočne i u ritmičkoj gimnastici. Odabrani su sljedeći motorički testovi: (1) poligon natraške; (2) koraci u stranu; (3) taping rukom; (4) taping nogom; (5) skok u vis – Sargent; (6) bacanje medicinke iz ležanja; (7) broj podizanje trupa iz ležanja na leđima u minuti; (8) broj čučnjeva u minuti; (9) pretklon raznožno; (10) visoko prednoženje desnom nogom iz ležanja (mjereno u stupnjevima); (11) visoko prednoženje lijevom nogom iz ležanja (mjereno u stupnjevima) i (12) ritmičko bubnjanje.

Za procjenu izvedbe skokova u ritmičkoj gimnastici odabrano je devet skokova bez sprave i sa spravom (težine razine A prema bodovnom pravilniku iz 2001. g.), primjerenih za početnice u ritmičkoj gimnastici: (1) kozački skok (bez sprave); (2) jelenji skok (bez sprave); (3) daleko–visoki skok (bez sprave); (4) trčeći koraci i skok škare kroz otvorenu vijaču okretanjem naprijed; (5) kruženje presavijenom vijačom u jednoj ruci, (6) kozački skok; bacanje i hvatanje lopte, (7) jelenji skok - prolaz kroz obruč, (8) kozački skok i kruženje čunjevima, (9) jelenji skok, kruženje trakom i daleko–visoki skok.

Uspjeh u izvođenju skokova procijenili su eksperti na temelju promatranja videozapisa. Pet sudaca neovisno je procjenjivalo uspješnost ritmičarki u svakom testu na Likertovoj ljestvici od pet stupnjeva. Povezanost motoričkih sposobnosti ritmičarki početnica s uspjehom u izvođenju skokova utvrđena je kanoničkom korelacijskom analizom.

Rezultati, rasprava i zaključak

Svi primijenjeni testovi za procjenu uspješnosti u izvođenju skokova sa spravama i bez njih imaju zadovoljavajuće vrijednosti objektivnosti (tablica 2), što ukazuje na objektivno ocjenjivanje i slaganje sudaca.

Budući da su se provjeravala samo znanja osnovnih skokova (težina razine A) te osnovne tehnike spravama, možemo pretpostaviti da djevojčice u početnoj fazi učenja osnovnih elemenata iz ritmičke gimnastike najteže usvajaju daleko-visoki skok te skokove povezane s izbacivanjem sprave (lopte). Dobro izvođenje daleko-visokog skoka zahtijeva, osim eksplozivne snage, i najviši stupanj fleksibilnosti nogu, koja se kod početnica još uvijek nije razvila do razine dostatne za kvalitetno izvođenje daleko-visokog skoka.

Kanoničkom korelacijskom analizom utvrđena je povezanost između rezultata motoričkih testova i izvođenja skokova u ritmičkoj gimnastici. Prema rezultatima linearne korelacijske i kanoničke korelacijske analize, koordinacija (osobito koordinacija u ritmu) te snaga (osobito eksplozivna snaga nogu) doprinose postizanju boljih rezultata u izvođenju skokova kod početnica u ritmičkoj gimnastici. Premda je bio očekivan, utjecaj fleksibilnosti na skokove u ritmičkoj gimnastici nije utvrđen.

Prema predstavljenim rezultatima, sposobnost za motoričko učenje skokova u ritmičkoj gimnastici osobito je uvjetovana koordinacijom. Osim koordinacije, boljem izvođenju skokova doprinosi i eksplozivna snaga nogu. Autori pretpostavljaju da eksplozivna snaga nogu doprinosi izvođenju visokih skokova te tako omogućuje veću amplitudu pokreta.