

## INVESTIGATION OF THE STRENGTH ABILITIES OF RHYTHMIC GYMNASTS

(Research note)

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### Abstract

120 rhythmic gymnasts from every club in Sofia and Plovdiv took part in the research. The subjects were between the age of 10 and 19 years old divided into 9 age groups, around 13 gymnasts per group. The measurement of strength abilities was done with three tests: Sit ups (dynamic force of the abdominal muscles); Back strength – lifting and holding the body at a level of about 45° until exhaustion. From a lying down position (facing the floor); Maximal vertical jump with free arms: one trial allowed. ANOVA was used to identify differences between the nine age groups. Pierson correlation analysis was applied on the three tests in order to find relation between the different muscle groups. The results from the three strength tests show the level of physical preparation in the main muscle groups needed in rhythmic gymnastics. The overall low results indicate a possibility for development in the measured ability of the subjects

**Keywords:** muscle flexibility, motor coordination, physical fitness, explosive leg strength, dynamic force of dorsal muscles, the dorsal muscle endurance, coefficient of correlation, analysis of variance (ANOVA).

### INTRODUCTION

The most important abilities in rhythmic gymnastics are considered to be flexibility and coordination. Nevertheless the physical preparation in this sport is vastly neglected compared to the technical one. For this particular reason the aim of this research is to prove that the physical preparedness and strength conditioning in particular can be easily improved and quickly enhance the sport result. Three basic tests were used to measure the gymnast's current state within the condition field. All of them are easy to use and applicable in practice. The collected results acknowledge the gaps in the gymnast's preparation.

Prerequisite for an excellent technical performance is the proper level of the physical preparation. Flexibility and coordination are determined as the most important abilities in rhythmic gymnastics (Gateva & Andonov, (Гатева & Андонов), 2005); Hadjiev, Andonov, Dobrev, & Petrov (Хаджиев, Андонов, Добрев, & Петров), 2011). The lack of sufficient physical preparation is one of the major problems appearing into the practice. This is a result of the negligence of the coaches due to their focusing mainly on the technical preparation

(Gateva (Гатева), 2008); Monem, Sands, Salmela, Holvoet, & Gateva (Monem, Sands, Salmela, Holvoet, & Gateva) 2011). The most neglected area of preparation is the strength conditioning. There are few articles (Gorohova (Горохова), 2002). Makarova, & Menhin (Макарова & Менхин), 1997; Menhin & Makarova (Менхин, & Макарова), 1997; Novohatnaia, & Vlasjuk, (Новохатняя & Власюк) 2005, about the physical abilities in rhythmic gymnastics where the problems about the power and strength are reviewed. We find as unacceptable that in some clubs there are cases of eight hours of training per day from which only five minutes are spared for physical preparation Gateva (Гатева), 2008.

The aim of this article is to measure and investigate the strength ability of rhythmic gymnasts.

We determined the following *objective* in order to achieve our aim:

1. To estimate the level of strength conditioning of abdominal and back muscles and the power of the lower limb of rhythmic gymnasts
2. To determine the level of power and strength conditioning according to the different age groups
3. To discover correlations between the variables and age groups.

## METHODS

### Subjects

120 rhythmic gymnasts from all clubs in Sofia and Plovdiv took part in the research. The subjects were between the age of 10 and 19 years old, divided into 9 age groups, around 13 gymnasts per group. The gymnasts were in their competitive period several weeks before the main competition of the season. All gymnasts had their own training regime.

### Preparation and protocol of the testing

The testing was done in one day. Prior to the start of the test gymnasts performed a good warm up for 10 min.

The measurement of strength abilities was done with three tests:

- Sit ups (dynamic force of the abdominal muscles): 15 repetitions are made as quick as possible. Each time the performer should touch his chest with the knees. The result is in seconds.

- Back strength - lifting and holding the body at a level of about 45° until exhaustion. From a lying down position (facing the floor), hands are up, straight and behind the head, legs are held by a partner: lift the body, without bending the back and hold until exhaustion. The result is in seconds.

- Maximal vertical jump with free arms: one trial allowed

We measure the distance between the highest point the subject can reach with a raised hand in a standing position and the point reached by hand during the jump.

### Procedure of data analysis

Descriptive statistics were performed for the data analysis with the objective of identifying and characterizing the level of physical condition. ANOVA was used to identify differences between the nine age groups. Pierson correlation analysis was applied on the three tests in order to find relation between the different muscle groups. The level of significance of  $p < 0.05$  was adopted in all cases.

## RESULTS

The three tests measure the main and most important muscle groups in rhythmic gymnasts' body. Back and abdominal muscle control are the basis for a successful technical performance in two of the three main body group exercises – pirouettes and balances; lower limb power is a key ability for jumps and leaps. Based on their rather easy application in field conditions due to the lack of sophisticated measuring equipment for determining the level of strength condition, those three tests are the simplest and quickest way for the coach to control and estimate the progress of the gymnasts.

The results from the *first test*– sit ups test, show expected decrease in the execution time – starting from 16 seconds with the 11 years old gymnast and going down to 13,8 seconds for the last age group tested – 19 years old. The difference between the groups is significant –  $p = 0.03$ ; nevertheless values vary in between age groups. The best result of 12,4 seconds is displayed by the 18 years old gymnasts and the second best of 12,8 from the 15 years old. All the other values are between 13 and 14 seconds except for the first age group, where the girls are slower than the others.

The *second test* (back strength) – lifting and holding the body at a 45° displays abnormal results with all age groups lacking significant differences with the exception of the first age group where lower values are recorded again. The average time for execution (holding the body in that position) is between 70 and 79 sec for different age group gymnasts. For the 11 years old the result is extremely lower – 41 sec. Those values should have a big impact on the specialists working in the area of rhythmic gymnastics, especially to the coaches who are responsible for the physical preparation and proper conditioning in our sport. The second problem that occurs is the lack of improvement in the strength of the back muscles during the development of the gymnast.

The *vertical jump test* gives us average results from 33 to 35 cm for all age groups except the youngest and the oldest who have respectively 29,4 and 37,4 cm. There is a significant difference between those two groups while there is a slight variation in the results of

Table 1. Descriptive Statistics

Age group	N	Abdominal muscle				Back muscle				Vertical jump			
		Min	Max	Mean	Sd.	Min	Max	Mean	Sd.	Min	Max	Mean	Sd.
11	12	15,0	17,6	16,0	1,0	34,7	50,4	41,7	7,2	26,0	33,0	29,4	2,8
12	17	9,7	20,0	14,4	2,0	39,6	160,0	74,7	30,8	22,0	49,0	32,7	6,0
13	11	9,9	18,0	13,4	2,0	31,5	106,3	71,3	21,4	25,0	47,0	34,0	6,1
14	15	10,9	16,1	14,0	1,5	40,9	102,2	73,0	20,3	28,0	41,0	33,9	3,8
15	12	11,3	16,3	12,8	1,8	41,0	94,0	73,0	18,6	30,0	40,0	35,1	3,2
16	15	10,7	17,4	13,8	2,4	44,8	106,7	70,4	20,8	27,0	44,0	34,6	5,0
17	13	11,8	18,0	14,8	2,3	35,7	124,0	70,8	30,3	28,0	42,0	34,6	4,1
18	14	9,7	15,7	12,4	2,1	46,4	122,0	78,8	28,5	26,0	43,0	33,0	5,7
19	11	11,1	17,8	13,8	2,7	54,7	125,0	79,5	26,6	32,0	53,0	37,4	8,7

Table 2. Results of Analysis of variance (ANOVA)

Variables	F	Sig.
Abdominal muscle	2,210	,032
Back muscle	2,112	,040
Lower limb power	2,281	,028

Table 3. Correlations between the variables

Tests	Abdominal muscle	Back muscle	Vertical jump	Age group
Abdominal muscle	1			
Back muscle	-,277**	1		
Vertical jump	-,169	,223*	1	
Age group	-,164	,105	,164	1
	,079	,264	,079	

\*\* . Correlation is significant at the 0.01 level (2-tailed). N - 120

\* . Correlation is significant at the 0.05 level (2-tailed).

the other seven groups which we find insignificant. There is an increase in the values going up from the first to the last age group and the height of the jump has improved as expected. Comparing our results with the results from the same test of the National System of Evaluation and Control of the Physical Preparation in rhythmic gymnastics, created by Ilia Vankov and approved and adopted by the Bulgarian Rhythmic Gymnastics Federation in 1983., we could see how our testing has the lowest value achieved in all age groups Vankov (Банков), 1982; Vankov (Банков), 1983.

We discovered a correlation between the back and abdominal muscle strength test and another one between the lower limb power and the back holding. The level of significance is 0,01 for the first pair and 0,05 for the second.

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## CONCLUSIONS

1. The testing determines the level of physical preparedness in all the clubs in Sofia and Plovdiv, and serves as a representative sample for the national level in Bulgaria. Correlation of results between different clubs gymnasts is not appropriate due to the non-regular number of participants from each club in each age group.

2. Difference between the age groups is seen only in few cases which is why we call for the attention of the specialists to improve and stress the importance of physical preparation in rhythmic gymnastics, apart from

flexibility and balance abilities.

3. We found a correlation between the abdominal muscles and back muscles with a high level of significance. Another significant level of correlation was discovered between back hold and maximum vertical jump.

4. The results from the three strength tests show the level of physical preparation in the main muscle groups needed in rhythmic gymnastics. The overall low results indicate a possibility for development in the measured ability of the subjects.

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