

**FACTOR STRUCTURE OF PREPAREDNESS OF YOUNG ATHLETES IN
AEROBIC GYMNASTICS**

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Purpose: to conduct a multifactor analysis of the training of young athletes in aerobic gymnastics, to identify the leading factors and justify the planning of the training process of athletes in this sport.

Material and methods: the study involved 20 athletes aged 7-9 years. Research methods: analysis and generalization of data of scientific and methodical literature, pedagogical observation, pedagogical testing, pedagogical experiment and methods of mathematical statistics.

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Results: the current state of the training process of young athletes in aerobic gymnastics has been studied and the specifics of this sport have been studied. The factor structure of training of young athletes of aerobic gymnastics is determined and 6 main factors are established. It has been experimentally proved and mathematically

confirmed that the first and most important factor included indicators of speed and strength training and topping test in combination with anthropometric data. The obtained data coincide with the data of correlation analysis and indicate that in modern aerobic gymnastics the accuracy of movements should be combined with speed and strength training and anthropometric data.

Conclusions: the results of factor analysis showed that when teaching the basic technical elements in aerobic gymnastics should focus not only on the spatio-temporal parameters of performance, but also on the speed-power aspect of their performance.

Keywords: aerobic gymnastics, factor analysis, young athletes 7-9 years old.

Introduction

Modern aerobic gymnastics requires the development of methods that will optimize the training process [3, 6, 14]. This is quite a difficult task, because the volume and intensity of training loads can not increase indefinitely [4, 5, 13]. This problem is further complicated by the fact that aerobic gymnastics is a complex coordination and athletic sport, which requires the development of all physical qualities [2, 3, 11], as well as possession of a wide arsenal of techniques and elements of complexity [1, 3, 11]. Therefore, for the harmonious construction of the educational and training process in aerobic gymnastics, the first priority is the need to determine the main directions of its construction.

According to leading experts in gymnastics [8, 9, 12], for a competent construction of the training process in aerobic gymnastics should use a wide range of indicators of preparedness, modern methods of analysis of the data [2, 11, 15]. Based on the synthesis of a wide arsenal of indicators of readiness to create training methods that best meet the requirements of the training process in a particular period of time, becomes quite relevant. Of the modern mathematical tools, the most suitable for this is factor analysis [10] of a wide range of indicators of preparedness.

Connection of research with scientific programs, plans, topics, programs. The study was conducted in accordance with the initiative theme of the Department of Gymnastics, Dance and Choreography Kharkiv state Academy of Physical Culture, «Theoretical and methodological foundations of system-forming components of physical culture (sports, fitness and recreation)» for 2020-2025, state registration number 0120U101215.

Purpose of the work is to conduct a multifactor analysis of the training of young athletes in aerobic gymnastics, to identify the leading factors and justify the planning of the training process of athletes in this sport.

Objectives:

1. To study the current state of the training process of young athletes in aerobic gymnastics.
2. To determine the factor structure of training of young athletes in aerobic gymnastics.

Material and Methods of research

The study was conducted on the basis of the municipal institution of children's youth sports school № 13 in Kharkiv. The experiment was attended by 20 athletes (7-8 years), the initial training group of the second year of study.

To solve this goal, research methods were used: analysis of scientific and methodological literature and documentary materials; questionnaire; pedagogical observation (in particular through video recording, analysis and evaluation of results to understand the characteristics of competitive activities and individual sportsmanship and training loads of athletes in aerobic gymnastics); pedagogical testing (to adjust tactics and training strategies); pedagogical experiment; expert evaluation (to identify and predict the degree of effectiveness of the results of the study); pedagogical testing and medical and biological examinations to determine the level of physical fitness; methods of mathematical statistics (correlation and factor analysis), using licensed packages of statistical computer programs «SPSS» and «XLSTT» (add-on to Excel) – to summarize the results and form objective conclusions.

The material for the analysis of the research results was the indicators of the extended complex testing of young athletes of aerobic gymnastics. The choice of tests to obtain information on the level of assessment of special physical and technical fitness was based on the analysis of the dominant motor mode of competitive exercises and the specifics of aerobic gymnastics, age characteristics of athletes and modern competition rules, as well as previous research in complex coordination sports (sports and rhythmic gymnastics, sports acrobatics, figure skating, cheerleading, etc.) [8, 9, 13]. Given this, to assess the level of special physical fitness of young athletes developed and used a set of control exercises, which are justified by the authors and meet the requirements of the theory of standardization of tests and sports metrology [4, 5, 7]. In addition, as an indicator of the level of development of the body of athletes, physical development was determined: 1) age (years); 2) height (cm); 3) weight (kg); 4) heart rate (beats, min); 5) VCL (ml). The results were processed using the methods of mathematical statistics [10].

Results of the research

Based on the results of extended comprehensive testing of young athletes, standardization of set values of variables was carried out. Pearson's correlation coefficients between the considered variables were calculated and the so-called relative variances of simple components (factors) or eigenvalues of factors, the number of which coincides with the number of indicators, were determined on the basis of the correlation matrix. The eigenvalues of the components (factors) were sorted in descending order (Fig. 1). Orthogonal rotation by the varimax method was performed to obtain unambiguous solutions.

As you can see from this chart, the number of main factors is six. At the next stage of the study was determined by the characteristics of the main factors whose contribution to the total variance is 100% of the total variance (Table 1).

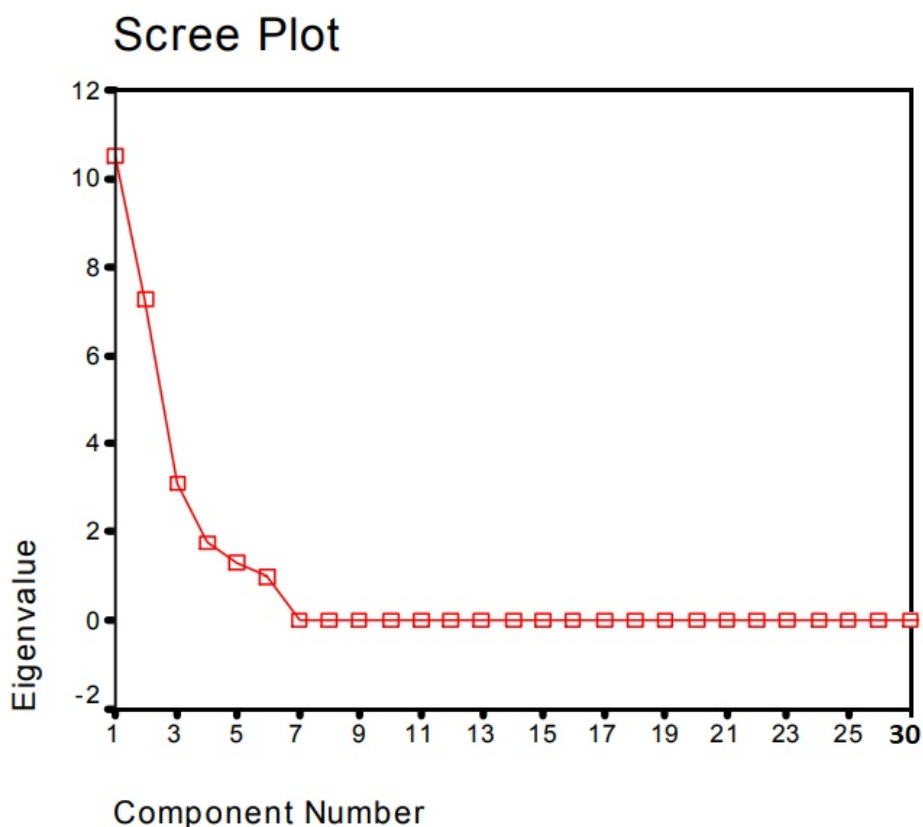


Fig.1 Diagram of eigenvalues of factors

Table 1 highlights the factor loads, based on which the semantic value of the factors is identified (Fig. 2).

The first factor (28,7%) conditionally named the factor of «speed and strength» included the following test indicators: height, weight, speed jump, jump, PWC170, shuttle speed and the complexity of aerobic gymnastics «group jump». It is easy to see that the growth, weight and absolute value of PWC170 are interdependent naturally: it is natural that with increasing growth, weight and PWC170 increase. In addition, it should be noted that the first, main factor is the indicators of speed and strength training in combination with coordination accuracy.

The second factor (26,9%) conditionally called by us the factor of «coordination abilities» included indicators of technical elements – «connection of aerobic tracks», «2 overturns, jump with a 360° rotation», «flamingo» test and indicator musicality. The obtained data indicate that after the speed and strength training of gymnasts in connection with anthropometric data and accuracy of

movements, the most important is the coordination and ability of the body to adapt quickly, as evidenced by the negative correlation coefficient in the topping test and positive correlation coefficient in heart rate.

Table 1

Factor structure of complex testing of young athletes of aerobic gymnastics (n = 20; p <0,05)

№ i/o	TESTS	FACTORS					
		1	2	3	4	5	6
1	Body length (cm)	0,52					
2	Body weight (kg)	0,57					
3	Shuttle run 3x10 (s)	0,67					
4	Jumping uphill from a deep squat in 20 s (number of times)	0,71					
5	Jump uphill with a wave of the hands (cm)	0,55					
6	Alternate swings of the legs forward (not less than 90°) in 20s (number of times)	0,63					
7	Raising and lowering straight arms from the starting position of the leg apart, hands down for 20s (number of times)	0,77					
8	Jump «grouping» (points)	0,65					
9	Flamingo (s)		0,48				
10	Turns on the inverted gymnastic bench (number, s)		0,53				
11	2 forward jumps, 360° turn jump (points)		0,63				
12	Aerobic track connections (points)		0,78				
13	Top-clap musicality test (points)		0,62				
14	360° rotation in vertical twine (points)		0,59				
15	Topping test (s)	0,48	0,51				
16	Age (years)			0,56			
17	Heart rate (beats/min)			0,51			
18	Flexion and extension of the arms in the supine position (number of times)			0,74			
19	Lifting the torso to the seat from a sitting position (number of times)			0,82			
20	Holding the «chair» position near the wall (s)			0,68			
21	Emphasis on the angle of the leg apart (s)			0,66			
22	Bridge (points)				0,55		
23	Unscrew with gymnastic stick (points)				0,49		
24	Tilt the torso forward from a sitting position on the floor (cm)				0,75		
25	Twine right, left, lumbar				0,68		
26	Pike (Bali)				0,66		
27	Running on the spot for 5s (number of times)					0,61	
28	Dietrich falling stick grip (cm)					0,73	
29	VCL (ml)						0,58
30	PWC170						0,47
Contribution to variance%		28,7	26,9	20,8	14,6	5,2	3,8
Cumulative contribution to variance%		28,7	55,6	76,4	91,0	96,2	100

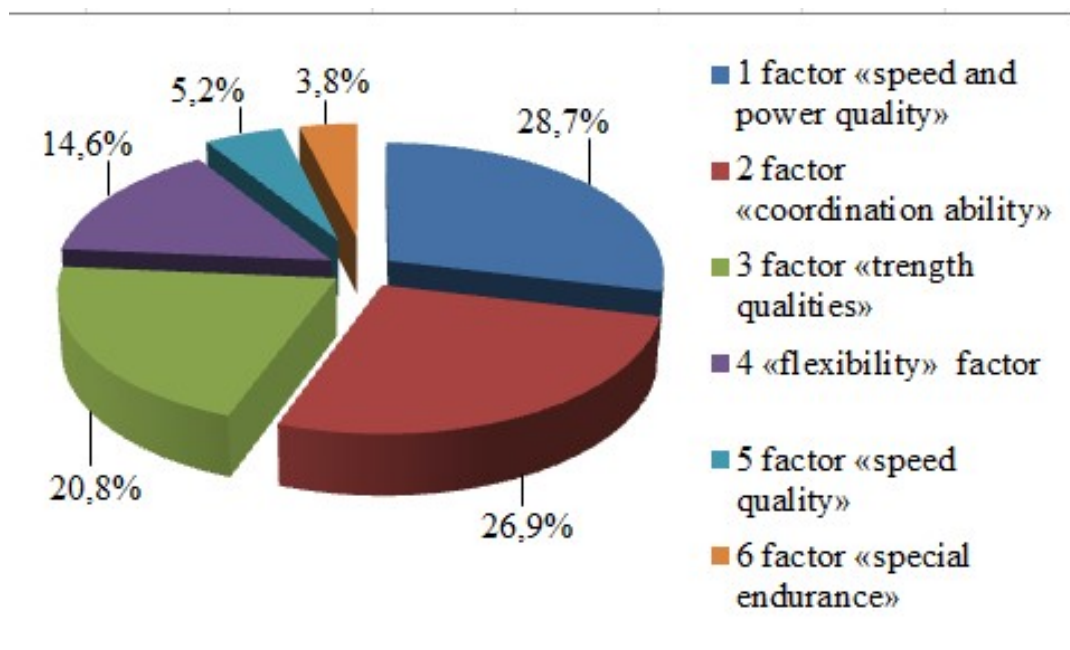


Fig. 2 Percentage value from the total variance of the main factors of complex testing of young aerobic gymnastics athletes

The third factor (20,8%) was interpreted as a factor of «strength qualities» which included such indicators as flexion and extension of the arms in the supine position, lifting the torso in the buttocks from a sitting position, «emphasis at the angle of the leg apart», which indicates enough a significant contribution to the strength training of athletes in this sport

The fourth factor (14,6%) determining «flexibility» included indicators - twine, slope, city and the element of complexity «cake», which indicates the relationship of flexibility indicators with the technical component.

The fifth factor (5,2%), which we named as the factor of «speed qualities», included indicators of speed technique and heart rate, which indicates the relationship of technique with the ability to relax, and the sixth factor (3.8%) – «special endurance», included PWC₁₇₀ and VC. However, the fact that the first and most important factor includes indicators of speed and strength training and accuracy of movement in combination with anthropometric data.

The obtained data coincide with the data of correlation analysis and indicate that in modern aerobic gymnastics the accuracy of movements should be combined with speed and strength training and anthropometric data.

Conclusions / Discussion

The results of the study confirm the existing opinion that the problem of improving the training process is still relevant [4, 5]. The authors of the works argued the planning of the training process for young athletes. In our study, the specifics of the training process in aerobic gymnastics at the stage of initial training were studied for the first time. Effective means, methods and methodical methods of training process are revealed and practically substantiated.

The results of the factor analysis showed that the applied indicators of the extended complex testing of young athletes of aerobic gymnastics are divided into six main factors. The first and most important factor included indicators of speed and strength training and topping test in combination with anthropometric data. The obtained data coincide with the data of correlation analysis and indicate that in modern aerobic gymnastics the accuracy of movements should be combined with speed and strength training and anthropometric data.

When teaching the basic technical elements in aerobic gymnastics, emphasis should be placed not only on the spatio-temporal parameters of performance, but also on the speed-power aspect of their performance. This requires the development of appropriate teaching methods.

In the perspective of further research it is planned to develop individual training programs for aerobic gymnastics athletes based on factor models of their training.

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