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CORRELATION OF THE SPECIFIC TESTING INDICATORS IN
WOMEN'S ARTISTIC GYMNASTICS TRAINING

Victor Buftea (a)*

*Corresponding author

(a) State University of Physical Education and Sport, 22 Andrei Doga St., Chisinau, Moldova,

Abstract

This paper aims to present the correlative analysis of the specific testing indicators of elite female gymnasts for checking the degree of connection between the various forms of training and practicing. For this purpose, an experimental ascertaining-preventive study was conducted in the national team of women's artistic gymnastics of the Republic of Moldova in the training macro-cycles 2010-2011 and 2011-2012, with the participation of 20 athletes. The following methods were used in this research: bibliographic study regarding the theoretical-conceptual, methodological and practical essences shown in the specialised scientific and methodical literature and the documentary materials; pedagogical observation; method of specific testing; pedagogical experiment; statistical-mathematical method and graphical representation of data. Thus, the specific tests considered to be useful and efficient for most of the training forms were selected, distributed and implemented. These tests are meant to help determine the training level of the most efficient cognitive traits, the complex of motor skills, technical abilities, affective-attitudinal traits, somatic and functional area and scope of creative aptitudes. The correlative analysis proves that, in most cases, these indicators have poor connections between the testing types, one of the solutions that could be used as a basis for the reorganization of elite gymnasts' training process. It can also contribute to the development of the strategic planning and control structure of the multi-annual training activity in women's artistic gymnastics.

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Keywords: Gymnastics, correlation, specific testing, training, performance.



1. Introduction

Artistic gymnastics develops in accordance with the laws and trends of world sport. The concept of development and improvement of artistic gymnastics was created during the preparation for the Olympic cycles, when the methodology was also established, enabling the efficient carrying out of the multi-annual athletic training (Arkaev & Suchilin, 2004).

Some of the basic trends specific to women's artistic gymnastics, resulting from changes in the technical requirements of the FIG Code of Points, are the decrease in difficulty of the competition programs for polyathlon events, the increase in execution quality and the extension of the geographical area of gymnastics practicing worldwide (FIG, 2016).

The specialised literature explains the theoretical principles of basic athletic training that should contribute to the methodical-scientific and practical development of the instructive-educational process and competitive activity (Vieru, 1997; Grigore, 2001; Arkaev & Suchilin, 2004; Readhead, 2011; Gaverdovskji, 2014).

Creating the strategic structure of planning and control of the multi-annual training activity in women's artistic gymnastics can be the basis of a well-argued selection of the most informative and efficient tests, parameters and indicators included in the program.

2. Problem Statement

Currently, the cybernetic aspects of management are more extensively implemented in the theory and practice of sport. In the first place, it should be noticed that the cybernetic system applied to the sports training is characterised by several specific traits (Manolachi, 2018).

The basic training involves the part of the instructive process oriented towards the achievement of the appropriate level of training involving the physical (motor), technical, tactical, psychological and theoretical components of this one (Rozin, 1997; Smolevskij & Gaverdovskij, 2014; Grigore, 2001; Manolachi, 2015).

Lately, it has been noticed the tendency to highlight the functional and integral training, but also its artistic, biological and competitive aspects. The theory and methods of gymnastics also include other forms of training – for example, the preparation of vaults, swings, acrobatic lines, choreography etc. (Arkaev & Suchilin, 2004; Gaverdovskji, 2014).

Given that the requirements of performance sport are increasingly higher and it is more and more difficult to achieve high performance, nowadays we witness the transfer and adaptation to sports training of new technologies taken from other fields of activity, such as: astronaut training; biomechanics; autogenic, psychotronic and alphagenic training techniques; breathing techniques; hypnosis technique; mental training (Grigore, 2001; Prassas, Kwon, & Sands, 2006; Laßberg, Rapp, Mohler, & Krug, 2013).

3. Research Questions

The following research questions are proposed in this study:

- Will the selection, distribution and application, for the examination of specific testing indicators, prove that not all of them can be considered useful and efficient in most of the training forms?

- Can the establishment of the preparation degree and level of the most efficient tests addressing the cognitive, somatic and functional spheres, motor skills, technical abilities, attitudinal-affective traits and creative aptitudes underlie the reorganization of the training process of elite female gymnasts?

4. Purpose of the Study

This paper aims to present the correlative analysis of the specific testing indicators of elite female gymnasts for checking the degree of connection between the various forms of training and practicing.

5. Research Methods

The following methods were used in this research: bibliographic study on theoretical-conceptual, methodological and practical aspects shown in the specialised literature and documents; pedagogical observation; method of specific testing; pedagogical experiment, statistical-mathematical method and graphical representation of data. An experimental ascertaining-preventive study was conducted to this effect in the national team of women’s artistic gymnastics of the Republic of Moldova throughout the training macro-cycles 2010-2011 and 2011-2012, with the participation of 20 athletes. Hence, specific tests were selected, distributed and implemented as indicators of the cognitive, somatic and functional spheres, motor skills, technical abilities, attitudinal-affective traits and creative aptitudes. The indicators of the specific tests are described in the table content and footnotes.

The correlative analysis was performed by means of r-parametric test – Pearson’s, demonstrating the degree of connection between the indicators of the testing type and the solution that was the basis of the reorganization of the training process of elite female gymnasts.

6. Findings

After the selection, distribution and application of the specific tests considered useful and efficient for most of the training forms, the indicators of correlation coefficients in the motor skill testing were listed in Table 01.

Table 01. Indicators of correlation coefficients in the complex motor skill testing

No.	Correlative criteria	Coefficient of correlation															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Test 1 (s)																
2	Test 2 (cm)	.272															
3	Test 3 (cm)	.151	-.306														
4	Test 4 (cm)	-.124	-.509	.124													
5	Test 5 (no. of reps)	-.475	-.467	.172	-.019												
6	Test 6 (no. of reps)	-.388	-.282	.281	.189	.667											
7	Test 7 (no. of reps)	-.248	-.125	-.131	-.243	.23	-.007										
8	Test 8 (s)	-.158	.391	.143	-.622	-.24	-.299	-.163									

9	Test 9 (s)	-.535	.378	-.438	-.017	-.192	-.049	.111	.106								
10	Test 10 (s)	-.177	-.615	.492	.639	.424	.432	-.25	-.391	-.279							
11	Test 11 (no. of reps)	.022	.014	-.173	.192	-.281	-.438	.393	-.408	.124	-.127						
12	Test 12 (no. of reps)	.000	-.301	.063	.368	-.212	-.177	-.607	.182	-.031	.227	-.229					
13	Test 13 (s)	-.129	.371	-.083	-.56	.012	.166	.447	.203	.193	-.58	-.072	-.544				
14	Test 14 (degrees)	.099	.397	-.493	-.379	-.393	-.352	.537	.083	.306	.773	.326	-.373	.583			
15	Test 15 (degrees)	-.229	.013	.184	-.275	.48	.689	.144	.075	-.049	.102	-.595	-.384	.567	.017		
16	Test 16 (no. of reps)	-.487	-.113	-.325	-.039	.235	-.224	.524	-.038	.493	-.199	-.009	-.125	.249	.414	.186	

Note: Test 1 - Speed running on 20 m (s); Test 2 - Standing high jump (cm); Test 3 - Standing long jump (cm); Test 4 - Depth jump with floor repulsion (cm); Test 5 - Arm bending and unbending from handstand on low parallel bars (no. of reps); Test 6 - From hanging position, leg raising up to the grip point (no. of reps); Test 7 - Power handstand from straddled bent standing on the floor (no. of reps); Test 8 - Rope climbing on 3 m without leg support (s); Test 9 - Supported high piked position maintained (s); Test 10 - Backward horizontal hanging maintained (s); Test 11 - Piked hanging from the low bar, mounting by stretched handstand (no. of reps); Test 12 - mounting by stretched handstand on the low bar (no. of reps); Test 13- Romberg test (s); Test 14 - Matorin test - turn to the right (degrees); Test 15 - Matorin test - turn to the left (degrees); Test 16 - Backbend from a stand (no. of reps)

The results of the correlative analysis of motor skills reveal every time close or average connections ($r= 0.535$ between maintaining the high piked position, a static element included in the competition program for the balance beam and floor events, and the 20-m speed running, a compulsory exercise for the handspring vaults when the gymnast runs down the runway and springs onto the vault). This connection and others too ($r= -0,615$ between horizontal hanging maintained - a position used on uneven bars and balance beam - with standing high jump, an exercise used on the floor and in acrobatics) highlight insignificant correlations, even below 0 (zero). There is an average correlation between the tests with exercises of same origin or structural group, for example: standing long jump with the depth jump, or between Romberg test and Matorin test etc. Although most correlation coefficients do not have strong connections, it is not possible to include in gymnasts' program only the exercises belonging to the same structural group or exercises with identical content. It is necessary to include various types of exercises that prove the multilateral training of female gymnasts and the overall specific character of artistic gymnastics.

Table 02 shows the results of the indicators of correlation coefficients after testing the technical abilities in terms of handspring vaults, uneven bars, balance beam and floor.

Table 02. Indicators of correlation coefficients after the testing of technical abilities

No.	Polyathlon apparatus	Correlative criteria	Coefficient of correlation			
			1	2	3	4
1	Handspring vaults	handspring vault with 180° turn without salto	-	-	-	-
2	Uneven bars	(high bar) – mount with extended body to handstand, free circle to handstand, back giant and dismount through layout salto with landing	-.350	-	-	-
3	Balance beam	side turn over (cartwheel), round-off, dismount by back salto tucked	-.283	-.575	-	-
4	Floor	round-off, flick-flack backward, somersault backward layout	-.379	-.022	.233	-

The most important component in the development of gymnasts' sports mastery is the technical training. Technical abilities, in their turn, are different depending on the way of executing the movements on each apparatus. These connections reflect the many-sided specifics of the technical execution of various exercises on different apparatus (Koh, Jennings, Elliot, & Lloyd, 2003; Potop, & Carp, 2017; Potop, & Crețu, 2018).

Table 03 highlights the results of the indicators of correlation coefficients in the attitudinal-affective tests regarding the self-confidence index, goal orientation index, index of the ability to concentrate, training capacity index, index of performance capacity increase and index of general behaviour.

As in the case of other forms of training, insufficient attention is paid to the psychological-moral training. The indicators of correlation coefficients of the attitudinal-affective traits prove insignificant connections ($r=0.083 - 0.322$). Supporting the idea of high psychological training for female gymnasts in the advanced mastery stage, our research team considered it necessary to carefully study these aptitudes too, despite the poor connections shown by the indicators of correlation coefficients.

Table 03. Indicators of correlation coefficients in the attitudinal-affective tests

No.	Correlative criteria	Coefficient of correlation					
		1	2	3	4	5	6
1	Self-confidence index (SCI)						
2	Goal orientation index (GOI)	-.682					
3	Index of the ability to concentrate (IAC)	-.678	.322				
4	Training capacity index (TCI)	.192	-.268	-.14			
5	Index of performance capacity increase (IPCI)	-.239	.277	-.234	-.202		
6	Index of general behaviour (IGB)	.083	-.109	-.331	-.145	.174	

Table 04 shows the results of the indicators of correlation coefficients of the somatic parameters, namely the height, weight, shoulder width, thoracic perimeter, Erissman index and Pignet index.

Table 04. Indicators of correlation coefficients of the somatic parameters

No.	Correlative criteria	Coefficient of correlation					
		1	2	3	4	5	6
1	Height (cm)						
2	Weight (kg, g)	.414					
3	Shoulder width (cm)	.375	.345				
4	Thoracic perimeter at ease, breathing in and breathing out (cm)	.091	-.129	-.315			
5	Erissman index	.652	.413	.255	.216		
6	Pignet index	.298	-.193	.243	-.187	.434	

The correlational analysis of the somatic indicators reveals poor connections between the tested parameters; a special aspect is shown by the relation between Erissman index and the height (size) ($r=0.652$). The other indicators have a poor connection too, because artistic gymnastics – compared to other sport events – has specific requirements in terms of body parameters, which must be consistent with the correct technical and artistic execution of movements on each apparatus. Thus, gymnastics requires a

weight under the average value, a smaller height than average height and a body structure enabling the nice and spectacular shape of the movements. The research focused especially on the standard body parameters of gymnasts, shown in the lists with indicators for the apparatus of artistic gymnastics events.

Table 05 highlights the results of the indicators of correlation coefficients in the testing of functional capacity, namely the heart rate, blood pressure, index of effort capacity, Stange test (breathing retraining at inspiration), Ghencea test and functional state of the cardiovascular system.

Table 05. Indicators of correlation coefficients in the functional capacity testing

No.	Correlative criteria		Coefficient of correlation					
			1	2	3	4	5	6
1	Heart rate (pulse/minute)							
2	Blood pressure (mm Hg)	systolic	0.439					
3		diastolic	0.413	0.272				
4	Index of effort capacity (pulse/minute)		-0.439	-0.344	-0.014			
5	Stange test (breathing retraining at inspiration) (s)		0.295	-0.037	0.317	-0.163		
6	Ghencea Test (breathing retraining at expiration) (s)		-0.014	-0.301	-0.408	0.193	-0.376	
7	Functional state of the cardiovascular system FCxTAS 100		0.734	0.812	0.385	-0.445	0.119	-0.209

The indicators of correlation coefficients resulting from the functional capacity testing reveal stronger connections between the functional condition of the cardiovascular system and the heart rate ($r=0.734$) and poor connections between all the other tested parameters. It is worth mentioning that the functional changes occurred in gymnasts' bodies cannot be kept under control without such measurements that help to take the right decisions in terms of training effort.

Table 06 shows the results of the indicators of correlation coefficients in the testing of creative aptitudes regarding the creation and application of a composition for the floor and balance beam events, and a project of general and special physical training.

Table 06. Indicators of correlation coefficients in the testing of creative aptitudes

No.	Correlative criteria	Coefficient of correlation			
		1	2	3	4
1	Test 1, points				
2	Test 2, points	-0.194	-	-	-
3	Test 3, points	0.403	-0.018	-	-
4	Test 4, points	-0.011	0.118	-0.097	-

Note: Test 1 - Creation and application of an acrobatic combination based on ten elements; Test 2 - Creation and application of a floor routine in 32 t; Test 3 - Creation and application of an artistic combination on the balance beam; Test 4 - A project of general and special physical training (points)

Studying the creativity of gymnasts - an element of excellence in the construction of competitive elements and combinations - and also their creative manifestations in any instructional training situation,

it is found that the correlation of the performed tests is also poor ($r = -0.011-0.403$), but these indicators did not have a negative influence on their training.

Generally speaking, the correlation studied in the preventive research revealed mostly poor connections between coefficients, because of the various movements included in the respective event. At the same time, the indicators of correlation coefficients specified in the ascertaining experiment supplied useful and concrete data for a possible subsequent research.

Most of the 43 tested parameters were selected for further research; some of them were replaced by more representative tests, depending on gymnasts' age and mastery level, the specifics of gymnastics apparatus and the intensive period of body development at this age.

On the other hand, taking into account the constructive contribution of each training form, although some correlational connections are under the average value, the basic research focused on their study in order to increase the efficiency of the training process.

Obviously, these forms of specific tests and the complex of gymnasts' training forms during the studied Olympic macro-cycle (2012-2016) were permanently guided by the forms of control and coherent planning of the training activity.

7. Conclusion

The analysis of the correlative coefficients obtained following up the tests made during the preventive research proves that most of these indicators have poor connections between the testing types. This is not a random situation, because the practice on each apparatus is differentiated and contains elements belonging to various structural groups (static, dynamic ones etc.) which entail close correlative connections. It is also impossible to exclude such practice from the centralised training of gymnasts, because most of these specific tests were analysed in the basic study.

One of the solutions that could be used as a basis for the reorganization of elite female gymnasts' training process can be the development of the strategic planning and control structure of the multi-annual training activity, and also the introduction of different models of training activity in the training process oriented towards higher efficiency, where the forms of control and planning become elements of high responsibility and correctness meant to achieve the intended program.

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