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Special Fitness and the Effectiveness of Technical Preparation in Gymnastic Vault Event in Athletes at the Directed Stage

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Keywords

artistic gymnastics, special fitness, individual profiles of special fitness, gymnastic vault

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A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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Introduction

Perfecting the training process in gymnastics relies, among others, on new scientifically based values of diagnosing physical fitness and determining its influence on the effectiveness of athletes' technical preparation. Working out a methodology and organisation of studies with a technology of testing, criteria of assessment of gymnasts' sports preparation, together with determining optimal groups of means and methods of interacting can create a prospective direction of development and improvement of the theory and methodology of training. The increasing athletes' orientation towards specialisation in few selected gymnastic events distinguishes athletes at the highest level of sports mastery with a high level of various motor skills with a clear advantage of at least one leading trait. Such an example is given by a Polish gymnast Leszek Blanik – gold and bronze medallist of the Olympic Games, the World and European Championships in vaulting – earlier side “horse” jumps. He is characterised by a very high level of explosive power. He also exhibits a high degree of the development of the sense of balance and spatial-temporal orientation. That is why there is a need to deepen the knowledge in the scope of studies on special preparation already in young gymnasts on the basis of tests carried out not only in training conditions but also in laboratory conditions. The obtained information can be used for the main purposes of training with consideration of individual capabilities of each athlete. Individual interpersonal differences insofar as biological development and physical fitness have been analysed by numerous known authors, among them S. Drozdowski [1], Z. Drozdowski [2], Ważny [3], Wolański [4], Woynarowska [5]. In artistic gymnastics an important contribution to explaining the significance of parameters of somatic build, motor skills, volumes of applied training loads and forecasting sports results at various stages of a sports career was made by Cichalewska [6], Dancewicz et al. [7], Karniewicz [8], Kochanowicz [9], Kruczkowski [10], Sawczyn [11], Zasada [12], Ziemińska [13]. Still, until now individual profiles collating indices of special fitness and technical preparation in selected gymnastic events taking into account specific requirements at a given stage of training have not been worked out.

Therefore, the aim of the present study was to determine the correlation between individual profiles of leading traits of special fitness with athletes' technical preparation in the event of gymnastic vault at the directed stage of training.

Material and Methods

The study involved 60 young gymnasts aged 11–13 practising artistic gymnastics at the stage of directed training in the sports club .MKS AZS AWFIS Gdansk and in the Sports Mastery School in Gdansk. The study was carried out in laboratory, training and sports competition conditions in years 2003–2007. The athletes achieved important successes in competitions both in Poland and abroad. Among them there were Polish champions in gymnastic all-round and medallists of the finals in particular sports events.

To carry out the aim of the study, the following research methods and techniques were used:

1. An analysis of literature and generalisation of practical experiments in the scope of test experiments in various sports disciplines.
2. Method of individual cases.
3. Method of observation.
4. Assessment of physical fitness in laboratory conditions. This was carried out by means of computerised measuring apparatus in the Laboratory of Physical Effort at the Academy of Physical Education and Sport in Gdansk. It enables registering indices (jumping, speed-

strength, and endurance-strength ability) corresponding with the conditions of sports activity. The following measurements were taken:

- Isokinetic muscle strength measured separately and jointly for upper extremities by means of ergometric measurement apparatus "Concept 2 Dyno". Also dynamic strength endurance was tested on this ergometer – *special speed-strength, and endurance-strength skills*.
 - Muscle strength of lower extremities (jumps with straight legs) measured on a tensometric mat by means of ERGO TESTER cooperating with a computer software GLOBUS ITALIA 1.1. The jump-off time was registered on it – *special jumping skills*.
5. An analysis of results obtained in official gymnastic competitions. For this protocols of regional and national competitions were used. The subjects of the same age group performed a jump – forward swing on a vault.
 6. To study the correlations of physical fitness indices with technical preparation in the vault event, Spearman's correlations were applied.

Results

The specificity of physical effort in gymnasts performing complex acrobatic manoeuvres requires, among others, a high level of dynamic strength of both arms and legs. Training loads of high dynamics are characterised by a very short time of performing a particular movement and by great explosive power. One should remember that gymnastic exercises are often an inseparable element of dynamic and static work. A gymnastic vault clearly reflects such specificity of effort which is determined by various manifestations of the dynamic strength of the lower extremities primarily at the moment of jump-off from the springboard and then of the upper extremities during a jump-off from the apparatus. The static strength is manifested at the moment of landing, thus opposing the dynamic strength.

In connection with the above, in order to realise the aim of this study an analysis of correlations of selected indices of special fitness determined in laboratory conditions with technical preparation in the event of gymnastic vault was carried out. It follows from the data presented in Table 1 that the greatest correlation with the final result and the correctness of performing the vaults assessed on the basis of committed errors was revealed in the index of jump-offs in jumps from both feet with straight legs. The correlative value oscillated mainly between -0.55 and -0.83 throughout the whole study period. We have also noted a high correlation between the final result, the quality of performing the vault assessed on the basis of the magnitude of errors and the index of strength endurance of upper extremities extensors in the conditions of isokinetic work; its correlative value fell between 0.61 and 0.72 at the beginning and the end of the study period. Also indices which can serve to supplement the earlier information have been presented. These are indices of isokinetic strength of extensors and flexors of upper extremities. Their correlative significance was present only in some of the six-month research macrocycles. The above study results enabled working out quantitative criteria of assessment of the level of special fitness and technical preparation in particular macrocycles of the training process.

Tab. 1. Numeric values of the coefficients of correlation between indices of physical fitness and technical preparation in vaulting jump in particular macrocycles of the training process

Vaulting	Six-month macrocycles	Indices determined in laboratory conditions					
		Time of jump-off in jumps from both feet	Max relative isokinetic strength of extensors of upper extremities	Max isokinetic strength of extensors of the left upper extremity j	Max isokinetic strength of extensors of the right upper extremity	Max relative isokinetic strength of extensors of the right upper extremity	Isokinetic strength endurance of extensors of upper extremities
Degree of exercise difficulty	I	<u>-0.71</u>	0.50	0.40	<u>0.63</u>	<u>0.66</u>	0.49
Final result		<u>-0.83</u>	0.42	0.49	<u>0.75</u>	<u>0.76</u>	<u>0.69</u>
Magnitude of errors		-0.31	-0.04	-0.09	-0.09	-0.16	-0.23
Degree of exercise difficulty	II	<u>-0.65</u>	-0.04	0.21	0.58	0.60	0.34
Final result		<u>-0.65</u>	0.34	0.42	<u>0.75</u>	<u>0.78</u>	<u>0.61</u>
Magnitude of errors		<u>0.61</u>	-0.45	-0.46	<u>-0.77</u>	<u>-0.79</u>	<u>-0.67</u>
Degree of exercise difficulty	III	-	-	-	-	-	-
Final result		-0.58	0.36	0.23	0.10	0.18	0.16
Magnitude of errors		0.58	-0.36	-0.23	-0.10	-0.18	-0.16
Degree of exercise difficulty	IV	-	-	-	-	-	-
Final result		-0.55	0.07	0.37	0.31	0.32	0.40
Magnitude of errors		0.55	-0.07	-0.37	-0.31	-0.32	-0.40
Degree of exercise difficulty	V	-0.28	-0.12	0.20	0.21	0.21	0.25
Final result		-0.49	0.48	<u>0.61</u>	<u>0.66</u>	<u>0.61</u>	<u>0.66</u>
Magnitude of errors		0.47	<u>-0.67</u>	<u>-0.66</u>	<u>-0.72</u>	<u>-0.66</u>	<u>-0.70</u>
Degree of exercise difficulty	VI	-	-	-	-	-	-
Final result		-0.55	<u>0.66</u>	<u>0.65</u>	0.37	0.32	<u>0.72</u>
Magnitude of errors		0.55	<u>-0.66</u>	<u>-0.65</u>	-0.37	-0.32	<u>-0.72</u>

Source: own research

The basis to create such criteria was the consistence of the study results with the requirements of the reliability of measurements and their normal statistical distribution. This enabled working out special scales of numeric assessment for particular control tests noted in various units of measurements. Due to significant changes taking place in the development of special fitness and technical preparation of young gymnasts, special scales of assessment from 0 to 10 have been prepared; they corresponded to the requirements in the given six-month macrocycle of the training process. The point values of the most significant indices of gymnasts' special fitness are presented in Table 2. It shows the criteria of qualitative and quantitative assessment in six half-yearly training macrocycles. The point values of the mentioned indices show that the requirements posed for gymnasts' special fitness at the stage of directed training change in the subsequent six-month macrocycles. For example, if in the examined competitor the value of the index of the time of jump-off in jumping from both feet in the first six-month macrocycle amounts to 0.168s, then he obtains 3 points for it. Yet for the same result of the index in the fourth six-month macrocycle he will receive only 1 point. In the next six-month macrocycle, the above value does not receive any points.

Thanks to the created criteria of quantitative criteria of the assessment of physical fitness and technical preparation, it was possible to present particular results of the most informative tests in one graph characterising a competitor's individual profile in a many-month training process.

Tab. 2. Point values of the most important indices of special fitness and technical preparation in 11–13-year-old gymnasts

	Point ranges									
	1	2	3	4	5	6	7	8	9	10
Time of jump-off in jumps from both feet with straight legs	0.180 - 0.175	0.174 - 0.169	0.168 - 0.163	0.162 - 0.157	0.156 - 0.151	0.150 - 0.145	0.144 - 0.139	0.138 - 0.133	0.132 - 0.127	0.126 - 0.121
Isokinetic strength endurance of extensors of upper extremities	5.6 - 8.3	8.4 - 11.1	11.2 - 13.9	14 - 16.7	16.8 - 20.0	20.1 - 21.7	21.8 - 23.3	23.4 - 24.9	25 - 26.5	26.6 - 28
Vaulting – final result	12.5 - 12.6	12.7 - 12.8	13.9 - 13.0	13.1 - 13.2	13.3 - 13.4	13.5 - 13.6	13.7 - 13.8	13.9 - 14.0	14.1 - 14.2	14.3 - 14.4
	Point ranges									
	1	2	3	4	5	6	7	8	9	10
Time of jump-off in jumps from both feet with straight legs	0.178 - 0.173	0.172 - 0.167	0.166 - 0.161	0.160 - 0.155	0.154 - 0.149	0.148 - 0.143	0.142 - 0.137	0.136 - 0.131	0.130 - 0.125	0.124 - 0.119
Isokinetic strength endurance of extensors of upper extremities	12.6 - 14.9	15.0 - 17.3	17.4 - 19.7	19.8 - 22.3	22.4 - 24.7	24.8 - 27.1	27.2 - 29.5	29.6 - 31.9	32.0 - 32.3	32.4 - 34.7
Vaulting – final result	12.6 - 12.7	12.8 - 12.9	13.0 - 13.1	13.2 - 13.3	13.4 - 13.5	13.6 - 13.7	13.8 - 13.9	14.0 - 14.1	14.2 - 14.3	14.4 - 14.5
	Point ranges									
	1	2	3	4	5	6	7	8	9	10
Time of jump-off in jumps from both feet with straight legs	0.176 - 0.171	0.170 - 0.165	0.164 - 0.159	0.158 - 0.153	0.152 - 0.147	0.146 - 0.141	0.140 - 0.135	0.134 - 0.129	0.128 - 0.123	0.122 - 0.117
Isokinetic strength endurance of extensors of upper extremities	16.3 - 18.2	18.3 - 20.2	20.3 - 22.2	22.3 - 24.2	24.3 - 26.2	26.3 - 28.2	28.3 - 30.2	30.3 - 32.2	32.3 - 34.2	34.3 - 36.2
Vaulting – final result	12.7 - 12.8	12.9 - 13.0	13.1 - 13.2	13.3 - 13.4	13.5 - 13.6	13.7 - 13.8	13.9 - 14.0	14.1 - 14.2	14.3 - 14.4	14.5 - 14.6
	Point ranges									
	1	2	3	4	5	6	7	8	9	10
Time of jump-off in jumps from both feet with straight legs	0.172 - 0.167	0.166 - 0.161	0.160 - 0.155	0.154 - 0.149	0.148 - 0.143	0.142 - 0.137	0.136 - 0.131	0.130 - 0.126	0.125 - 0.121	0.120 - 0.116
Isokinetic strength endurance of extensors of upper extremities	21.6 - 23.2	23.3 - 24.9	25.0 - 26.6	26.7 - 28.3	28.4 - 30.0	30.1 - 31.7	31.8 - 33.4	33.5 - 35.1	35.2 - 36.8	36.9 - 38.5
Vaulting – final result	12.8 - 12.9	13.0 - 13.1	13.2 - 13.3	13.4 - 13.5	13.6 - 13.7	13.8 - 13.9	14.0 - 14.1	14.2 - 14.3	14.4 - 14.5	14.6 - 14.7
	Point ranges									
	1	2	3	4	5	6	7	8	9	10
Time of jump-off in jumps from both feet with straight legs	0.165 - 0.161	0.160 - 0.155	0.154 - 0.150	0.149 - 0.145	0.144 - 0.140	0.139 - 0.135	0.134 - 0.130	0.129 - 0.125	0.124 - 0.120	0.119 - 0.115
Isokinetic strength endurance of extensors of upper extremities	22.6 - 24.5	24.6 - 26.5	26.6 - 28.5	28.6 - 30.5	30.6 - 32.5	32.6 - 34.5	34.6 - 36.5	36.6 - 38.5	38.6 - 40.5	40.6 - 42.5
Vaulting – final result	12.9 - 13.0	13.1 - 13.2	13.3 - 13.4	13.5 - 13.6	13.7 - 13.8	13.9 - 14.0	14.1 - 14.2	14.3 - 14.4	14.5 - 14.6	14.7 - 14.8
	Point ranges									
	1	2	3	4	5	6	7	8	9	10
Time of jump-off in jumps from both feet with straight legs	0.162 - 0.158	0.157 - 0.153	0.152 - 0.148	0.147 - 0.143	0.142 - 0.138	0.137 - 0.133	0.132 - 0.128	0.127 - 0.123	0.122 - 0.118	0.117 - 0.113
Isokinetic strength endurance of extensors of upper extremities	23.6 - 24.8	24.9 - 26.7	26.8 - 28.6	28.7 - 30.5	30.6 - 32.4	32.5 - 34.3	34.4 - 36.2	36.3 - 38.1	38.2 - 40.0	40.1 - 41.9
Vaulting – final result	13.0 - 13.1	13.2 - 13.3	13.4 - 13.5	13.6 - 13.7	13.8 - 13.9	14.0 - 14.1	14.2 - 14.3	14.4 - 14.5	14.6 - 14.7	14.8 - 14.9

While characterising particular gymnasts, the most reliable control indices were used. They made it possible to classify competitors in the subsequent macrocycles distinguishing their leading as well as worse developed traits of special fitness with reference to the sports level in gymnastic vault. Figures 1–3 present sample profiles of three selected athletes whose character of individual strength capabilities in the three-year study period significantly differed. However, some common features have been noted.

Among all examined gymnasts, competitor P.J. was characterised by the highest level of special fitness and technical preparation in vaulting insofar as the criteria of assessment by points

developed for particular six-month macrocycles of the training process (Fig. 1). The highest point value of indices of special fitness enabled the gymnast to achieved the level of technical preparation exceeding the syllabus of the 3rd grade of a sports school. Mean points values of special fitness fell between 8 and 10 points. While analysing the structure of the presented profile, it emerged that for this competitor the isokinetic strength endurance of extensors of upper extremities determined the final result of the vault to the greatest extent. This correlation can be explained by the relations which took place in the first, fifth and sixth study macrocycle. Looking at the first and the fifth six-month macrocycle, it was observed that the level of technical preparation in gymnastic vault remained at a very high level while the level of jumping ability measured by the time of jump-off in jumping from both feet with straight legs fell to the value of 8–9 points. In the sixth macrocycle, when the level of jumping ability increased to the value of 10 points, a deterioration in the level of technical preparation in vaulting was observed. Supposedly, this could have been caused by a significant fall in the level of the index of isokinetic strength endurance of extensors of upper extremities from 10 to 8 points.

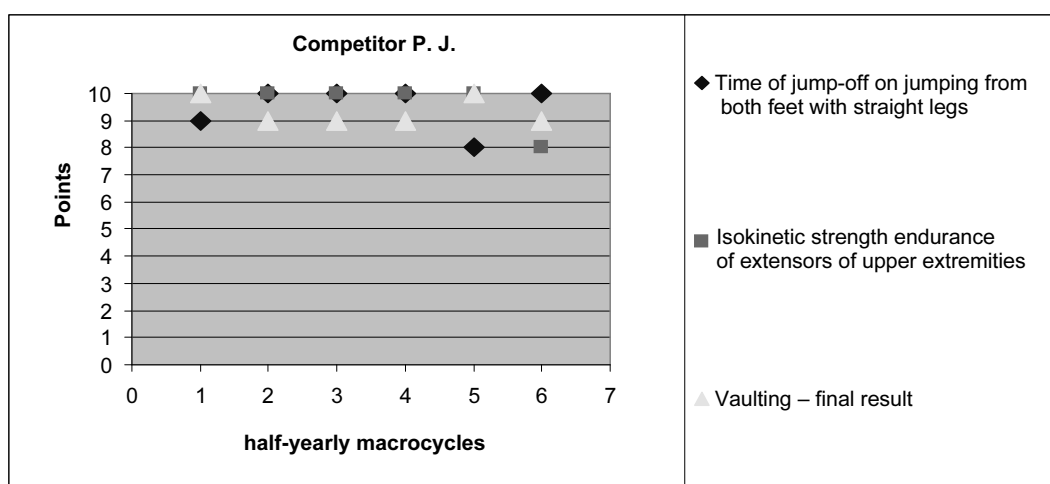


Fig. 1. The character of changes in selected indices of special fitness in competitor P.J. in a three-year study period

Gymnast A.L. revealed different properties of special fitness (Fig. 2). As can be seen in the below profile, jumping capabilities, which developed at the highest level in the three-year study period, are the leading trait in this athlete. Although this ability was very highly developed, it did not give the athlete a possibility to achieve the greatest result in vaulting. One can assume that the main reason was too low a level of isokinetic strength endurance of extensors of upper extremities, which was placed at the level of 3–6 points in particular macrocycles.

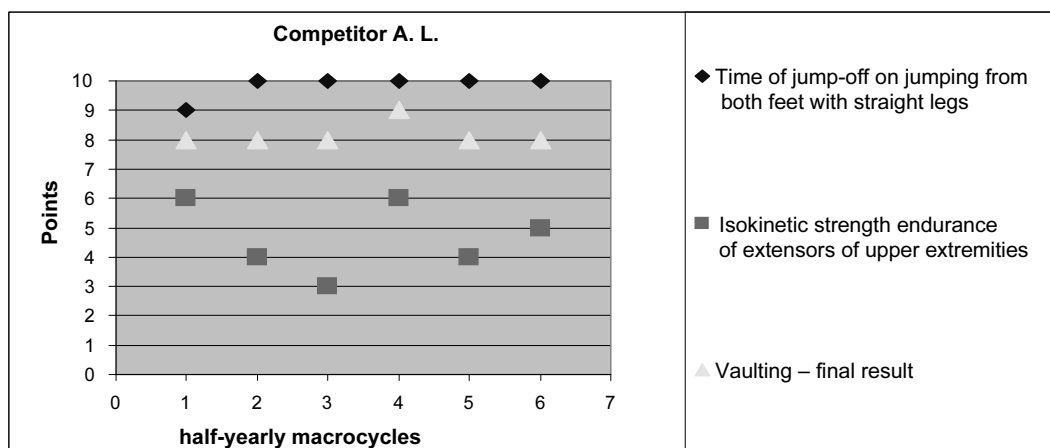


Fig. 2. The character of changes in selected indices of special fitness in competitor A.L. in a three-year study period

Analysing the leading traits of gymnast L.B.'s special fitness, one can notice similar co-dependence on the final result in vaulting. As follows from the below profile, the jumping ability was the most developed. It was running at the level of 5–10 points. Very poorly developed isokinetic strength endurance of extensors of upper extremities (1–3 points) largely limited a possibility to achieve a higher sports result in vaulting.

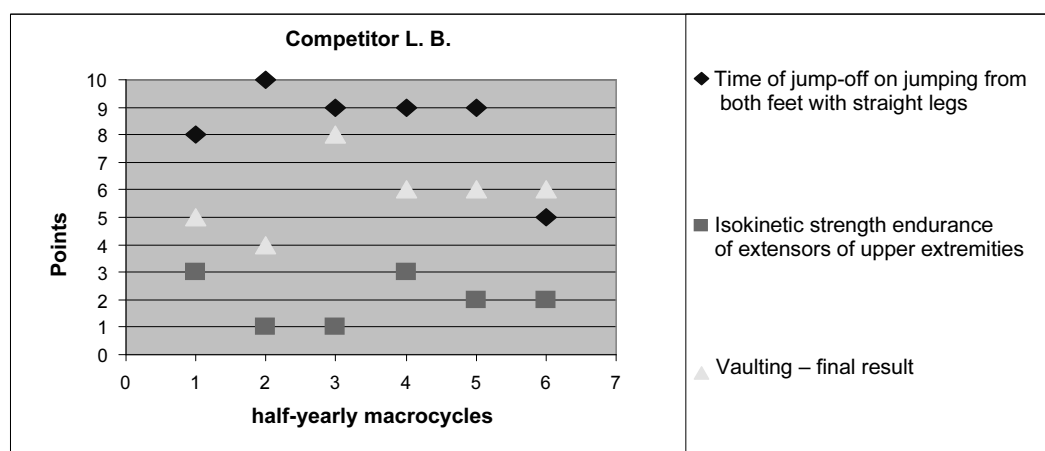


Fig. 3. The character of changes in selected indices of special fitness in competitor L.B. in a three-year study period

Discussion

Determining the most important factors influencing the effectiveness of technical preparation will surely allow improving the level of sports results. Results of studies by Arkayev & Suchilin [14], Starosta [15] and others showed that there are significant correlations between the level of development of selected components of physical fitness and the effectiveness of technical preparation. Zaciorski [16], Menchin [17], Gavierdovskij [18] considered strength and its derivatives as the key link in the special preparation conditioning the achievement of a high level of technical preparation. According to Arkayev and Suchilin [14] the most important factors influencing

the results in artistic gymnastics are: strength, flexibility (significant influence), endurance (moderate influence), speed (slight influence). Also Smolevsky & Gavierdovskij [19] are in agreement that strength capabilities decide to a large extent about the quality and the effectiveness of teaching gymnastic exercises. A similar view is expressed by Kochanowicz [9], Sawczyn [11], Zasada [12], who stress that mastering exercises of great difficulty requires a high level of development of strength, speed, endurance and flexibility. They indicate the need to develop these abilities already at the stage of comprehensive training.

In specialist literature little space has been devoted to the studies on correlations of particular motor skills and the effectiveness of technical preparation in selected gymnastic events. Also apparent is the lack of studies insofar as individual profiles of athletes' physical fitness at particular stages of training with reference to selected gymnastic events. Due to the complexity of the research problem, its study requires a multi-stage approach. The presented analysis of correlations of selected features of special fitness and technical preparation in vaulting can exemplify perfecting the technology of control in the remaining gymnastic events. The greatest correlation with the final result in vaulting in 11-13-year-old gymnasts was noted in the index defining the time of jump-off in jumping from both feet with straight legs and in the index of isokinetic strength endurance of the extensors of upper extremities. Criteria of quantitative assessment in particular six-month study macrocycles have been worked out for the above indices of special fitness and technical preparation. They made it possible to refer various test indices to the curriculum requirements for the given macrocycle in a unified point scale. Owing to that one can present particular results of the most informative effort tests in one graph characterising an athlete's individual profile in a many-month training process. Such a solution enables indicating an appropriate direction of activity and corrections in the content of training depending on athletes' individual effort capabilities. An analysis of individual profiles of special fitness and technical preparation in gymnastic vaulting proved that despite highly formed jumping abilities of the studied athletes, one should pay attention to the remaining factors determining a high level of the performed vault. These include endurance-strength abilities of extensors of upper extremities measured in the conditions of isokinetic work.

Conclusions

1. An objective quantitative assessment creates a possibility to optimise the training process of the examined competitors through an appropriate selection of training means and methods.
2. Working out the structure of athletes' special preparation with consideration for the curricular requirements in subsequent six-month macrocycles will enable optimising the training process directed not only at the all-round events but also at the possibilities to specialise in selected gymnastic events.
3. The above study can also stimulate a further development of the theory and methodology of training in artistic gymnastics.

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