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Influence of Rhythmic Gymnastics on the Morphological Characteristics and Physical Performance of Young Athletes

Aliya Zhumanova

Kazakh Academy of Sport and Tourism, Kazakhstan

Abstract: The author studied the development of physical features, the composition of the components of the body and physical performance of 10-13 years gymnasts. It is proved that the model of the relative muscle mass in young gymnasts matches to the models of winter sports women representatives. The asymmetry of the arms and legs affects the amount of lipid component, but has no significant effect on the amount of muscle of the lower extremities and has no influence on the amount of muscle mass hands. Adaptation processes of the body of young gymnasts depend on their qualifications, the competition schedule and the training period, which is necessary for considering the design of training programs.

Key words: Young gymnasts · Body composition · Physical performance

INTRODUCTION

The propulsion activity in each kind of sport creates the preconditions for the development of a specific body that is caused by morphological changes occurring in the body of athletes [1, 2, 3]. In most types of sports body determines not only the sport specialization of athletes, but also the level of their sporting achievements [4]. In particular, in rhythmic gymnastics morphological indicators are a basis of the model characteristics defining potential opportunities of gymnasts at a stage of the highest sports skill [5]. So, for rhythmic gymnastics are more suitable children ectomorphological type, fine-boned, with no excess body fat, lean muscle with marked relief [6]. People with such a physique show the ability to sport that requires endurance, precise coordination and agility [7].

The current stage of development of the artistic gymnastics is characterized by the growth of the difficulties of tracks with items that require large amounts of manifestations and intensity of the training load during the early stages of preparation [8]. Moreover, today, gymnastics places high demands on the characteristics of the structure of the body, to the experience of sports training. These are the same high demands on efficiency, expressed in the need for a high level of motor characteristics with primary development of flexibility, agility (as a set of coordination abilities), jumping ability, overall stamina [9].

Complication competitive program requires adequate organizational and methodical scientific approach to the training process. Failure to do so adversely affects the health level gymnasts, especially the young. Speeding up training in the pursuit of high results leads to injuries and functional disorders of the musculoskeletal system, psychological breakdown was not firmly established in children. At very high loads can deplete reserves adaptation in certain systems, which can cause disease [10, p. 27].

In addition, it is in childhood lays the foundation of the future achievements in sports, especially some of the components are formed physical working capacity [11]. Therefore, the training process must build age-appropriate, individual capabilities and features of the formation of sportsmanship gymnasts that will provide a health effect of employment [12, p. 19].

Amongst many indicators of individual characteristics of the athletes of great interest to all-out dimensions of the body, its proportions, the composition [4]. They influence the display of strength, speed, endurance, flexibility, adaptation to different environmental conditions, performance, recovery and athletic performance.

Corresponding Author: Aliya Zhumanova, Kazakh Academy of Sport and Tourism, Kazakhstan.

To evaluate the effectiveness of the training process is carried out comprehensive medical and pedagogical examination of morphological and functional indicators of physical fitness and health. The obtained data allow establishing the relationship anatomical and morphological parameters with the physical qualities and characteristics of technical and tactical skills for the surgical correction of orientation training volume and intensity of the applied loads, individual approach to the construction of the training process of each gymnast [5, 13]. The knowledge of these characteristics contributes to the process of preparation, as it allows you to pick up the exercises in accordance with the advantages and disadvantages of the structure of the body to correct morphological constraints and reduce their influence.

However, the study of physical development, body composition and physical performance of athletes engaged in artistic gymnastics, performed for a long time, existing models require the same adjustments as are intended for mature gymnasts. However, the medical control in the country with application advanced equipment organized considerably worse than in the sphere of sports. Relevance of the problem increases the tendency reducing the age of onset of rhythmic gymnastics, as well as the level of health and physical fitness of children in recent years [14].

The purpose of the study is to determine the characteristics of the physical development of the components of the body and physical performance 10-13 years old gymnasts.

Methods and Organization of Studies: The program of in-depth comprehensive survey of young gymnasts consisted of identification of the most distinctive morphological features by anthropometry on the following parameters: length and weight to calculate the mass-growth-index, vital lung capacity (LC ml), the life index (LI), heart rate (HR, beats / min), blood pressure (BP, mm Hg), the components of body composition and physical performance PWC on the pulse of 130, 150 and 170 beats / min. Investigations were carried out in the laboratory of Institute of the Kazakh Academy of Sport and sports tourism. The group consisted of eight promising 10-13 years old gymnasts, members of the national team of the Republic of Kazakhstan and Almaty. Measurements of morphological parameters were carried out as V. Bunak in the modification of A. Stavitskaya and D. Aron [15] and functional - according to conventional techniques: vital lung capacity was measured by a water spirometer, pulse rate - by kardiotestera of Swiss company «Polar», systolic and diastolic blood pressure - an electronic device.

Structure of components of the body was determined by bioimpedance with an electronic analyzer firm Tanita (Japan). The advantage of this method consists in the possibility of simultaneous reading of the basal metabolism, body weight and its components (water, fat and muscle tissue). In addition, the analyzer can determine the composition of the body segment by segment (arms, legs and torso) [4, 16].

The level of efficiency of the organism PWC on the pulse of 130, 150 and 170 beats / min were determined at junior bicycle ergometer Evgomedic 828E «Monark».

Resulting digital data subjected to statistical analysis using the application «Microsoft Excel».

The Results of Research: Most of the morphological indicators of promising gymnasts differ from existing standards, which we attribute to the mismatch of their age and study skills gymnasts, as well as with the recent training in rhythmic gymnastics. This indicates the need for further research. Thus, indicators of mass-height index for the most promising of young gymnast's external data considerably below existing standards: 195.4 and 213.6 g / cm vs. 220-260 g / cm (Table 1).

Bioimpedance technique allowed with the maximum accurately quickly determines the composition of the components of the body investigated (Table 2). However, the analysis of the data has any difficulties. The published standards for representatives of the artistic gymnastics published a long time and sometimes contradictory. In addition, they are designed for highly skilled gymnasts. In the course of our analysis used a model of the Olympic Games in 1992 [17].

Using percentages, we were able to compare the model with the standards of highly skilled gymnasts representatives of winter sports. [18] As a result, we obtained some interesting data. Thus, the index of relative body fat gymnasts complies with all-rounder's skaters and skiers, with those of men: 11.8% versus 10,3-10,9%. The same pattern was observed when comparing the mass of muscle tissue: 46-51% versus 50,6 - 51,8%. For comparison, the rate is within skiers 18,0-18,6 % and 47,2-48,2%, respectively.

The share of muscle tissue investigated complies with junior gymnasts qualifications (45-48% vs. 46-50%) and the amount of adipose tissue gymnasts meet the standards in 1972: 15.2 and 15.9% vs. 15.5% [18].

Table 1: Morphological indicators of young gymnasts

		The length of the body, cm		Body weight, kg		Weight of fat / body weight		
The athletes	Age, years	AI	Standart	AI	Standart	AI	Standart	Mass index growth, g / cm
E. R.	9,7	133	128-144	24,5	23-24	15,2	N	184,2
J. A.	10,2	138		30,8	25-26	19,0	H	223,2
S. Y.	10,1	151		33,7	33-36	16,6	H	223,2
M. A.	10,8	151	137-155	31,4	29-32	15,9	H	195,4
A. A.	11,2	147		29,5	33-36	15,3	N	213,6
G. E.	13,1	158	148-163	38,5	37-40	15,6	N	243,7
C. A.	13,6	158		38,1	37-40	16,2	H	241,1
G. V.	14,2	155		36,2	33-36	17,1	H	233,5

Comment – AI – absolute indicator

Continuation of Table 1: Functional performance of young gymnasts

					BP.	
Name	Age, years	VLC, ml.	LI, ml / kg	Resting HR, beats / min	Systolic	Diastolic
E. R.	9,7	1500	61,2	104	60	78
J. A.	10,2	1700	55,2	101	59	73
S. Y.	10,1	2250	66,8	98	66	85
M. A.	10,8	2050	69,5	98	63	76
A. A.	11,2	1950	62,1	112	75	93
G. E.	13,1	2450	63,6	107	69	104
C. A.	13,6	2950	77,4	104	65	80
G. V.	14,2	2700	74,6	114	73	100

Notes: VLC - vital lung capacity, LI - living index, HR - heart rate, BP - blood pressure.

Table 2: Composition of the body components of young gymnasts

	Composition of the components of the body															
		BMR							Impedance					Trunk		
The athletes	BMI	kj	kcal	FAT, %	FAT mass	FFM	TBW	Whole body	Right leg	Left leg	Eight art	Left art	FAT, %	FAT mass	FFM	Predicted muscle mass
E. R.	13,9	4134	988	15,2	3,7	20,8	15,2	759	291	294	432	435	8,0	1,1	12,3	11,8
J. A.	16,2	4556	1089	19,0	5,9	25,0	18,3	725	266	270	422	432	13,0	2,2	14,5	13,9
S. Y.	14,8	4849	1159	16,6	5,6	28,1	20,6	741	303	303	411	412	8,9	1,6	16,6	15,9
M. A.	14,5	4623	1105	15,9	5,0	26,4	19,3	751	287	295	423	426	8,7	1,5	15,3	14,7
A. A.	15,4	5100	1219	15,6	6,0	32,5	23,8	706	274	282	407	398	8,1	1,6	18,6	17,8
G. E.	15,3	5042	1205	16,2	6,2	31,9	23,4	736	280	282	435	433	9,4	1,9	18,3	17,5
C. A.	15,14	4770	1140	17,1	6,2	30,0	22,0	793	309	315	449	448	10,6	2,1	17,8	17,0
G. V.	12,9	4535	1084	15,3	4,5	25,0	18,3	847	319	327	498	485	8,1	1,3	14,7	14,1
x̄	14,8	4701,1	1123,6	16,4	5,4	27,5	20,1	757,3	291,1	296	434,6	433,6	9,4	1,7	16,0	15,3
Sx̄	0,4	110,1	26,3	0,4	0,3	1,4	1,03	15,7	6,4	6,6	10,2	9,1	0,6	0,1	0,8	0,7
S	1,01	311,3	74,4	1,25	0,91	4,0	2,9	44,3	18,1	18,7	28,9	25,8	1,7	0,4	2,2	2,1

Comment: BMI - the index (the ratio of body weight to growth; BMR - daily energy expenditure (basal metabolic rate) kcal; FAT,% - percentage of total fat mass to body weight; FAT mass, kg - absolute fat mass; FFM - body weight, free from fat; TBW - water, kg; predicted muscle mass, kg - estimated absolute skeletal muscle mass

However, used by us standards can only serve as a guide, as outdated and are intended for adult gymnasts and the latter are designed for gymnastics. Therefore, research is required using the modern techniques.

Analysis of the data segment of the body revealed that the gymnasts are not observed significant differences in terms of fat and muscle components between right and left limbs (continuation of Table 2).

However, children with more severe asymmetry right and left hands percent is more than fat component in the non-dominant hand. So, if SJ, equally well owning the right and left hand, right hand body fat percentage (FAT, %) is 26.9%, the left - 26.8%, then the HA with the dominant right hand, respectively 30.1 and 31.3%. The difference in these rates lower extremities same: 25.2 and 25.6%, 24.8 and 26% respectively.

If we compare the figures of mass body weight fat-free (FFM) of upper and lower limbs of these children then dominant asymmetry did not significantly affect the amount of muscle mass of the lower extremities:

Continuation of Table 2: Composition of the components of the body segment of young gymnasts

	Composition of the components of the body															
	Right leg				Left leg				Right arm				Left arm			
The athletes	FAT, %	FAT mass	FFM	Predicted muscle mass	FAT, %	FAT mass	FFM	Predicted muscle mass	FAT, %	FAT mass	FFM	Predicted muscle mass	FAT, %	FAT mass	FFM	Predicted muscle mass
E. R.	22,6	1,0	3,6	3,4	23,4	1,0	3,4	3,2	26,2	0,3	0,8	0,7	26,0	0,3	0,8	0,7
J. A.	24,8	1,4	4,4	4,2	26,0	1,4	4,1	3,9	30,1	0,4	1,0	0,9	31,3	0,4	1,0	0,9
S. Y.	25,2	1,6	4,7	4,4	25,6	1,5	4,5	4,2	26,9	0,4	1,2	1,1	26,8	0,4	1,2	1,1
M. A.	23,2	1,4	4,6	4,4	24,2	1,4	4,3	4,1	26,2	0,4	1,1	1,0	26,4	0,4	1,1	1,0
A. A.	23,0	1,7	5,8	5,5	24,0	1,7	5,4	5,1	25,4	0,5	1,3	1,2	25,1	0,5	1,4	1,3
G. E.	23,1	1,7	5,7	5,4	23,7	1,7	5,4	5,1	26,6	0,5	1,3	1,2	27,0	0,5	1,3	1,2
C. A.	24,6	1,7	5,1	4,8	24,9	1,6	4,8	4,6	26,1	0,4	1,2	1,1	26,7	0,4	1,2	1,1
G. V.	22,7	1,3	4,3	4,1	23,3	1,2	4,0	3,8	27,1	0,4	1,0	0,9	26,4	0,4	1,0	0,9
x̄	23,7	1,5	4,8	4,5	24,4	1,4	4,5	4,3	26,8	0,4	1,1	1,01	26,9	0,4	1,1	1,03
Sx̄	0,4	0,09	0,3	0,2	0,4	0,1	0,2	0,2	0,5	0,02	0,06	0,06	0,7	0,02	0,07	0,07
S	1,04	0,25	0,7	0,7	1,01	0,2	0,7	0,7	1,4	0,06	0,2	0,17	1,8	0,06	0,19	0,19

Comment: FAT,% - percentage of total fat mass to body weight; FAT mass, kg - absolute fat mass; FFM - mass of the body segments, free from fat; predicted muscle mass, kg - estimated absolute skeletal muscle mass

Table 3: Indicators of the load test and calculate the physical performance of young gymnasts

		The first load			The second load			Физическая работоспособность					
								HR 130 beats / min		HR 150 beats / min		HR of 170 beats / min	
Name	Resting HR, beats / min	HR at the start, beats / min	Power kgm / min	HR, beats / min	Heart rate at the start, beats / min	Power kgm / min	HR, beats / min	kgm / min	kgm / kg	kgm / min	kgm / kg	kgm / min	kgm / kg
E. R.	78	96	113	131	112	283	176	109	4,45	184,5	7,53	260	10,61
J. A.	73	91	235	145	97	432	186	163	5,29	259	8,41	355	11,53
S. Y.	85	92	158	151	105	306	180	102	3,03	152,9	4,54	255	7,57
M. A.	93	101	118	128	107	306	164	128	4,08	232	7,39	336	10,7
A. A.	104	117	177	136	128	379	164	134	3,48	278	7,22	422	10,96
G. E.	80	99	240	119	99	489	167	297	7,79	401	10,52	511	13,41
C. A.	100	93	244	150	113	373	174	158	4,36	244	6,74	352	9,72
G. V.	76	94	122	123	104	318	181	146	4,95	236	8,00	304	10,31
x̄	86,1	97,9	175,9	135,4	108,1	360,8	174	154,6	4,68	248,4	7,54	349	10,6
Sx̄	4,1	2,99	20,2	4,3	3,5	25,3	2,9	21,7	0,5	26,0	0,6	30,05	0,6
S	11,6	8,5	57,0	12,2	9,8	71,6	8,3	61,4	1,5	73,6	1,7	85,0	1,6
V, %	13,5	8,7	32,4	9,0	9,1	19,8	4,8	39,7	32,1	29,6	22,5	24,4	15,1

Comment - HR - heart rate.

the figures on the right and left legs were 4.7 and 4.5 kg in S.Y. and 4.4 and 4.1 in H.A. and have no effect on muscle mass Hands - 1.2, 1.2 and 1.0 kg, 1.0 kg, respectively.

As indicators of the muscle and fat body components, the fatty component more expressed in children with wider chest and full-bodied: 8.1% (v gymnasts model) to 13%, whereas in terms of the muscular part no significant difference observed: respectively 14.7 and 14.5 kg.

The analysis of core identified the exchange that it depends on the absolute muscle mass. For comparison, we took the figures of girls of the same age (11 years) and BMR (1089 and 1084 kcal), while that of the first girls absolute fat component was 5.9 kg (above the threshold), while the second - 4.5 kg (standard). Absolute skeletal muscle mass did not differ from each other: 13.9 vs. 14.1 kg, respectively. This confirms the data in the literature that the muscle tissue contributes significantly to the energy expenditure of the body in the main exchange, which amounts to approximately a quarter of the total energy.

Therefore, the results of studies of the composition of the body young gymnasts all show strong performance which are close to indicators of adult gymnasts, indicating their great potential. However, studies of the functional mechanisms of adaptation to physical exercise showed that their physical performance is low, which is attributed to the fatigue of the recent performances in the competition and for the year (Table 3).

At the same time the level of physical performance at a heart rate 130, 150 and 170 beats / min gymnasts are significantly different from each other. So performance athletes S.J. were 2-3 times lower than C.A. what we associate with different sports qualified gymnasts, besides, the first in the spring was a lot of passes on the disease, gymnast C.A. - A member of the national team of Kazakhstan trained according to plan.

Such a way observed dependence of the physical efficiency the following factors are the following:

- The qualifications of the gymnasts: the best indices have members of the national team of the Republic of Kazakhstan;
- From the competition schedule: performance of gymnasts team leaders of Kazakhstan lower with a busy schedule of participation in the competition;
- From the training period: the end of the competition period is characterized by a decrease in the adaptation processes of the body of young athletes.

CONCLUSION

- The absence of indicative standards morphological parameters and body composition of young gymnasts using modern methods suggests the need for further research.
- Indicators of relative muscle mass 10-13 years old gymnasts do not differ from those gymnasts - participants of 1992 Olympic Games: 45-48% vs. 46-50% are normal and highly skilled skiers (47,2 -48,2%).
- Fat mass, even the most advanced on the external data 10-13 years old gymnasts complies with gymnasts 1972: 15.2 and 15.9% vs. 15.5%.
- The asymmetry of the arms and legs affects the amount of fat component in the dominant extremity it smaller. At the same time, the dominant asymmetry has no significant effect on the amount of muscle mass of the lower extremities and has no effect on the amount of muscle mass of hands.
- The dependence between the development of muscle tissue and primary metabolism in young gymnasts.
- The level of physical performance depends on the skills of gymnast's individual schedule of participation in competitions and training period.

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