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THE INTERRELATIONSHIP BETWEEN SOMATOTYPES AND SPORT SPECIALIZATION IN JUNIOR ACROBATS DURING THE INITIAL TRAINING STAGE

ВЗАИМОСВЯЗЬ СОМАТОТИПОВ И СПОРТИВНОЙ СПЕЦИАЛИЗАЦИИ У ЮНЫХ АКРОБАТОВ НА ЭТАПЕ НАЧАЛЬНОЙ ПОДГОТОВКИ

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ANNOTATION: *The article presents experimental materials on the introduction of young acrobats into the training process, taking into account the differentiated assessment of the physical status of the type-determined constitutional signs as thoracic, muscular, asthenoid and digestive, at the initial stage of their sports training.*

АННОТАЦИЯ: *В статье представлены экспериментальные материалы по внедрению в тренировочный процесс юных акробатов с учетом дифференцированной оценки физического статуса определяемых по типу конституциональных признаков как торакальный, мышечный, астеноидны и дигестивный, на начальном этапе их спортивной подготовки.*

KEY WORDS: *monitoring, intensity, body types, microcycles, stages of sports training, gradation of physical qualities, intergroup indicators, total body size.*

КЛЮЧЕВЫЕ СЛОВА: *мониторинг, интенсивность, типы телосложения, микроциклы, этапы спортивной тренировки, градация физических качеств, межгрупповые показатели, тотальные размеры тела.*

INTRODUCTION Group acrobatics, as a complex-coordination sport, holds particular importance in the study of the investigated factor when determining “bottom” (base) or “top” (flyer) partners. A significant role is played by the examination of physical development parameters, which incorporate genetically determined characteristics such as body height and weight, chest circumference, and body proportions. The studied traits were analyzed both individually and in interrelation, which made it possible to identify indicators of specific physical development parameters in acrobats at the initial stage of sports improvement that exhibit significant differences. There arises a necessity to take into account the heterochronicity (uneven timing) of organism development until the completion of the pubertal period, during which linear body dimensions increase substantially, affecting body mass

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characteristics and leading to functional changes in the organism [1, 3].

Monitoring the data from a questionnaire survey of coaches working with junior acrobats revealed the expediency of developing a differentiated assessment of motor preparedness and physical development, with the necessity of distributing young athletes at the initial stage of their sports training according to constitutional (somatotypic) characteristics. In adolescence, the most important indicators of the body's maturity in adolescents are body height and body mass, which change unevenly during ontogenesis. The differences between individual phases of development are both quantitative and qualitative in nature [2].

LITERATURE REVIEW. Acrobatic gymnastics is a complex coordination sport where success in pair/group exercises depends on morphological compatibility of partners and correct role assignment (“top” flyer vs. “bottom” base) (Boloban, 2013; Nizhnikova, 2018). Studies using the Heath-Carter method show that “top” athletes typically have predominant ecto- and mesomorphic components, lower body mass and height, whereas “base” partners exhibit greater meso- and endomorphy, higher mass, and wider skeletal dimensions (Sidorova, 2020). Significant anthropometric differences between future “tops” and “bases” are already evident at the initial training stage (ages 7–11): lower mass, narrower shoulders, and longer relative leg length in “tops” (Gaverdovskiy, 2014; Rumba, 2019). Basic constitutional parameters (height, proportions, bone width) are highly heritable and remain stable despite training, while body mass and fat component fluctuate markedly during puberty, requiring dynamic monitoring and possible role correction (Malina et al., 2015; Baxter-Jones & Sherar, 2017). Thus, literature data support a close relationship between somatotype and role-specific success in acrobatic gymnastics, justifying differentiated morphological selection from the earliest stages of long-term training.

RESULTS AND DISCUSSION. The evaluation of motor abilities in junior acrobats was carried out using a purposefully designed test battery that comprised the following exercises: 100 m sprint, 3000 m cross-country run, 3x10 m shuttle run, standing long jump, long jump with a run-up, push-ups (flexion and extension of the arms in prone support), pull-ups on the high bar, and medicine ball (grenade) throwing. Examination of the development level of key motor abilities in young acrobats — namely absolute strength, joint mobility, speed-strength qualities, and stability of the vestibular analyzer — made it possible to identify specific patterns and peculiarities in their manifestation at the initial training stage.

Analysis of mean absolute strength values in the two primary specialization groups (“top” and “bottom” acrobats) demonstrated that “top” athletes were significantly inferior to their “bottom” counterparts in muscle strength parameters. Absolute muscle strength in “bottom” partners exhibited a strong positive correlation with body mass ($r=0,75–0,91$, $p<0,001$), confirming the important role of body weight as a natural «load» in the development of strength capabilities in base athletes.

Joint mobility development constitutes an essential element of special physical preparation for junior acrobats. The assessment of mobility indicators revealed distinctive patterns in the range of motion of

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the spinal column, shoulder, and hip joints (see Table 1). “Top” acrobats displayed significantly greater mobility in the shoulder girdle and spine which is consistent with the demands of performing elements overhead and maintaining balance in elevated positions whereas “bottom” athletes demonstrated advantages in hip joint mobility, facilitating stable support and effective force transmission during partner interactions.

Table 1

Intergroup indicators of absolute muscle strength in junior acrobats “top” and “bottom” partners

Indicators	bottom partners (n=12)	top partners (n=12)	Significance of differences	
	$\overline{X}$±σ	$\overline{X}$±σ	t	P
Right hand grip strength (kg)	24,1±1,05	21,5±1,23	3,25	P<0,01
Left hand grip strength (kg)	22,8±1,28	20,6±1,14	2,32	P<0,05
Back strength (kg)	67,6±3,41	48,6±**2**,92	4,48	P<0,001
Summary strength indicators (kg)	114,5±5,74	90,7±**5,29**	3,35	P<0,01

The development of joint mobility constitutes an integral component of the specialized physical preparation of junior acrobats. When evaluating the research findings, distinctive characteristics were identified in the development of mobility in the vertebral column, shoulder joints, and hip joints. It has been established that all competitive exercises in pair-group acrobatic disciplines incorporate a substantial number of elements requiring the manifestation of spinal flexibility. Elevated mobility in the shoulder joints is necessary for the execution of fundamental acrobatic elements—namely, vertical balances (handstands) performed by «top» partners on the extended arms of “bottom” partners (see Table 2).

Table 2

Intergroup indicators of joint mobility in junior acrobats “top” and “bottom” partners

Indicators	bottom partners (n=12)	top partners (n=12)	Significance of differences	
	$\overline{X}$±σ	$\overline{X}$±σ	t	P
Forward bend (cm)	15,8±0,75	17,9±1,12	1,32	P>0,05
Shoulder retraction (cm)	18,6±0,71	16,9±1,05	1,86	P>0,05
Longitudinal split	9,3±1,20	6,8±1,2	2,3	P<0,

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(cm)		6	6	05

The study revealed that the range of motion in the hip joints was significantly greater in the “top” acrobats compared to the “bottom” acrobats ($p<0,05$). This difference is attributed to genetically predisposed mobility characteristics in the hip joints.

Speed-related capabilities are necessary for acrobats in the performance of dynamic exercises. Specifically, in representatives of the “top” partners group, movement speed is particularly evident during the execution of acrobatic elements and sequences that involve angular accelerations.

The assessment of speed-strength abilities revealed that “bottom” junior acrobats significantly outperformed “top” acrobats in the execution of motor tasks ($p<0,01$). This indicates that the competitive programs of acrobats specializing as “bottom” partners are characterized by a high proportion of exercises requiring the manifestation of speed-strength capabilities.

The vestibular analyzer plays a crucial role in the motor function of junior acrobats. In complex coordination sports, the load on the vestibular apparatus is extremely high; however, no statistically significant differences were found in the test indicators between the “top” and “bottom” partners ($p>0,05$) (see Table 3).

Table 3

Intergroup indicators of vestibular analyzer stability under loading in junior acrobats “top” and “bottom” partners

Indicators	bottom partners (n=12)	top partners (n=12)	Significance of differences	
	$\overline{X}\pm\sigma$	$\overline{X}\pm\sigma$	t	P
Romberg test (s)	18,3±2,03	19,1±1,05	1,19	P>0,05
Yarotsky test	23,17±0,22	25,47±0,81	2,28	P<0,05

“Top” partners tolerate dynamic loading significantly better than «bottom» partners, with their results being statistically higher ($p<0,05$). The competitive routines of “top” acrobats include a large number of elements involving multiple rotations around the sagittal, longitudinal, and frontal axes. Consequently, athletes in this group devote greater attention to vestibular apparatus training, which is a determining factor in the successful execution of complex acrobatic elements.

Pedagogical observations and analysis of questionnaire data obtained from coaches working with junior acrobats revealed the expediency of developing a differentiated assessment of motor preparedness and physical development. This approach necessitates the distribution of junior acrobats at the initial stage of sports training according to constitutional body types (thoracic, muscular, asthenic, and digestive) while taking into account their developmental patterns (retarded, normal, and accelerated).

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The most important indicators of organismal maturity in adolescents are body height and body mass, which change unevenly during ontogenesis. The differences between individual phases are both quantitative and qualitative in nature.

The combination of ratios of the three total body dimensions makes it possible to determine the body build type of junior acrobats of different specializations. The data are presented in the table, where the mean values of physical development for the "bottom" and "top" specializations indicate that junior acrobats specializing as "bottom" partners significantly surpass those specializing as "top" partners across all physical development indicators ($p<0,01$). The conditional units (indices) of body build types in "bottom" acrobats are significantly lower than the corresponding values in "top" acrobats ($p<0,01$).

The significantly higher somatotype index observed in "top" partners reflects a relative reduction in chest circumference and body mass in relation to body height among junior acrobats. This alters body proportionality in the opposite direction, resulting in a more elongated and rectangular body build (see Table 4).

Table 4

Intergroup indicators of selected physical development characteristics in junior acrobats "top" and "bottom" partners

Indicators of physical development	bottom partners (n=12)	top partners (n=12)	Significance of differences	
	$\overline{X}\pm\sigma$	$\overline{X}\pm\sigma$	t	P
Body height (cm)	146,4±0,7	127,2±0,6	4,12	P<0,001
Body mass (kg)	42,4±0,7	22,2±1,1	4,54	P<0,001
Chest circumference (cm)	78,7±0,5	63,4±0,7	4,46	P<0,01
Body build type (index)	75,8±0,6	67,3±0,7	3,21	P<0,01

The statistically higher somatotype index observed in "top" acrobats reflects a reduction in chest circumference and body mass relative to stature, resulting in a more elongated, rectangular somatotype. These intergroup differences in anthropometric characteristics are primarily the outcome of long-term selection processes inherent to sports acrobatics—a discipline requiring exceptional development of complex coordinative abilities—implemented across all phases of initial training. Experienced coaches working with this cohort of junior athletes place particular emphasis on identifying talented children who exhibit specific morphological traits and guiding them toward the appropriate acrobatic specialization ("top" or "bottom"). The larger absolute body dimensions of "bottom" partners enable them to resist considerable external loads during static elements when supporting one or several partners. In

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dynamic elements, their greater strength and body mass allow powerful projections of "top" partners over substantial distances from the support base. Multiple experimental investigations have confirmed that the lower body mass of "top" acrobats facilitates the acquisition of complex acrobatic skills. Specifically, reduced body-mass parameters significantly extend flight trajectories, thereby optimizing spatial-temporal characteristics, increasing element difficulty, and enhancing overall aesthetic impression.

Longitudinal monitoring research demonstrated significant interrelationships among physical development indicators in junior acrobats. These interdependencies were substantiated by high correlation coefficients observed between the investigated morphological parameters.

Correlation coefficients for the examined relationships ranged from r=0,591–0,785 in the "top" partner group and from r=0,640–0,832 in the "bottom" partner group. Particularly high inter-correlations among the investigated traits were found in the "top" group, which, in our opinion, reflect (either separately or collectively) body mass, compactness, and overall body form, thus characterizing the structural and mechanical properties of the body.

Junior acrobats in the "top" and "bottom" specializations exhibit distinct profiles of motor tasks that differ in biomechanical structure and performance conditions. Experimental findings showed varying proportions of athletes with a normosthenic body type across specializations: 78,5% of "top" partners in men's fours, 94,2% of second-middle partners, 87,8% of first-middle partners, and 59,7% of "bottom" partners among the total sample of junior acrobats examined.

CONCLUSION. The results of the conducted studies showed that none of the acrobats specializing as "bottom" partners exhibited an asthenic somatotype. Experimental data revealed that a substantial proportion of junior "bottom" acrobats possess a pyknic somatotype: 13,2% among "first-middle" partners in fours and 44,7% among "bottom" partners in fours. The pyknic body build typical of "bottom" partners creates an overall impression of stockiness, massiveness, and fundamental structural robustness in junior acrobats belonging to this group. This particular combination of constitutional and anatomical features of physical development provides favourable prerequisites for successful mastery of other complex coordination motor tasks. In contrast to "top" partners, it enables "bottom" athletes to withstand considerable strength loads on the musculoskeletal system during group exercises. Analysis of the pedagogical experiment results indicated that the majority of acrobats across various narrow specializations possess a normosthenic somatotype, which harmoniously aligns with their physical development characteristics.

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