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Original Scientific Article

Assessing Gender Dimorphism Indicators in Anthropometric Characteristics and Features of the Bony Pelvis of Female Representatives of Pair and Group Types in Sports Acrobatics

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

Objectives. The study aimed to examine individual anthropometric indicators, focusing on the bony pelvis size in female acrobats of various roles during the puberty and youth age, as well as in persons who do not engage in playing sports.

Materials and methods. The sports qualifications of female acrobats were sub-elite and elite athletes. The study population comprised 32 athletes having appropriate positions — top, middle, and bottom: (12 female acrobats performing their roles at the top, 20 female acrobats performing their roles in the middle and at the bottom). Girls of the same age categories (12-15 and 16-23 years old) who did not engage in playing sports (control group 1 and 2) also took part in the study. The research methods employed included the measurements of body length (cm), body weight (kg), shoulder width (cm), determination of body mass index (conventional unit); pelvimetry was performed to detect the transverse and longitudinal dimensions of the bony pelvis, as well as the degree of maturity of the pelvic bones using the index of pelvic bone (IPB). The methods of mathematical statistics were used to gain a comprehensive understanding of the data.

Results. A comparative analysis was conducted to identify the differences between female acrobats aged 12-15 years old and performing their roles at the top, female acrobats aged 16-23 years old and performing their roles in the middle and at the bottom, and control groups of the same age categories. The analysis revealed the presence of changes in morphofunctional indicators of the bony pelvis below the normative values during the study.

Conclusions. Morphological criteria of sexual dimorphism were found in female acrobats, namely: in the indicators of shoulder width and bony pelvis. These processes can be regarded as adaptive, occurring under the influence of physical and psychological training, as well as competitive loads of high intensity.

Keywords: sexual dimorphism, female acrobats, role, anthropometry, bony pelvis, pelvimetry.

Introduction

In modern research on sports medicine and morphology, the issues of studying the phenomena of masculinization, inversion of sexual dimorphism of female athletes are relevant. In the direction of further development of the general theory of sports and the system of training of athletes, the problematic issues of medical and biological research of the female organism in the process of training in Olympic and professional sports remain relevant (Shakhlina, 2020; Anderson et al., 2023; Nagorna et al., 2023; Nagorna et al., 2024).

Also relevant are studies aimed at studying and resolving the most controversial issues in the system of training women in various sports. In the study (Shueva, Ivashchenko, & Jagiello, 2021). It is shown that combined technologies of teaching complex coordination physical exercises using

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the algorithmic instructions method are effective for adapting the female body to training and competitive loads, which allow obtaining factor models of training programs at the level of 70.6% and 68.5% of the variation of results. The authors of the study (Andrieieva et al., 2020) note that combined fitness programs are effective for the female body, which allow to significantly increase the level of physical and functional fitness of the body. In turn, in sports activities this is the key to effective implementation of sports programs in complex coordination sports, especially in women's programs (Solohubova, et al., 2020).

Study authors (Douda et al., 2024), on materials of rhythmic gymnastics, by methods of factor analysis, the main components (with 45% variation of results) that affect the effectiveness of the training and competitive process were determined morphometric indicators account for about 6.8%. At the same time, the anthropometric component significantly affects the indicators of the overall effectiveness of sports training and competitive activity: $r = 0.5$ at $p < 0.01$. In the process of modeling, when applying the formulas of multiple regression equations to the indicators of qualified female athletes, it was determined that up to 33.6% (arm span – 12.0%, mid-thigh circumference – 13.1%, body weight – 8.5%) is accounted for by morphometric indicators that significantly differ by gender characteristics.

Also, gender specificities of somatotype and other morphometric characteristics were highlighted in the study (Sanchez Munoz et al., 2020), in which the indicators of running disciplines (middle and stayer distances) indicated the gender specificities of athletes who achieve maximum physical development in the age range of 17-23 years. This creates a basis for using the data obtained to optimize the control of the training process, as well as for more effective identification of talents and selection of athletes. Previously, similar results regarding the presence of gender specificities were obtained in the study – Altavilla et al. (2017).

The results of the study (Gonzalez Macias & Flores, 2024) indicate the existence of a relationship between somatotype indicators, body composition and flexibility manifestations. Differences were found between athletes of male rhythmic gymnastics (MAG), female rhythmic gymnastics (WAHS) and female rhythmic gymnastics (WAG) in terms of fat mass, bone mass, residual body mass, as well as the corresponding somatotype – endomorphic, mesomorphic and ectomorphic. These differences may indicate that somatotypes are associated with sports results, since the authors found correlations between anthropometric measurements, body composition and flexibility manifestations.

Opala-Berdzik, Głowacka, and Juras (2021) determined that the body mass index of acrobatic gymnasts and the BMI index are negatively correlated with the speed characteristics of the anterior-posterior and medial-lateral centers of foot pressure on the support in different visual conditions (r, from -0.64 to -0.93; at $p < 0.05$). The average speed indicators of the center of foot pressure in non-athletes are insignificantly correlated with their age and anthropometric indicators ($p>0.05$). The above indicates that female athletes – representatives of complex coordination sports, have peculiarities of physical development and specific morphometric manifestations, due to the adaptation of the body to training activities and the specifics of the sports orientation.

The results of long-term experimental studies (Atikovic, 2020) showed significant differences between female gymnasts in body weight and height over a 20-year period: from 1996 to 2016. No significant differences were found in the study materials of men in artistic gymnastics. The results presented are significant for determining comparative model parameters in the process of selection and sports specialization regarding morphological characteristics according to the gender characteristics of athletes – representatives of complex coordination sports. Of particular importance, in this case, are manifestations of age dynamics of the formation of vestibular stability and balance, which can also significantly differ in gender in representatives of complex coordination sports, as shown in experimental studies (Petran et al., 2023).

Special attention is paid to experimental studies aimed at studying the mental and physiological aspects of the human body. In particular, the problematic issues of body image and psychological resilience in view of the complex impact of social media and physical measurements on self-esteem and mental health of young athletes with an emphasis on their connection with cultural and gender factors are highlighted in the study (Merino et al., 2024). Also significant, from this point of view, are experimental studies aimed at gender differentiation of physiological indicators of optimal human mental state based on the identification of connections between neurotransmitters, hormones, inflammatory markers, microbiome and well-being (de Vries, van de Weijer, & Bartels, 2022). Active transformation of biologically active compounds to these substances occurs in the human body under the influence of optimal physical activity, which is relevant, namely, in the gender aspect (Curby et al., 2023). This is relevant both for young athletes and for women of early adulthood who are actively engaged in physical exercises and are involved in conditioning training to maintain the optimal physical status of their body (Shyshkina, & Beihul, 2023).

In experimental studies, based on materials from shooting sports (Bugaevsky, 2024), it was found that in the studied groups there are athletes of gynomorphic and mesomorphic sexual somatotypes, and there are no athletes of andromorphic sexual somatotype, which indicates either the peculiarities of the organism`s adaptation to specific training and competitive loads, or the effects of factors of the sports orientation of the specified contingent of athletes.

This scientific direction additionally raises the issue of the relationship between the somatotype and morphometric parameters of young female athletes with individual manifestations of neurological typology – the basis of these mechanisms are genetic factors and factors of adaptation to specific conditions of training activities in various sports (Tyshchenko et al., 2023).

Significant gender differences in the training process are also indicated by the authors of the study (Dave et al., 2022), who present the generalized results of a meta-analysis of gender differences in the frequency of repeated concussions in various sports with an emphasis on the group of complex coordination sports, which is significant for optimizing medical support for the process of sports improvement and reducing the level of sports injuries (Sheviakov et al., 2020).

The analysis of research works that thoroughly consider the issues of studying the features of adaptive changes in anthropometric and morphometric indicators of female rep-

resentatives of complex coordination sports, in particular, pair and group sports acrobatics, requires expansion and addition due to number of finally unresolved issues. Age, genetic, gender features of changes in physical development indicators, other anthropometric and morphometric indicators under the influence of factors of adaptation to the conditions of training activities and sports orientation are parallel processes in the conditions of development of the body of female athletes in the process of their many years of improvement. The above requires a detailed and in-depth study of these issues in the conditions of training in sports acrobatics, taking in to account the specific features of the female body, which allowed us to formulate the goal of our work.

Materials and Methods

Study Participants

Female athletes specialising in pair and group sports acrobatics of different roles and ages took part in the research: female athletes at the puberty age take their roles at the top (13.25 ± 1.65 years, n = 12), athletes of youth age take their part at the middle and at the bottom (19.34 ± 1.95 years old, n=20). The sports qualifications of female acrobats were sub-elite and elite athletes. The study population comprised 32 athletes having appropriate positions — top, middle, and bottom: (12 female acrobats performing their roles at the top, 20 female acrobats performing their roles in the middle and at the bottom). Girls of the same age categories (12-15 and 16-23 years old) who did not engage in playing sports (control groups 1 and 2) also took part in the study.

The studies were performed in accordance with all relevant national norms and rules of institutional policy and the National Health Council, according to the Declaration of Helsinki. All participants and parents of minors gave written agreement (consent) for the study and were informed of the purpose and procedures of the testing, as well as the possibility of withdrawing consent at any time for any reason. Informed consent was obtained from all individuals included in this study.

Study Organization

The study aimed to examine individual anthropometric indicators, focusing on the bony pelvis size in female acrobats of various roles during the puberty and youth age, as well as in persons who do not engage in playing sports.

Anthropometry was included in the research program: measurements of body length (cm), body weight (kg), shoulder width (cm), determination of body mass index (conventional unit).According to the classical method, pelviometry was performed with the detection of the transverse and longitudinal dimensions of the bone pelvis, as well as the degree of maturity of the pelvic bones using the index of pelvic bone (IPB) according to the modern methods (Wang, Asokan, & Onnela, 2024).

Statistical Analysis

Statistical processing was carried out using the STATISTICA 10.0 computer program and MS Excel XP software packages with an open license for non-commercial use. The main indicators of mathematical statistics were arithmetic mean (X), standard deviation (SD), standard error of the arithmetic mean (m), median, 25 % and 75 % quartiles. Comparison of indicators between samples of female acrobats of different roles with each other, as well as with the control group (population) was carried out using the non-parametric Mann-Whitney U-test (in cases where the sample didn't have a normal distribution) and Student's t-test (in cases when the sample had a normal distribution). In mathematical and statistical processing, the level of significance $\alpha = 0.05$ ($p < 0.05$) was used, in some cases the results were obtained at higher levels of significance ($p < 0.01$ and $p < 0.001$).

Results

The average height of female acrobats performing the function of those at the top role is 139.84 ± 3.89 cm, the average height of female athletes performing the roles in the middle and below is 163.47 ± 3.65 cm.

Differences between height and body weight indicators from female role partners those that are statistically significant in the middle and at the bottom (differences are reliable at $p < 0.001$) reflect the peculiarities of functional duties and specific activities during interaction in an acrobatic pair or group (Fig. 1).

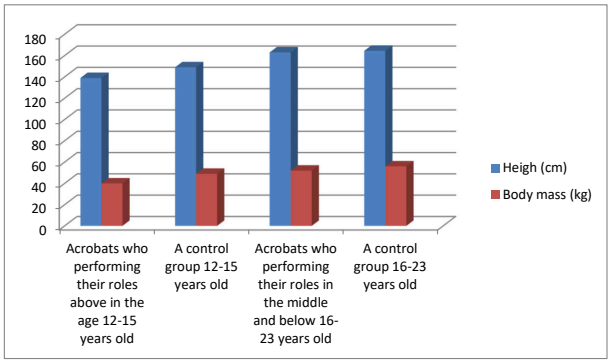

Fig. 1. Comparative characteristics of individual anthropometric indicators of female acrobats of different roles and the control group

Female acrobats of the roles above are statistically different from the population in terms of height and body weight ($p < 0.001$). According to the indicator of the body mass index (BMI), a deficit was found in female athletes of the above roles (Fig. 2).

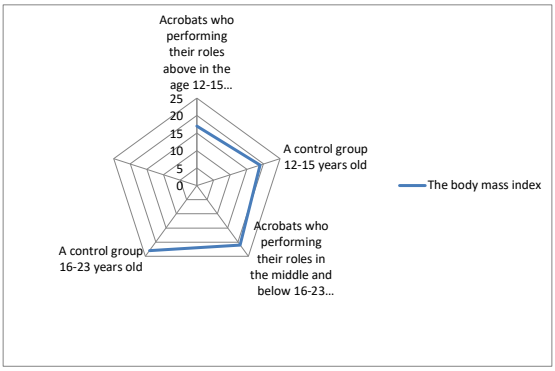

Fig. 2. Comparative characteristics of the body mass index (BMI) of female acrobats of different roles and the control group

Table 1. Indicators of pelvimetry and shoulder width, taking in to account the role of female acrobats and those who don't play sports, n = 64

No	Groups	Normative values (cm)	Statistical indicators			
			X ± SD	Me	25-75 %	P
			Shoulder width (biacromial size,)			
1.	exp. group 1 (n = 12)	–	30.51 ± 0.78	31.12	29.93-30.93	p1.2 < 0.05
2.	control group 1 (n = 12)		32.37 ± 0.80	32.76	31.49-32.89	p1.3 < 0.001
3.	exp. group 2 (n = 20)		36.00 ± 0.73	35.98	35.20-36.58	p2.4 < 0.05
4.	control group 1 (n = 20)		34.70 ± 0.51	34.65	34.17-34.98	p3.4 < 0.05
			Distantia spinarum (cm)			
1.	exp. group 1 (n = 12)	25-26	18.84 ± 0.43	20.25	19.89-20.67	p1.2 < 0.001
2.	control group 1 (n = 12)		23.63 ± 0.34	23.69	23.24-23.82	p1.3 < 0.001
3.	exp. group 2 (n = 20)		23.19 ± 0.56	23.17	22.73-23.17	p3.4 < 0.01
4.	control group 1 (n = 20)		25.69 ± 0.35	25.80	25.54-25.98	
			Distantia cristarum (cm)			
1.	exp. group 1 (n = 12)	28-29	23.95 ± 0.29	23.89	23.67-24.22	p1.2 < 0.01
2.	control group 1 (n = 12)		26.75 ± 0.29	26.75	26.51-26.97	p1.3 < 0.01
3.	exp. group 2 (n = 20)		26.12 ± 0.66	25.97	25.65-26.64	p2.4 < 0.01
4.	control group 1 (n = 20)		28.65 ± 0.33	28.64	28.37-28.98	p3.4 < 0.05
			Distantia trochanterica (cm)			
1.	exp. group 1 (n = 12)	30-32	25.29 ± 0.59	25.28	24.65-25.87	p1.2 < 0.01
2.	control group 1 (n = 12)		29.61 ± 0.34	29.51	29.32-29.77	p1.3 < 0.01
3.	exp. group 2 (n = 20)		28.11 ± 0.64	27.98	27.64-28.63	p2.4 < 0.05
4.	control group 1 (n = 20)		31.07 ± 0.65	30.84	30.49-31.76	p3.4 < 0.001
			Conjugata vera (cm)			
1.	exp. group 1 (n = 12)	11	9.84 ± 0.21	9.76	9.65-9.95	p1.2 < 0.05
2.	control group 1 (n = 12)		11.05 ± 0.22	11.03	10.87-11.23	p1.3 < 0.05
3.	exp. group 2 (n = 20)		10.57 ± 0.41	10.65	10.08-10.98	
4.	control group 1 (n = 20)		11.17 ± 0.15	11.18	11.12-11.25	
			Conjugata externa (cm)			
1.	exp. group 1 (n = 12)	20-21	16.92 ± 0.25	16.89	16.63-17.12	p1.2 < 0.05
2.	control group 1 (n = 12)		18.20 ± 0.27	18.22	17.89-18.34	p1.3 < 0.001
3.	exp. group 2 (n = 20)		19.05 ± 0.55	18.97	18.24-19.67	p2.4 < 0.05
4.	control group 1 (n = 20)		20.88 ± 0.29	20.98	20.72-21.04	p3.4 < 0.05

Notes: exp. group 1 – female acrobats at the roles above (12-15 years old); exp. group 2 – female acrobats at the roles in the middle and below (16-23 years old)

A comparative analysis of female acrobats performing roles at the top of 12-15 years old, female acrobats performing their roles at the middle and at the bottom of 16-23 years old, and control groups of the same age categories proves that the changes in the morphofunctional indicators of the bone pelvis below the normative values were detected during the research. This may be related to high and intense physical loads in the educational and training process of female athletes specializing in pair and group types of sports acrobatics, as well as the early period of sports. No pathological changes were detected in the control groups aged 12-15 and 16-23 (Table 1).

The indicators of shoulder width in female acrobats in the roles above, as well as in female athletes in the roles in the middle and below, exceed the indicators of pelvis width ($p < 0.05$).

Variability was revealed in individual anthropometric indicators in comparison with the control group. In girls aged 12-15 years old, the above indicators are statistically different from those in the control group ($p < 0.05$-0.001). In female acrobats of the roles in the bottom and in the middle, individual anthropometric indicators and the bone pelvis values have statistical differences compared to similar data in the group of roles at the top (90 % and 95 % confidence level).

The data obtained during the study regarding the size of the pelvis of female acrobats indicate an adaptive restructuring in their body and an inversion of sexual dimorphism. The analysis of the obtained data when measuring the width of the shoulders showed that these indicators exceed the dimensions of the width of the pelvis ($p < 0.05$). The average statistical values in the group are below the normative val-

ues, these indicators of female acrobats cannot be attributed to normative normal sizes, that is, they are female acrobats with indicators of an anatomically narrowed pelvis.

In the case of an individual assessment of the data obtained in two female acrobats, the roles in the middle and below, d. spinarum (cm) showed values close to the normative ones (24.67 and 24.54 cm), d. cristarum in two female acrobats (27.37 and 27.22 cm are close to the normative values). Also, one female acrobat has the role of the one in the middle, d. trochanterica (28.99 cm – approximate normative values).

The degree of maturity of the pelvic bones was determined according to the method using the index of the pelvic bone (IPB). It is an integral indicator of the formation of the bones of the pelvis. At the age of 12-13 years old, the highest peak increases in the size of the bone pelvis are observed. The same age is characterized by the appearance of menarche (Wang, Asokan, & Onnela, 2024).

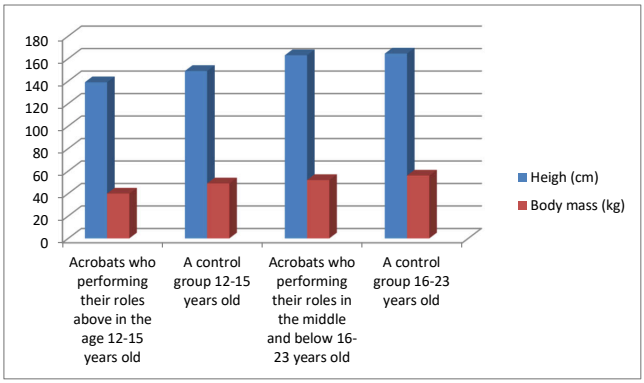

Fig. 3. Comparative characteristics of the index of pelvic bones (conventional unit) in acrobats of different roles and control groups (population)

In the average group values, this indicator was 28.25 ± 1.08 conventional unit in female acrobats performing their roles above (12-15 years old), that is, the process of formation of pelvic bone structures is observed in them. In the control group of the same age category, the value was 30.54 ± 1.11 conventional unit. ($p < 0.05$) (Fig. 3).

In female acrobats with roles in the middle and at the bottom of 16-23 years old, the IPB value is 32.45 ± 1.04 conventional unit, in the control group 36.34 ± 1.10 conventional unit (differences are significant at $p < 0.01$), i.e. the indicators are within the normal range, which indicates the completion of the process of maturation and formation of pelvic bone structures. For young female athletes, the normative values of IPB are indicators of 30-40 conventional unit. The age periods of the test subjects who took part in the experiment, namely puberty and youth ages, are critical periods of the process of formation and maturation of the pelvic bones.

Based on the data obtained during the study, female acrobats have shoulder width indicators that exceed those of the control group (population). The indicators of the width of the pelvis don't correspond to the norm (the difference is statistically significant at the probability level of 90 % and 95 %) (Table 1).

Discussion

The problematic issues of the influence of sexual dimorphism on anthropometric characteristics and features of the bony pelvis in female athletes – representatives of complex coordination sports – have received a detailed description in modern studies (Atikovic, 2020; Opala-Berdzik, Głowacka, & Juras, 2021; Petran et al., 2023).

In modern sport, the level of competitive results has reached such values that require female athletes to have the appropriate physical, morphological, functional, psychophysiological and mental abilities and data. Under the specific effect of training and competitive loads, certain structural changes are observed in the body of female athletes (Shakhlina, 2020).

Knowledge in the direction of studying the anthropometric and morphometric features of female athletes of puberty and youth, specializing in pair and group types of acrobatics, can help to rationally plan the training process at important stages of multi-year improvement. This can increase the quality of the construction of the educational and training process, the level of results of competitive activities and help to preserve reproductive health, slow down the process of rebuilding the body towards andromorphic development and help to control this process at a scientific level (Bachynska & Sarychev, 2023).

The increased level of androgens in the body of female athletes leads to the formation of a male somatotype, which is characterized by an increase in the width of the shoulders with a simultaneous decrease in the width of the pelvis. Experts also emphasize that the influence of androgens on the reproductive system of female athletes can be manifested in the suppression of the development of signs of puberty – growth of mammary glands, menarche, et al. (Hirschberg, 2020).

According to several authors, the early start of sport, namely before the onset of menarche, before the establishment of the menstrual cycle, as well as factors such as physical and psycho-emotional loads of high intensity, in a significant percentage of female athletes lead to a delay in puberty (especially in complex-coordinating types of sports). Mesomorphic and andromorphic sexual somatotypes are also formed. These processes are observed in the pubertal and adolescent age of female athletes (Andrieieva et al., 2020; Douda et al., 2024; Gonzalez Macias & Flores, 2024).

Specialists are investigating very important issues, namely the impact of training and competition loads on the reproductive functions of female athletes, the dependence of manifestations of masculinization of their bodies and high sports results. Scientists give examples that signs of sex inversion at the hormonal level affect the formation of a masculine body structure.

It is believed that female athletes with signs of masculinity are more successful in their chosen sport, therefore the search for morphological and other criteria that indicate signs of masculinization of female athletes is relevant at the current stage of research. During the sports selection of the requirements for the roles in the middle and below, the coaches emphasize such criteria of female athletes as broad shoulders, power qualities, special endurance, male psychological characteristics, that is, the manifestation of masculinization is a priority.

We consider the processes discovered during our research as adaptive changes in the body of female acrobats. They occur under the influence of physical and psycho-emotional loads of high intensity. We determined that all subjects had an early start to acrobatics (average age 7.25 ± 1.23), i.e. long before the onset of menarche. 98 % of subjects have already formed mesomorphic and andromorphic sexual somatotypes, which are explained in more detail in our previous publication (Bachynska et al., 2023).

Specialization and selection of female acrobats for the roles above and those in the middle and below should be carried out taking in to account not only the age difference of these female athletes, but also taking into account such anthropometric indicators as the length of the upper and lower limbs, the width of the shoulders and pelvis, morphofunctional index values. Adaptation to training and competitive loads of high intensity, reduction of fat mass, changes in neuro-humoral regulation of processes in the body of female athletes lead to changes in anthropometric, morphometric, and psychological characteristics of female acrobats (Shueva, Ivashchenko, & Jagiello, 2021).

Female pair group acrobatics is a specific type of specialization. The roles of those at the top and those in the middle and at the bottom (in pairs and groups) differ from each other primarily by anthropometric and morphometric indicators. In general, those partners above are younger in age, smaller in height and weight. They show signs of delayed puberty. Is this the result of loads or the specificity of selection, where the one at the top role should be light weight and smaller in height? Probably, both factors play a huge role here.

According to the requirements for the role of female athletes in pair and group pairs, there are anatomical, morphological and anthropometric features. The functional duties of those in the middle role (if a group) and those at the bottom role (pairs, groups) include are number of components: throwing, catching, supporting the partner at the top, on two and one hand, so these female athletes must be taller in height, weight and have significantly higher power indicators. That is, the training work includes exercises with the partner's body weight from 30 to 40-45 kg (depending on age categories and qualifications). This requires considerable strength and endurance, therefore, for female acrobats, the roles in the middle and those at the bottom, the training activity can be attributed to the so-called masculine. These factors can shape body image concerns in athletes across a variety of sports and skill levels. This is particularly important in acrobatics, where judges assess the level of difficulty of exercises with a certain level of artistry and aesthetic impact (Burgon, Beard, & Waller, 2023).

Prospects for further exploration in this direction lie in further differentiation of criteria for the success of competitive activity, which are associated with morphometric parameters and features of the formation of the bone pelvis in young female athletes. First, this concerns individual and pair-group types of sports acrobatics.

Conclusions

As a result of the research, it was found that the morphological criteria of sexual dimorphism were found in female acrobats who has their roles at the middle and below, namely: in the indicators of shoulder width and bone pelvis. These processes can be regarded as adaptive processes occurring in female athletes under the influence of physical, psychological training and competitive loads of high intensity.

When selecting for roles in acrobatic pairs and groups, coaches select female athletes based on height and body weight. It is also necessary to consider the anthropometric indicators of the width of the shoulders and pelvis, as well as other morphofunctional values. In the training process, it is necessary to differentiate training loads taking in to account the age characteristics of female athletes due to individual types of training process (individual elements, jumping on acrobatic tracks, general and special physical training exercises). This will make it possible to individualize the training process of female acrobats taking in to account their role and anthropometric and functional values, which will minimize the negative impact of loads on the body of young female athletes and preserve reproductive health. We cannot stop the growth of loads and change the specifics of the sport, but it is possible to slow down the process of morphofunctional adaptive changes (minimize this process) by controlling and planning the training process taking in to account the characteristics of the female body. It also requires individualization of load planning in such a way that the volume and intensity differ significantly from the training process of men.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Статевий диморфізм в антропометричних характеристиках та особливостях кісткового тазу представників парних і групових видів спортивної акробатики

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 1 табл., 3 рис., 35 джерел.

Мета. Вивчення індивідуальних антропометричних показників, розмірів кісткової тканини тазу акробаток різного амплуа статевого та юнацького віку, а також осіб, які не займаються спортом.

Матеріали і методи. Контингент дослідження – 32 спортсменки (12 акробаток, амплуа – які зверху, 20 акробаток, амплуа – які посередині та внизу). У дослідженні також брали участь дівчата цих же вікових категорій (12-15 та 16-23 роки), які не займаються спортом (1 і 2 контрольна група). Методи дослідження: вимірювання довжини тіла (см), маси тіла (кг), ширини плечей (см), визначення індексу маси тіла (умовна одиниця); пельвіометрія з визначенням поперечного та поздовжнього розмірів кісток таза, а також ступеня зрілості кісток тазу за індексом тазової кістки (ІТК); методи математичної статистики.

Результати. Порівняльний аналіз показників акробаток (амплуа – верхні), 12-15 років, та акробаток (амплуа – середні та нижні), 16-23 років, дівчат і жінок контрольних груп тих самих вікових категорій доводить, що зміни у процесі дослідження виявлено за морфофункціональними показники кісткової тазової кістки, які зафіксовані на рівні нижче за нормативні значення.

Висновки. Виявлено морфологічні критерії статевого диморфізму у акробаток різного амплуа, а саме: за показниками ширини плечей, кісткового тазу. Ці процеси можна розглядати як адаптивні, що відбуваються під впливом фізичної та психологічної підготовки і змагальних навантажень високої інтенсивності.

Ключові слова: статевий диморфізм, акробатки, амплуа, антропометрія, кістковий таз, пельвіометрія.

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