Features of sexual dimorphism in elite pentathletes

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Abstract

Objective of the study was to establish the degree of manifestation of sexual dimorphism in elite athletes specializing in modern pentathlon.

Methods and structure of the study. The study involved 18 elite athletes, both men and women, specializing in modern pentathlon and having the sports qualifications from MS to WCMS. In order to address the research issues, somatometric methods commonly used in sports morphology were applied. In addition, the method of bioimpedance analysis of body composition using the "Medass – ABC-01" device (Russia) was applied.

The degree of manifestation of sexual dimorphism was determined by five categories [5, 6]. The sex differences were deemed absent when the compared values approximated – ±1%; when these values differed within ±10%, the degree of manifestation was deemed low; within ±10-30% – average; within ±30-50% – high; above ±50% – very high. In addition to the generally accepted statistical indicators, the Mollison criterion (kM) was used to quantify the degree to which sexual **dimorphism manifested itself in the subjects.**

Conclusion. The study found that, according to the morphological characteristics, the degree of manifestation of sexual dimorphism in elite pentathletes was low to average. The body composition analysis revealed the high (SMM, IW and TBW, ACM), average (EW, fat mass) and low (percent SMM) degrees of manifestation of sexual dimorphism. In terms of almost all the studied indicators, the men were found to predominate over women, except for the fat mass.

Sexual dimorphism in assessing competitive performance in individual pentathlon events indicates that women are inferior to men in almost all the studied indicators, except for shooting. The most significant gender differences (kM) were found in mixed relay, 4,800 m running and swimming. The least significant differences were found in shooting.

To reduce the degree of manifestation of sexual dimorphism, attention should be paid to the sports selection of female athletes.

Keywords: *sexual dimorphism, elite athletes, modern pentathlon, competitive performance, morphological indicators, body component composition.*

Background. In modern sports training system, apart from the general provisions for men and women, we have two fundamental approaches concerning the orientation of women's training. In one of the cases, the authors emphasize that women's sports are characterized by their own unique features [1, 3, 12, 13]. In their opinion, specific requirements of individual sports generate differences in the adaptation processes in women. Therefore, individual biorhythmic characteristics of the reproductive system of a particular female athlete [1, 7, 8, 11-13] must be taken into account when organizing training activities.

Whereas, some authors [3, 10] are convinced that the training process should be planned regardless of the athlete's sex but based on the general patterns of sports training. Thus, T.S. Soboleva et al. [10] state that in most elite sports where women with an androgen hormonal profile are represented it is necessary to follow common approaches that are widely used in men's sports. This position is based on the fact that the elevated level of natural androgens (congenital hyperandrogenism) allows such female athletes to compete with men.

The authors [5, 12, 13] define dimorphism as the presence of two more or less different forms within the same species. There is another definition of dimorphism – the distinction between sexes at the genetic, anatomical, physiological, and psychological levels [2]. It is emphasized [3, 5, 6, 10, 11] that the possibility of female athletes to achieve high sports results is predermined by the convergence of the physiological and morphofunctional indicators in highly-qualified athletes of both sexes. For this purpose, according to T. Sokhi [11], it is necessary to strive for the adequacy of pedagogical effects of dimorphic differences in adaptive processes in the female body and psyche under the influence of training loads.

Several scientific works consider differences in the morphological and functional characteristics of women who are actively engaged in men's sports. The studies found a tendency towards leveling out of the dimorphic differences and suggested masculinization of women through sports activities [1, 6, 9, 10] and convergence in their competitive performance in a particular sport [4, 8-10, 12].

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The degree of manifestation of sexual dimorphism was determined by five categories [5, 6]. The sex differences were deemed absent when the compared values approximated – ±1%; when these values differed within ±10%, the degree of manifestation was deemed low; within ±10-30% – average; within ±30-50% – high; above ±50% – very high. In addition to the generally accepted statistical indicators, the Mollison criterion (kM) [13] was used to quantify the degree to which sexual dimorphism manifested itself in the subjects. The latter was calculated by the formula:

$$kÌ = \frac{\overline{\tilde{O}_f} - \overline{\tilde{O}_m}}{S_m},$$

where $\bar{X}_f$ – arithmetic mean of the given feature in females; $\bar{X}_m$ – arithmetic mean of the given feature in males; S_m – quadratic deviation of a given feature in males. The higher the numerical values of the criterion, the higher the degree of manifestation of sexual dimorphism.

The competitive performance of the athletes of both sexes in various modern pentathlon events not influenced by external factors was also assessed.

Table 1. *Morphological indicators in highly-qualified athletes specializing in modern pentathlon*

Indicator	Men			Women			%	kM
	$\bar{X}$	S	V%	$\bar{X}$	S	V%		
Body length, cm	182.8	6.14	3.35	167.25	8.34	4.98	9.29	6.52
Body mass, kg	73.04	7.24	9.91	59.6	8.27	13.87	22.55	5.40
Body mass index, u.	21.86	1.55	7.09	21.25	1.23	5.78	2.87	1.41
Waist circumference, cm	76.4	3.97	5.19	67.25	3.40	5.05	13.61	7.95
Hip circumference, cm	95.4	4.21	4.41	92.5	5.25	5.67	3.13	1.89
Waist/hip ratio	0.79	0.86	5.12	0.72	0.02	3.95	9.72	0.41

Table 2. *Body component composition in elite athletes specializing in modern pentathlon*

Indicator	Men			Women			%	kM
	$\bar{X}$	S	V%	$\bar{X}$	S	V%		
Percent ACM, %	62.24	2.62	4.2	60.1	1.23	2.0	3.5	1.91
ACM, kg	38.66	4.12	10.6	28.0	2.63	9.3	38.0	10.19
SMM, kg	34.54	2.32	6.7	23.95	2.93	12.2	44.2	2.44
Percent SMM, %	55.76	1.48	2.6	51.3	1.26	2.4	8.6	10.43
Fat mass, %	14.96	1.85	12.3	21.15	4.33	20.4	-29.2	-5.51
Intracellular water, kg	27.62	2.58	9.3	19.8	1.73	8.7	39.4	11.71
Extracellular water, kg	17.76	1.29	7.2	14.35	1.78	12.4	23.7	6.73
Total body water, kg	45.4	3.84	8.4	34.17	3.46	10.1	32.9	9.82

Results and discussion. Given in Table 1 are the results of the comparative analysis of the morphological indicators in the athletes of both sexes specializing in modern pentathlon.

According to the morphological indicators, the degree of manifestation of sexual dimorphism was low to average. The indices of the athletes' body length (9.29%), hip circumference (3.13%), waist/hip ratio (9.72%) and body mass index (2.87%) had a low degree of manifestation of sexual dimorphism, while their body mass (22.55%) and waist circumference (13.61%) rates had an average degree of manifestation of sexual dimorphism.

The body composition analysis (Table 2) revealed a high degree of manifestation of sexual dimorphism in terms of the following indicators: skeletal muscle mass (SMM) (44.2%), intracellular water (IW) (39.4%), total body water (TBW) (32.9%), active cell mass (ACM) (38.0%).

The average degree of manifestation of sexual dimorphism was found in terms of the following indicators: extracellular water (23.7%), fat mass (29.2%), and the low degree – in the percent skeletal muscle mass (8.6%). The very high degree of manifestation of sexual dimorphism according to the Mollison criterion (kM) was detected in the following body composition indicators: intracellular water – 11.71; percent skeletal muscle mass – 10.43; active cell mass – 10.19. In general, the variability of the studied indicators was higher in the female pentathletes.

Given in Table 3 are the sexual dimorphism rates obtained during the assessment of the competitive performance of athletes in various modern pentathlon events.

The results obtained showed that the women lagged behind the men in almost all the studied indicators: swimming – 9.25%, **mixed relay** total time – 9.95%, and one of its events – 4,800 m running – 12.35%. The exception was the time of shooting in the mixed relay. The women were 5.49% ahead of the men (low degree). In our view, such difference in the values was ensured by a higher level of development of movement coordination, stress tolerance, economy and technical efficiency of the female athletes during shooting.

The analysis of the relative variability (coefficient of variation) rates obtained in both men and women during swimming and mixed relay revealed fairly stable results. The greatest variability in all the indicators was found among the women. However, the mixed relay events (shooting and 4,800 m running) showed wide ranges of variability. Thus, in the mixed relay, the athletes achieved identical results due to both the relatively even level of development of the main components of competitive performance and sharply disproportionate results demonstrated.

Conclusion. The study found that, according to the morphological characteristics, the degree of manifestation of sexual dimorphism in elite pentathletes was low to average. The body composition analysis revealed the high (SMM, IW and TBW, ACM), average (EW, fat mass) and low (percent SMM) degrees of manifestation of sexual dimorphism. In terms of almost all the studied indicators, the men were found to predominate over women, except for the fat mass.

Sexual dimorphism in assessing competitive performance in individual pentathlon events indicates that women are inferior to men in almost all the studied indicators, except for shooting. The most significant gender differences (kM) were found in mixed relay, 4,800 m running and swimming. The least significant differences were found in shooting.

To reduce the degree of manifestation of sexual dimorphism, attention should be paid to the sports selection of female athletes. Nowadays, as a rule, it is female athletes, who have been swimming in the past and have not performed well in this sport, who go in modern pentathlon. We also believe that more emphasis should be placed on fencing and running, as with the forthcoming change in the rules of modern pentathlon competitions this may trigger an increase in competitive performance.

Therefore, the dimorphic features in the structure and functions of the female body affect the

Table 3. *Competitive performance rates in highly-qualified athletes of both sexes specializing in modern pentathlon*

Indicator	Men			Women			%	kM
	$\bar{x}$	S	V%	$\bar{x}$	S	V%		
200 m swimming, s	2:06.11	4.81	3.49	2:18.53	4.77	3.14	9.25	2.66
4x800 m running, s	10:31.18	13.44	1.94	11:49.13	44.99	5.79	12.35	5.79
Shooting, s	56.27	15.36	25.1	53.34	16.82	28.79	5.49	-0.19
Mixed relay total time, s	11:27.44	5.93	0.79	12:42.46	33.49	4.01	9.95	10.91

competitive performance rates, which necessitates constant correction of the contents of training effects and their adequacy to the current state of the female athlete's body at the time of training. In doing so, and in keeping with the strategic objectives of training, it is necessary to take into account individual characteristics of female pentathletes and their leading motor abilities.

References

1. Denisova U.Zh., Azamov R.M. Sexual dimorphism in women's sports. Fan-Cportga. 2018. No. 3. pp. 63-69.
2. Ilyin E.P. Differential psychology of men and women. St. Petersburg: Piter publ., 2002. 345 p.
3. Kochetkova E.F., Oparina O.N. Features and problems of sexual dimorphism in sports. Sovremennye nauchnye issledovaniya i innovatsii. 2014. No.7 (39). pp. 17-19.
4. Lashkevich S.V., Vrublevskiy E.P., Chitaykina N.B. et al. Criteria for competitive activity of footballers. Teoriya i praktika fiz. kultury. 2021. No. 5. pp. 88-90.
5. Martirosov E.G. Sexual dimorphism of morphofunctional indicators in elite athletes. Voprosy antropologii. 1988. no. 7. pp. 14-20.
6. Oleinik E.A. Indicators of absolute and relative markers of constitution in 18-23-year-old women engaged in various types of motor activity. Doct. Diss. Abstract (Biol.). St. Petersburg, 2012. 45 p.
7. Sevdalev S.V., Skidan A.A., Vrublevskiy E.P. Organizational and methodological aspects of individualization of women's health-improving training. Chelovek. Sport. Meditsina. 2020. V. 20. No. 1. pp. 69-76.
8. Sevdalev S.V., Vrublevskiy E.P., Kozhedub M.S. et al. Biorhythm-based individualization of training of female different distance runners. Teoriya i praktika fiz. kultury. 2020. No. 5. pp. 83-85.
9. Sevdalev S.V. Modeling of competitive activity of elite athletes specializing in modern pentathlon. Mir sporta. 2021. No. 2 (83). pp. 54-59.
10. Soboleva T.S., Sobolev D.V., Chernukhina O.V. Sexual dimorphism in women's sports. Kultura fizicheskaya i zdorovye. 2013. No. 2 (44). pp. 53-55.
11. Soha T. Women's sports (new knowledge - new training methods). Moscow: Teoriya i praktika fiz. kultury, 2002. 203 p.
12. Shakhlina L. Ya.-G., Chistyakova M.A. Gender policy and issues of sexual dimorphism in practice of modern sports. Sportivna meditsina I flzichna reablIltatslya. 2019. No. 2. pp. 18-23.
13. Asienkiewicz P. Dymorfizm cech somatycznych iproporcji ciała oraz sprawności motorycznej młodzieży Uniwersytetu Zielonogórskiego w świetlewiel kościzamieszki wanego środowiska. Aktywność Ruchowa Ludziw Różnym Wieku, 2016, 4 (32). pp. 39-52.