

Research Article

Masculinization Phenomena and Sexual Somatotypes in Female Athletes Engaging in Shot Put

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Abstract

The article presents the results and analysis of the study, concerning the study of the characteristics of sexual somatotypes and masculinization phenomena in adolescent athletes engaged in shot put. The study used a number of morphological index values, the obtained indicators of which objectively testify to the inversions of sexual somatotypes in athletes and adaptive changes, with the phenomena of masculinization and hyperandrogenism.

Keywords: Female Athletes, Shot Put, Adolescence, Sexual Somatotypes, Masculinization, Adaptation.

Aim of study

The purpose of this study is: to study and analyze the identified individual characteristics of masculinization, in the identified sexual somatotypes, in adolescent female athletes involved in shot put.

1. Introduction

The study of medical and biological features of modern women's elite sports is a very relevant topic among domestic and foreign researchers of women's elite sports. Issues of adaptive changes, the phenomena of masculinization, hyperandrogenism, inversions of sexual somatotypes in athletes of different age groups are in great demand for study, and are an additional source of information about the problem of ontogenetic changes in the population, under the influence of intense physical and psycho-emotional stress. Naturally, we took into account the selection criteria for girls and women in this type of athletics, such as shot put, taking into account their initial morphological, constitutional and functional characteristics.

In recent years, women's sports and its medical and biological features have been the object of close study by specialists from various fields of medicine, psychology and biological sciences. A high level of workload, increased competition, the desire for victory and self-affirmation in life through sports success and achievements - this is not a complete list of motivations for female athletes of different age groups. Mass participation in sports, incl. and the desire of women to be on an equal footing with men, to "conquer" men's sports and achieve success in them is characteristic of female athletes,

both in our country and abroad [1-7]. At the same time, often both the athletes themselves and their coaching team do not take into account, and sometimes, clearly ignore, the changes that occur in the athlete's body as adaptive processes in response to intense demands, both in frequency and in their volume, physical and psychological stress in the training and competitive process of these athletes [2, 4, 8]. Depending on the age of the athlete and the time she started playing sports, as well as the specifics of this sport, somatic changes in many organs and systems of the female body are formed. As a result, negative changes in metabolism, hormonal changes, shifts in sexual somatotypes, disturbances in the functioning of the reproductive system and other processes occur [2, 4, 8].

1.1. Abbreviation

- BMI - body mass index;
- SDI - sexual dimorphism index;
- MI - masculinization index;
- AI - andromorphy index;
- RPWI - relative pelvic width index);
- BPI - brachiopelvic index.

2. Material and methods

When conducting this study, we used methods such as: anthropometry, with determination of the length and body weight of female athletes, determination of their interacromial diameter (shoulder width) and intercrestal size (pelvic width), as well as trochanteric size (distance between the greater trochanters of the femoral bones); index method, with determination of body mass index (BMI) of female

athletes, sexual dimorphism index (SDI), according to the J. Tanner formula, masculinization index (MI); (SDI andromorphy index (IA); method of literary analysis, using available domestic and foreign materials related to the problem under study; method of mathematical statistics of the obtained research results.

3. Results and discussion

19 female youth athletes, actively involved in shot put, were recruited to participate in the study in a number of sports clubs in Nikolayev and Novaya Kahoka, Kherson region, Ukraine. The average age of the athletes was 22.47 ± 1.03 years. The age of practicing this sport is from 3 to 6 years. Level of sportsmanship – 1st sports category (15 young female athletes), candidate master of sports (4 young female athletes). Training frequency: 5-6 times a week, 1.5-2 hours per workout.

Table 1: Anthropometric indicators in young female athletes engaging in shot put.

Indicator name	Body length, cm	Body weight, kg	Shoulder width (bi-acromial diameter), cm	Pelvic width (d. cristarum), cm
Young female sports-mens (n=19)	$179,14 \pm 0,64$	$83,21 \pm 0,47$	$38,43 \pm 0,77$	$27,33 \pm 0,41$

Additionally, when conducting pelviometry, we determined the values of the interspinous (d. spinarum) - 24.12 ± 0.67 cm and intertrochanteric (d. trochanterica) - 30.07 ± 0.88 cm of the transverse external dimensions of the bony pelvis of female athletes. These pelviometric indicators, like the intercrestal size (d. cristarum), are smaller than the sizes generally accepted in morphology and anatomy, 25-26, 31-32 cm, 28-29 cm, respectively [1, 7, 8]. These anthropometric measurements are a necessary component for determining a number of morph functional index values as a marker of masculinization and adaptive somatic inversions in female athletes.

After obtaining anthropometric and pelviometric indicators, a mathematical recalculation and analysis was carried out of such morph functional index values as: body mass index (BMI), sexual dimorphism index (SDI) according to J. Tanner, andromorphy index (IA), masculinization index (MI), relative pelvic width index (RPWI), or morphine index for women, brachiopelvic index (BPI).

When using them, we took into account that: - The value of the relative pelvic width index (RPI), or the morphine index for women, is determined by the formula: as a % ratio of the pelvic width (PW) d. cristarum, cm, divided by body length, cm of this morph functional index value: stenopyelia (narrow pelvis) – indicators less than 15.9; metropyelia (normal-average pelvic size indicators) – indicators from 16.0 to 17.9; euryppyelia (wide pelvis) – indicators from 18.0 and above [2, 4-9].

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To obtain the necessary research data, we used: the anthropometry method, with determination of the length and body weight of athletes, their biacromial size (shoulder width), the pelviometry method (measurement of the external dimensions of the bone pelvis), with the determination of the interspinous (d. spinarum), intercrestal (d. cristarum), intertrochanteric (d. trochanterica) transverse external dimensions of the bony pelvis of female athletes; index method, with the determination of a number of morph functional index values, such as: body mass index (BMI), sexual dimorphism index (SDI) according to J. Tanner; andromorphy index (AI), masculinization index (MI), relative pelvic width index (RPWI), or morphological index for women; method of literary critical analysis of available literature; method of mathematical statistics. The results obtained from anthropometric Studies are presented in table. 1:

one to determine the ratio of body proportions to the sex of the person being studied [2, 4-9]. Its value is calculated using the following formula proposed by these scientists: triple the acromial diameter (BD), minus the d value. Cristarum multiplied by 100 (%). For women, the following dimensions are accepted, in cu: values less than 73.1 – gynecomorphic sexual somatotype; from 73.1 to 82.1 – transitional mesomorph sexual somatotype (sex dysplasia); indicators from 82.1 and above – pathological, inverse, andromorphy sexual somatotype [2, 4-9].

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Andromorphy Index (AI), defined as the difference between triple the shoulder width and double the d value. Trochanterica (intertrochanteric size). Values less than 67.5 are the hypergynoid type; from 67.5 to 73.5 – orthogynoid type; more than 73.5 – android type [2, 4-9].

Masculinization index (MI), one of the main markers occurring in a woman's body, incl. and female athletes, adaptive somatic changes, is calculated as the derivative of dividing

the biacromial size indicator (shoulder width), in cm, by the value *d. trochanterica* (intertrochanteric size), in cm [2, 4-9]. It is believed that in menstruating female athletes, the masculinization index value is normally between 1.15 and 1.23. Values exceeding 1.23 indicate a high level of hyperandrogenism and an imbalance of estrogen-androgen balance in a woman's body [2, 4-9].

Shoulder-pelvic index (SPI), calculated according to the methodology proposed by E.N. Krysanova, 2002 [2, 4-9].

This indicator is defined as a mathematical percentage obtained by dividing *d. cristarum* (SH), per shoulder width, in cm [2, 4-9]. This allows us to judge the shape of the body of the person being studied. The parameters of the obtained index values are as follows: values up to 69.9 units indicate a trapezoidal body shape, from 70.0 to 74.9 units, an average body shape, and values from 75.0 units. And more about the rectangular shape of the body [2, 4-9]. The values of these morph functional indices obtained as a result of the mathematical recalculations are given in Table. 2, at $p < 0.05$:

Table 2: Morph functional values in young female athletes engaging in shot put.

Indicator name	Young female sportsmens
Body mass index (kg/cm ²), BMI	25,51±0,28
Relative pelvic width index (cm), RPWI	15,43±0,24
Sexual dimorphism index, SDI	89,86±0,31
Masculinization index, MI	1,27±0,11
Andromorphy Index, AI	57,10±0,32
Brachiopelvic index, BPI	70,77±0,62

Analysis of the obtained results of a number of markers of the process of adaptive masculinization of young female athletes convincingly indicates that female athletes have a masculine, hypergynoid body type - with manifestations of stenopyelia (narrow) pelvis and broad shoulders, with 100% presence in the study group, the opposite for women, pathological andromorphy sexual somatotype. The values of the masculinization index (MI) indicate a high degree of hyperandrogenism, with hypoestrogenism, i.e., a violation of the hormonal steroid balance between androgens and estrogens in the body of the studied athletes [1, 2, 4-9]. The value of body mass index (BMI) indicates that female athletes exceed the normative weight-height ratios, towards the predominance of fat mass [1, 2, 4-9].

4. Conclusions

In the studied group of female youth athletes engaged in shot put, there are completely no representatives of the physiological for women, gynecomorphic sexual somatotype, with the presence of 100% of athletes with a pathological andromorphy sexual somatotype. Analysis of the results obtained using a number of morph functional index values as markers of masculinization in female athletes of this age group convincingly indicates that they have manifestations of masculinization and hyperandrogenism. We believe that the identified morph functional changes, with the phenomena of masculinization and hyperandrogenism identified in female athletes, are adaptive in response to intense physical activity in female athletes, both during their training and during their participation in competitions. The identified changes, in our opinion, became possible and led to a complete change in the somatotype, since when selecting athletes to engage in this sport, girls with initial masculine constitutional characteristics were consciously selected. The research results we obtained and the practical conclusions made coincide with the data of other researchers of this problem, and their views re-

garding the problems of masculinization, hyperandrogenism and adaptation in modern female athletes.

References

1. Bugaevsky KA., Women's athletic sports and martial arts: changes in gender somatotypes // Current problems of physical culture, sports and tourism: materials of the XIV International Scientific and Practical Conference: in 2 volumes / Ufmsk. State aviation tech. univ. – Ufa: RIK UGATU, 2020. XIV International Scientific and Practical Conference “Current Problems of Physical Culture, Sports and Tourism.” Ufa, March 25-27, 2020. pp. 276-281.
2. Bugaevsky KA., Oleinik EA Studying the issue of the prevalence of masculinization and hyperandrogenism in female athletes in a number of athletic and strength sports // Training of martial artists: theory, methodology and practice: materials of the VII All-Russian scientific and practical conference dedicated to the 40th anniversary of the founding of the Tchaikovsky State Institute of Physical Culture (Tchaikovsky, ChSIFK, April 3-4, 2020) / under the general. ed. V. V. Zebzeeva. – Tchaikovsky: Federal Budget Educational Institution of Higher Education “ChGIFK”, 2020. ill. pp. 126-131.
3. Bulbanovich SV., Brusova IN. Features of the selection of track and field throwers // Tsarskoye Selo readings. 2016. XX:284-287.
4. Grets IA., Gretz GN., Silovanova I.M. Assessment of the severity of sexual dimorphism based on morph functional indicators of highly qualified throwing athletes // Theory and practice of physical culture. 2013. 5:68-70.
5. Nenenko, N. D., Abramova, O. A., Chernitsina, N. V., & Kuchin, R. V. (2014). Study of Sex-Dependent Characteristics of Athletes, Representatives of Feminine, Macular and Neutral Sports. *Sovremennyye problemy nauki i obrazovaniya*, 15-25.

6. Koryagina YuV, Matuk SV. Morphological features of athletes as a result of adaptation to various strength sports // Omsk Scientific Bulletin. 2010. 4 (89):140-142.
7. Nadeina, S. A., Klotz, V. M., & Zvyagintseva, L. A. (2011). Determination of Morpho-Functional Features in Athletes with Different Somatotypes According to the Classification of J. Tanner. *Izvestiya AltGU*, 3-2.
8. Nikityuk DB., Nikolenko VN., Klochkova SV. Body mass index and other anthropometric indicators of physical status taking into account age and individual typological features of the constitution of women // *Nutrition issues*. 2015. 4:47-54.
9. Bugajewski K.A. Określanie szczególności liczby wartości indeksów morfounkcyjnych i somatotypów płciowych u sportsmenek w wieku młodzieżowym uprawiających rzut dyskiem / K.A. Bugajewski // *POLISH SCIENCE JOURNAL (ISSUE 10 (31), 2020)*. Warsaw: Sp. z o. o. "iScience", 2020. Pp. 14-19.