



Modern Women's Sport: Consideration of a Number of Adaptive Morphofunctional Index Values and Anatomical and Anthropological Indicators in Female Athletes of Reproductive Age

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Abstract

In this research article, its author presents the obtained results and their analysis concerning the consideration of a number of anatomical and anthropological indicators and morphofunctional values in female athletes in 6 types of modern women's sports. It has been reliably shown that as a result of the intense physical exertion occurring in the organisms of these athletes during their training and competitive processes, and the adaptive, adaptive changes, the process of masculinization of their bodies progresses.

Keywords: Female Athletes; Anatomical and Anthropological Changes; Morphofunctional Index Values; Adaptive Adjustment Processes; Masculinization

Abbreviation

AI: Andromorphy Index; BMI: Body Mass Index; MI: Masculinization Index; SDI: Sexual Dimorphism Index; PI: Pelvic Index; IRWP: Index Relative Pelvic Width; ANP: Anatomically Narrow Pelvis; SFP: Simple Flat Pelvis; GUNP: Generally Uniformly Narrowed Pelvis; TNP: Transversely Narrowed Pelvis; BMI: Body Mass Index; SI: Soloviev Index

Introduction

Modern women's high-performance sports require female athletes of different age groups to achieve incredible, sometimes at the limit of their physical and psychological capabilities, desired, victorious results. This applies to absolutely all modern sports in which female athletes participate. Their participation in traditionally male sports challenges their biology, anatomy and physiology, leading to adaptive inversions of their somatic sexual somatotype, forced, compensatory under incredible physical and psychological stress, restructuring of their body and psyche. The female body is artificially "rebuilt" into a male one, under the influence of its own endocrine system, adaptively reducing the production of its own estrogens, and increasing the production of androgens, which, as a result, inevitably, through forced adaptation, leads to their masculinization [1,2].

The ovarian-menstrual cycle of female athletes is sacrificed, significantly complicating, and sometimes excluding from the physiology of female athletes the function of fertility. All this diminishes and levels out their biologically important female reproductive system. The restoration of the latter, after the athlete stops actively, professionally, playing sports, often has many complications and obstacles, leading to secondary infertility of the athlete, with the inability to independently become pregnant, maintain and bear the fetus [1,2]. Therefore, the study of medical and biological problems, and the issue of adaptive somatic restructuring in female athletes of reproductive age, is very relevant and in demand.

Aim of study

The aim of the study is to determine and analyze the indicators of a number of anatomical and anthropological indicators and morphofunctional index values in female athletes of reproductive age who are originally involved in male sports, such as: weightlifting, powerlifting, sambo wrestling, boxing, shot put and hammer throw.

Hypothesis of the study

In the process of preparing and conducting this study, its author came up with the following hypothesis, the essence of which was as follows: under the influence of long-term and intense physical and

psycho-emotional loads, female athletes, during their training and competitive processes, may experience adaptive changes in their anatomical-anthropological indicators and morphofunctional index values, which are markers of the masculinization processes occurring in them.

Methods and means of research

In writing this research article, its author used the method of literary critical analysis of the sources of information available to him on the issue he was studying, including research articles by other authors and scientific and methodological manuals. During the study, the following methods were used: anthropometry, with determination of the length and weight of the body of the female athletes, their shoulder width. Also, pelvimetry was carried out, with determination of three latitudinal and two transverse sizes of the bony pelvis of the female athletes. Using the obtained results of anthropometric and pelviometric measurements, a number of morphofunctional index values were determined, such as: body mass index (BMI); andromorphy index (AI); masculinization index (MI); sexual dimorphism index (SDI) according to the method of J. Tanner; pelvic index (PI) index of relative pelvic width (IRWP). Also, we used the method of literary-critical analysis of available sources of information, the method of mathematical statistics.

The study involved 111 young female athletes from different regions of Ukraine, specializing in discus throwing. Their sports

experience ranged from 2.5 to 7.5-8 years. The level of sports skills ranged from candidate master of sports to master of sports, representing 6 sports that can be conventionally classified as traditionally male. The representation by sports was as follows: weightlifting (n = 21); powerlifting (n = 19); sambo wrestling (n = 22); boxing (n = 18); shot put (n = 16); hammer throw (n = 15). The average age of the young female athletes was 23.47 ± 1.23 years. The experience of practicing these sports ranged from 5 to 12 years. All athletes in the study groups gave their voluntary, both verbal and written, consent to participate in the study conducted by the author.

Results of the study and discussion

At the beginning of the study, we carried out the following anthropometric measurements, which were carried out according to the classical method: measurement of the shoulder width, cm; measurement of the pelvis width, or interspinous size (d. spinarum), cm; body length, cm; body weight, kg. Also, the external dimensions of the pelvic bone were determined (three transverse and two longitudinal). Measurement of the external dimensions of the pelvic bone (pelvimetry) was carried out using a Martin pelvimeter (compass), according to the classical method accepted in anatomy and obstetrics [2,6,7]. Based on the results of the obtained anthropometric indicators, by means of mathematical recalculations, with strict consideration of the author's versions of the formulas, the necessary morphofunctional index values were calculated. The obtained anthropometric values, in each of the groups of athletes, are presented in table 1, at $p < 0.05$:

Name of the indicator	Shoulder width. cm	Pelvis width. cm	Body length. cm	Body weight. kg
Weightlifting (n = 21)	40.08 ± 1.06	27.06 ± 0.54	178.34 ± 1.01	71.14 ± 1.06
Powerlifting (n = 19)	39.12 ± 1.31	27.19 ± 1.03	177.48 ± 0.93	71.32 ± 1.11
Sambo wrestling (n = 22)	38.55 ± 1.87	27.11 ± 0.84	175.76 ± 1.16	68.74 ± 1.27
Boxing (n = 18)	39.19 ± 1.23	27.53 ± 0.53	175.89 ± 1.14	67.58 ± 1.23
Shot put (n = 16)	40.13 ± 1.06	26.98 ± 1.26	178.56 ± 1.24	68.89 ± 1.13
Hammer throw (n = 15)	40. 65 ± 1.08	28.02 ± 0.77	177.12 ± 0.63	71.67 ± 0.93

Table 1: Anthropometric indicators in the study groups (n = 111).

Anthropometric indicators in the study groups (n = 111)

An analysis of the obtained anthropometric values showed that, according to the average group values, the female athletes in all six examined groups have broad shoulders and reduced pelvic width (d. cristarum), which is normally 28-29 cm [2,6,7]. This means that the female athletes in the examined groups have a male body type, which is one of the signs of the masculinization process occurring in their bodies. The ratio of body length and weight indicates the

formation and proportionality of its component composition. The most powerful anthropometric indicators, compared with female athletes in other groups, are found in young athletes involved in weightlifting, powerlifting and hammer throwing. These are fairly strong athletes with a masculine body type. After conducting pelvimetry, the results of three longitudinal and two transverse external dimensions of the bone pelvis were obtained in female athletes in each of the examined groups. The obtained pelvimetry results are presented in table 2, at $p < 0.05$.

Name of the indicator	d. spinarumcm	d. cristarumcm	d. trochante-rica. cm	c. externa. cm	c. vera. cm
Weightlifting (n = 21)	24.13 ± 0.47	27.06 ± 0.54	30.73 ± 0.63	19.11 ± 0.51	10.37 ± 0.11
Powerlifting (n = 19)	24.37 ± 0.33	27.19 ± 1.03	31.17 ± 0.88	19.31 ± 0.77	10.23 ± 0.66
Sambo wrestling (n = 22)	24.81 ± 0.27	27.11 ± 0.84	31.02 ± 0.61	19.87 ± 0.21	10.45 ± 0.49
Boxing (n = 18)	25.01 ± 0.24	27.53 ± 0.53	30.15 ± 0.74	20.03 ± 0.74	10.89 ± 0.67
Shot put (n = 16)	24.63 ± 0.97	26.98 ± 1.26	31.18 ± 0.39	19.87 ± 0.52	10.78 ± 0.71
Hammer throw (n = 15)	25.11 ± 0.61	28.02 ± 0.77	31.24 ± 0.34	20.12 ± 0.21	10.93 ± 0.31

Table 2: Pelvimetric indices in the study groups (n = 111).

*For the convenience of placing a large number of indicators, the sports were written as abbreviations

WL: Weightlifting; PL: Powerlifting; SW: Sambo Wrestling; ShP: Shot Put; HTh: Hammer Throw

The results of calculating the indicators of a number of morpho-functional index values obtained in the studied groups of athletes are presented in table 3, at $p < 0.05$: Table 3 Indicators of morpho-functional index values in the studied groups (n = 113).

Name of the indicator	Results obtained						
	BMI	RPWI	Andromorphy index	Masculinization index	SDI	Pelvic index	SI
WJLn = 21)	22.42 ± 0.14	15.39 ± 0.17	60.7 ± 0.04	1.49 ± 0.17	95.82 ± 0.73	86.06 ± 0.13	16.12 ± 0.31
PL (n = 19)	22.78 ± 0.23	15.82 ± 0.24	57.19 ± 0.13	1.43 ± 0.11	93.07 ± 0.44	87.72 ± 0.23	16.03 ± 0.17
SW (n = 22)	22.37 ± 0.31	15.83 ± 0.37	58.0 ± 0.32	1.45 ± 0.23	93.31 ± 0.32	87.73 ± 0.19	15.83 ± 0.33
Boxing (n = 18)	21.98 ± 0.19	15.85 ± 0.23	59.48 ± 0.16	1.44 ± 0.31	93.2 ± 0.14	88.47 ± 0.11	15.76 ± 0.11
ShP (n = 16)	21.68 ± 0.22	15.71 ± 0.41	60.43 ± 0.21	1.46 ± 0.22	95.43 ± 0.38	89.05 ± 0.31	16.18 ± 0.37
HTh (n = 15)	22.98 ± 0.28	16.20 ± 0.53	62.03 ± 0.19	1.45 ± 0.18	96.4 ± 0.56	88.87 ± 0.27	16.34 ± 0.37

Table 3: Indicators of morphofunctional index values in the study groups (n=113).

The analysis of the obtained pelviometry results reliably showed that the female athletes of all six examined groups have clinical manifestations of an anatomically narrow pelvis. This is convincingly evidenced by the reduced, in comparison with the normative, all transverse and longitudinal dimensions of the bony pelvis. For example, d. spinarum, in the norm (for this age group), should correspond to 25-26 cm; d. cristarum - 28-29 cm; d. trochanterica - 30-31 cm; c. externa - 20-21 cm; c. vera - 11 cm [2,6,7]. The shape of these pelvises differs from the classic female, with expanded wings of the ilium. The pelvises of female athletes in all groups involved in traditionally male sports tend to lengthen and compress, in accordance with male, masculine forms of the bony pelvises. This adaptive process of changing the size and shape of female athletes in athletic sports is forced and adaptive, in response to intense physical activity during training and competition processes [2,6,7].

The analysis of the obtained results of 7 morpho functional index values in the female athletes of the studied groups, who have been professionally involved in traditionally male sports for a long time, is disappointing. Taking into account the average indicators for the groups, they all have an anatomically narrow pelvis (ANP), with an advantage of a simple flat pelvis (SFP), generally uniformly narrowed pelvis (GUNP) and transversely narrowed pelvis (TNP) [1,3-5]. The narrowing of the pelvis in female athletes is also confirmed by the indicators of the pelvic index (PI) and the index of relative pelvic width (IRWP) [1,3-5]. The indicators of the body mass index (BMI) in all the studied groups of female athletes correspond to the norm. The andromorphy index (AI) and the masculinization index (MI), as well as the Soloviev index (SI), reliably confirm the significant expression of the adaptive processes of hyperandrogenism and somatic masculinization in female athletes in all the exam-

ined groups. Also, the indicators of the sexual dimorphism index (SDI) are quite convincing. According to the obtained values, in all groups of female athletes, there are no representatives of the physiological, gynecomorphic sexual somatotype. Representatives of the transitional, mesomorphic sexual somatotype are isolated in the groups where the athletes are engaged in boxing and sambo wrestling. The dominant, in all groups, is the pathological for women, inverse sexual somatotype [1,3-5].

Conclusions

- It has been established that female athletes of reproductive age, who have been involved in strength, traditionally male sports for a long time, experience intensive adaptive somatic processes that lead to their masculinization.
- Statistically, all the obtained indicators, a number of morphofunctional index values, indicate the phenomena of adaptive masculinization and hyperandrogenism, the opposite of the initial, basic feminine state of female athletes of reproductive age.
- It has been reliably established that in all the studied groups of athletes, there are no representatives of the physiological, feminine, gynecomorphic sexual somatotype.
- It has been determined that the dominant sexual somatotype, in all groups of athletes, is the inverse, andromorphic sexual somatotype, identified in 97.54% of all the studied athletes.
- It was established that the remaining 2.46% of female athletes have a transitional, mesomorphic sexual somatotype.

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