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Hormonal status of female athletes of speed - power sports in period of intensive training

Zmiany poziomu hormonów u zawodniczek trenujących szybkościowo – siłowe dyscypliny sportu

Summary

The article presents the characteristics of the hormonal status of female athletes on the background of many years of intensive training of speed-power orientation. The possible mechanisms and causes of reproductive disorders of weightlifting athletes, acrobats and gymnasts are observed. Based on the data of hormonal status it is indicated the most favorable age for the girl's sport career beginning in speed-strength sports.

Key words: female body, antigen, hormonal status, intensive training activity, speed-strength sports.

Streszczenie

W pracy przedstawiono cechy układu hormonalnego kobiet - zawodniczek przez wiele lat intensywnie poddawanych pracy treningowo - szkoleniowej, ukierunkowanej na szybkość i wytrzymałość. Ukazano niektóre z możliwych mechanizmów i przyczyn zaburzeń reprodukcyjnych u zawodniczek, specjalizujących się w podnoszeniu ciężarów, akrobatek i gimnastyczek.

Słowa kluczowe: organizm kobiety, układ hormonalny, intensywność treningu, sporty szybkościowo - siłowe.

Introduction

The desire of women to achieve high results, as well as the fact that without progress in this area, no country can join the group of leaders in the Olympics, promotes the role of women's sports (Jordanskaya, 1992). This explains the fact that in recent years, there is a tendency towards convergence of content, volume and intensity of training loads of men and women (Medvedev, 1997; Socha S, Socha T., 1999). At the same time, the maximum focus on individual characteristics of athletes, the adequacy of the functional capacity of the planned training and competitive pressures, in such circumstances are of great potential for raising the efficiency of sports training.

In this regard, the physiological rationale for optimizing the training loads, taking into account features of the female organism, can be considered as an urgent problem, allowing to achieving high results with no risk to their health (Skierska, Socha et al. 1996; Shakhlina, 1993; 2000; Drinkwater et al. 1997; Lebrun 2001). This is due to the fact that in the theory and methodology of sports training, there are features that are unique to women, which lead to differences in the course of adaptive processes in the female body.

The antigen is especially expressed in a puberty, which ends in girls aged 17-18 and young men – 20-22 years. These age-related features is necessary to consider in constructing a sports training, particularly the temporal structure in the macrocycle of the “sports ontogeny.” Girls are able to show good results for 2-3 years before boys, but because of the complex hormonal changes they have much more critical periods of development.

According to information received, the loads of modern sport, especially in species that require the development of speed-strength abilities in women cause functional changes. Without systematic integrated monitoring in order to confirm the rationality of the construction of training loads and the possibility of adjusting them, you can not build a model-targeted training program of athletes in such sports.

In this case, methodology for assessing the functional state in women’s sport on the criteria of efficiency of cardiovascular and respiratory systems in speed-strength sports, which proposed in the works of some authors, are also ineffective. This is due to the fact that in sports like weightlifting, gymnastics, sports acrobatics, etc. most of the work is fulfilled on the breath and straining in a very short period of time. According to (Gaverdovsky, 1979; Vorobyev, 1989; Hagberg et al. 1983; Stone, 1990; Patsha, Gilmore et al. 2004) the representatives of these sports’ changes in the cardiovascular and respiratory systems are small and differ little from those of healthy people who are not involved in sports. In this regard, there is a need to find better criteria for evaluating the functional state of athletes for the representatives of these sports.

In connection with the foregoing, it seems urgent to systematize the functional characteristics’ features of the state of female-athletes’ hormonal status, physiological study of speed-power load’s influence in their bodies, the definition of progressive approaches to achieve adequate pedagogical influences dimorphic specificities deployment of adaptive processes in the female body under the influence of specific coaching loads.

Organization of the study and characterization of subjects

To assess the state athletes in sports of speed-power orientation, and also taking into account the particular relevance of accounting medical and biological characteristics of the organism during physical exercise, we have carried out studies on the representative of the three sports - weightlifting, gymnastics and sports acrobatics. By the nature of training activities, these activities can be classified as such modes, which are already at the initial stage of preparation is very important the development of speed-strength.

The purpose of this study was to identify differences in hormonal status and adaptive response of the athletes’ organism on the background of intense speed-power loads in similar by the mechanism of effects on the body sports. A sports qualification of all athletes was not below the Candidate Master of Sports. Age - 18-20 years. We examined 86 female athletes, who were classified, in-depth medical examinations, to the first group of health.

Traditionally, to the first group of health on the basis of a comprehensive assessment of the state include healthy people who have no abnormalities on all grounds of health: who were not ill, or occasionally sicken during the observation period, with the normal physiological and psychological development, with no deformities, injuries and

functional disorders. There can be isolated carious teeth, a positive reaction of Pirke with no signs tube intoxication, hypertrophy of tonsils of first degree, an increase in thyroid cancer of the second degree, without violation of its function. That is a fairly homogeneous contingent, which does not need rehabilitation.

According to the results of the survey, the acrobats' average age in the beginning of long-term athletic training was 8.83 ± 1.01 years, gymnasts - 6.83 ± 0.70 years and weightlifter - 8.75 ± 2.02 years (Table 1). Most of the girls came immediately to the appropriate sport before any other sports were not engaged. That is, on the top of specialization, the earliest is gymnastics, girls in Bashkortostan in weightlifting and acrobatic come in about the same age. This is due to the fact that the sports schools on these sports usually recruit girls from the initial classes of comprehensive school.

Tab. 1. The questionnaire's data of various sports' athletes

The data of questionnaire	Groups		
	Acrobat (n=6)	Gymnast (n=6)	Weightlifter (n=6)
The beginning of sports specialization, age	$8,83 \pm 1,01$	$6,83 \pm 0,70$	$8,75 \pm 2,02$
Menarche, age	$13,67 \pm 0,42$	$15,33 \pm 0,42$	$12,67 \pm 0,21$
Menstrual cycle:			
normal, %	75,4	70,9	86,5
abnormal, %	24,6	29,1	13,5
Training in phase I and V CMC:			
with restrictions, %	33,3	0,0	18,8
without restrictions, %	66,7	100,0	81,2

One of the important parameters of sex, and, consequently, the general development - the age of menarche was the earliest in weightlifters - 12.67 ± 0.21 years, which corresponds to the physiological norm of ordinary girls - not athletes, very late - in gymnasts - 15.33 ± 0.42 years.

The duration of the female athletes' menstrual cycle is an average of 28-30 days, and the ovarian-menstrual phase is characterized by normal or heavy blood separation. The number of athletes who have violations of ovarian-menstrual function, which manifests itself in lengthening the cycle to 60-90 days was 29.1% among surveyed gymnasts, 24,6% - acrobats and 13,5% -weightlifters. Absolutely all athletes train in the critical days and only 33.3% of acrobats and 18,8% weightlifters reduce load on the state of health. None of the surveyed female gymnasts had not pointed out reducing the loads during the critical days, so perhaps it is among the representatives of this sport has the highest percentage of violations of the ovarian-menstrual function. These figures point out that the preparation of highly qualified athletes completely ignores physiological characteristics of the female body, which is an unfavorable sign, and worrisome for the future health of athletes.

In this case, none of the athletes face the problem of choosing the “sports or personal life, all of them choose sports. 28.6% of the respondents said that during the sports training they have formed such psychological qualities as aggressiveness and rudeness, but the vast majority has indicated only the development of such personality traits as dedication and patience. On the question of how they evaluate their appearance, only one athlete has given a negative assessment, 25.0% of respondents do not pay attention to their appearance, but 78,6% of respondents believe that “sport”, “beauty” and “femininity” are compatible, so sports can be combined with a normal family life. 60.7% of females believe that after the sports career adaptation to life will be easy, as the sport gave them something that would help to arrange their lives. But 39.3% believe it will be hard to adapt to reality due to the fact that, after the athletic career, it will be much different from the lifestyle that they are now.

In order to study the long-term adaptation of high qualification athletes' hormonal status to significant speed-power loads in the competitive season, after an intensive eight-week training, we studied the serum levels of hormones for assessing the functional activity of individual systems: testosterone and cortisol as indicators of activity of the adrenal glands, estradiol - ovaries, prolactin, luteinizing hormone (LH) and follicle-stimulating hormone (FSH) - the hypothalamic-pituitary system.

Blood sampling for biochemical analysis was carried out in the morning on an empty stomach in the follicular phase of the ovarian-menstrual cycle. In order to study the features of adaptation of the endocrine system of highly skilled athletes for intense speed-power loads after the eight-week training we have analyzed the serum levels of testosterone, cortisol, estradiol, prolactin, luteinizing hormone (LH) and follicle-stimulating hormone (FSH) by standard biochemical methods using appropriate sets of reagents produced by «Uniplan» on immunosorbent analyzer.

Results

Revealed by us the majority of athlete's violation of CMC (dysmenorrhea, oligomenorrhea) may point out on the one hand, a violation of the neuroendocrine function of the reproductive system on the background of many years intense speed-power load. Today, it is proved that the ovaries are very sensitive to physical stress - their hormones are involved in adaptive reactions of the organism.

On the other hand, data from studies (Soboleva, 1999) suggest that such a high frequency of irregularities in the functioning of genital system of qualified athletes is the result of selection of athletic somatotype, which has a combination of clinical signs of hyperandrogenism.

In order to study the features of adaptation of the endocrine system of highly skilled athletes for intense speed-power loads after the eight-week training we have analyzed the serum levels of testosterone, cortisol, estradiol, prolactin, LH and FSH. It is known that secretion of most hormones is regulated by a mechanism of negative feedback. Table 2 presents data on hormone levels in athletes with normal menstrual function.

Tab. 2. The contents of hormones in the blood serum of athletes of different sports with normal menstrual function

Groups	Cortisol nmol / l	Testosterone nmol / l	Estradiol (FF), nmol / l	Prolactin IU / L	LH (FF) IU / L	FSH (FF) IU / L
Not involved in sports (n=20)	202,1±2,1	0,62±0,04	0,64±0,06	267,9±8,80	10,61±0,8	6,37±0,09
Acrobats (n=6)	401,43±3,02	1,58±0,24	0,41±0,09	196,63±7,29	3,59±0,86	3,88±0,54
Gymnast (n=6)	389,53±3,59	1,66±0,38	0,24±0,06	275,57±2,33	6,12±0,96	2,64±0,48
Weightlifter (n=6)	385,30±4,28	1,81±0,26	0,47±0,04	239,82±3,42	6,19±0,90	5,71±0,86
P ₁₋₂	< 0,001	< 0,01	< 0,05		< 0,001	< 0,01
P ₁₋₃	< 0,001	< 0,01	< 0,01		< 0,01	< 0,01
P ₁₋₄	< 0,001	< 0,01	< 0,05		< 0,01	
P ₂₋₃			< 0,01		< 0,01	
P ₂₋₄					< 0,01	< 0,01
P ₃₋₄			< 0,01			< 0,01

Note: P 1-2 - Significant difference in performance compared acrobats and those who not involved in sports,
P 2-3 - Significant difference in performance compared to the gymnasts, and those who not involved in sports,
P 1-4 - Significant difference in performance compared weightlifter and those who not involved in sports,
P 2-3 - Significant difference in performance compared acrobats and gymnasts,
P 2-4 - Significant difference in performance compared acrobats and weightlifter,
P 3-4 - Significant difference in performance compared to the gymnasts and weightlifter.

The study found that the surveyed athletes, as compared with the physiological norm of women who were not involved in sport, increased levels of cortisol and testosterone in serum significantly. The greatest level of cortisol was observed in acrobats - 401.43+3.02 nmol/l ($p < 0,001$), and testosterone in weightlifting athletes -1.81+0.26 nmol/l ($p < 0,001$). According to the theory of H. Selye, in any stress the adrenal glands play a major role in the adaptation to stressful situations (cold, pain or physical exertion). The leading role H. Selye assigns glucocorticoids (cortisol), but not androgens, the result of the impact can be masculinization.

High levels of androgens, which are antagonists of estrogen, may lead to suppression of pituitary functions of synthesis of gonadotropins. That is what we observed in the studied athletes. The level of LH and FSH in the serum of female athletes was lower than that of persons not involved in sports. Moreover, LH levels were lowest among acrobats - 3.59+0.86 IU/l ($p < 0,001$) and FSH with gymnasts - 2.64+0.48 IU / l ($p < 0,001$). Closest to the physiological norm values were detected in weightlifting athletes - 6.19+0.90 IU/l ($p < 0,001$) and 5.71+0.86 IU/liter.

The level of estradiol in the blood serum was reduced in all examined our athletes, but also the smallest, as expected, due to low levels of gonadotropins of gymnasts on the average for the group 0.24 ± 0.06 nmol / liter. This decrease in the concentration of gonadotropins, apparently, is that a functional basis, which leads to inhibition of ovarian function in female gymnasts, which leads to gipoestrogenem and gipoestrogen and, consequently, to delay sexual development, and abnormalities in reproductive functions. Lack of sufficient concentrations of estradiol and its metabolites may also cause a deterrent formation of estrogen-dependent trait, menstrual dysfunction.

The level of secretion of prolactin by pituitary was within normal limits in all the surveyed athletes on a par with those not involved in sports and was at acrobats - 196.63 ± 7.29 IU/l, at gymnasts 275.57 ± 2.33 IU/l, at weightlifting athletes 239.82 ± 3.42 IU/l, with a mean of such persons not engaged in sports 267.9 ± 8.80 IU/liter.

Because the symptoms of depression of ovarian function, reflected in reduced concentrations of estradiol and lower levels of gonadotropic hormones observed in the majority of our athletes surveyed higher education should be assumed that the cause of menstrual dysfunctions in these sports is, apparently, hyperandrogenic of hypothalamic origin.

An effect of physical exercise on the female body and, in particular, on the gonads, obviously, has a complex mechanism. Playing the role of age, which begin systematic training (for the gymnasts, they are the earliest), and the absence of a differentiated approach to individual athletes (all of them train in full force and effect regardless of the phases of ovarian-menstrual cycle and well-being). We should not deny also the influence of special exercises specific to each of the species of sport, and the original selection in the sports section of sportswomen who have inherited traits of hyperandrogenism (Soboleva, 1997). As it is known, the most rigorous selection of athletes is precisely in Section gymnastics.

Multivariate analysis of variance showed that the reason for such a low level of gonadotrophic hormones in female gymnasts, apparently, is also the earliest age of onset of training 5-6 years. Acrobats and weightlifters, which start career, later in 7-9 years, are in a better position. In this regard, from the standpoint of preserving reproductive function of girls this age should be considered as the most preferred for the start of the course speed-strength sports.

Thus, early sports specialization has a significant impact on the adaptive characteristics of the women. Data that characterizing the pleads correlation of sports specialization beginning and long-term process of adaptation are presented in Table 3.

Obtained by nonparametric statistics, correlation coefficients and levels of statistical significance suggests that the earlier a child begins to engage, the later menstruation starts ($R = -0,352$), and subsequently the higher will be her achievements in sports -it is talking about its negatively closing communication age of early specialization by a factor of Sinclair ($R = -0,463$) and the success of competitive activity, expressed in points ($R = -0,703$).

Tab. 3. Correlation dependence of early sports specialization and indicators of long-term adaptation of weightlifter to loads of speed-power orientation (n = 28)

Indicators	R	P
Beginning of menstruation	-0,352	<0,04
Factor of Sinclair	-0,463	<0,02
The success of competitive activity	-0,703	<0,01
Estradiol	-0,586	<0,05
Prolactin	0,575	<0,04
LH	-0,433	<0,01
FSH	-0,429	<0,01

However, with early specialization in adult female athletes on the background of intensive training load will be less suppressed functional activity of the ovaries - the coefficient of the relationship with estradiol ($R = -0,586$) and the development of gonadotropin-releasing hormone - LH ($R = -0,433$), with FSH ($R = -0,429$).

Discussion

Glands of internal secretion play a leading role in the regulation of metabolic processes. Now it is established that the constancy of internal environment and the body's ability to adapt to environmental changes caused mainly harmonious interplay of various endocrine organs. Change of the secretory activity of a cancer necessarily affect the secretion of other glands, which causes a range of processes leading to the recovery of the initial stable state or to the emergence of a new level of balance between the components of the endocrine glands involved in these processes. This phenomenon is known in endocrinology as a "synergistic effect" according to Ingle, or the "interaction of hormones" according to Selye.

An example of such a relationship can serve as a system of "ovary - adrenal gland". These glands are closely related by common embryological origin. Apparently, the common origin determines the ability of the adrenal glands, along with corticosteroids, produce sex hormones. In addition, the adrenal cortex and ovaries are linked by common chemical structure of hormones produced by them.

In general, it should be noted that the maximum focus on individual characteristics of female athletes, the adequacy of the functionality of the planned training and competitive pressures, recreation, food, media recovery reserves are undoubtedly improve the efficiency of sports training.

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