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WOMEN'S PROFESSIONAL SPORTS: REPRODUCTIVE HEALTH, HORMONAL CONTRACEPTION, DOPING ISSUES

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▪ The article presents an overview of current data regarding reproductive health in female athletes, rationale and possibility of hormonal contraception use, as well as the role of licit hormonal agent use in reproductive health maintenance and restoration among female athletes.

▪ **Keywords:** women's professional sport; hormonal contraception; reproductive health; doping.

ЖЕНСКИЙ СПОРТ: РЕПРОДУКТИВНОЕ ЗДОРОВЬЕ, ГОРМОНАЛЬНАЯ КОНТРАЦЕПЦИЯ, ДОПИНГ

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▪ В статье представлен обзор современных данных об особенностях состояния репродуктивной системы спортсменок, о целесообразности и возможности применения гормональных контрацептивов и роли незапрещенных гормональных препаратов в сохранении и восстановлении репродуктивного здоровья женщин в спорте.

▪ **Ключевые слова:** женский спорт; гормональные контрацептивы; репродуктивное здоровье; допинг.

The Physical Culture and Sports Committee is focused on implementing the measures of the State Program for the Development of Physical Culture and Sports, taking into account the May decrees (May 7, 2018) of the President of the Russian Federation and the National Project "Demography" approved in 2018, which includes such Federal projects as "Strengthening Public Health" and "Sport is the norm of life." Modern society considers the protection and restoration of women's reproductive health as the only way to preserve the gene pool and as a factor of national security.

Unfortunately, by the age of 14–17, when the reproductive system matures, 10% of girls have disharmonic physical development, and 40 %–60 % of women of childbearing age suffer from somatic and/or gynecological pathology [1–3]. The reproductive behavior of young people has changed because 25 % of women of reproductive age do not plan a pregnancy or postpone it indefinitely.

In this case, the main method of birth control remains the artificial termination of pregnancy. However, this method has serious consequences on the reproductive health of women. Contemporary demographic trends reflect and complete this critical reproductive circle.

Fostering a culture of reproductive behavior represents an urgent medical and social problem. Currently, solving this problem requires a differentiated approach to the choice of various methods of contraception because the state of reproductive health and some aspects of a woman's reproductive behavior are largely related to the peculiarities of her lifestyle and professional activities. In modern society, professional and mass sports where women take part actively are being developed.

According to the data provided by institutions and organizations of St. Petersburg (summary information of the Physical Culture and Sports Committee of the Administration of St. Petersburg for 2017), about 1.9 million people in St. Petersburg are involved systematically in physical education and sports, about 40 % of which are women. The share of pupils and students involved systematically in sports in 2017 amounted to 88.7 %, which is the country's reproductive potential. In this regard, the phenomenon of "women's sports" is appropriate to study from at least two positions of the reproductive system. From the standpoint of environmental reproductive medicine [4] and taking into account the current demographic situation in the country, high physical activity is one of the environmental factors that can affect the reproductive health of female athletes. Thus, the age of menarche in athletes exceeds 15 years, which is significantly different from the average population indicator (13.2–13.4 years). Among athletes, the frequency of delayed sexual development is higher [5], anorexia nervosa occurs in 15 %–62 % of cases, and amenorrhea occurs in 5 %–50 % of athletes (compared with 2 %– 5% in the general population); these data are influenced by the type of sports loads, the amount of training activity, and the level of sportsmanship and are associated with systemic hormone-dependent disorders [5]. In 1992, the American Association of Sports Medicine proposed the term "Female Athlete Triad" to refer to a syndrome that combines eating disorders, exercise-associated amenorrhea, and osteoporosis. The "triad" is detected with a frequency of 5 %–72 %, depending on the sport, taking into account all three components or one or two components manifested individually [5, 6]. K. Berz et al. [7] systematized the results of studies focused on separate and combined manifestations of the "Female Athlete Triad" and provided evidence of numerous long-term life-long consequences, which include an increase in the frequency of musculoskeletal injuries, stress fractures, abnormal lipid profiles, endothelial dysfunction, and potentially irreversible loss bone mass, depression, and low self-esteem. The key factor triggering the "triad" development is a decrease in the frequency of the gonadotropin-releasing hormone pulsating rhythm secretion in the hypothalamus; impaired secretion of gonadotropic hormones by the pituitary gland results in ovarian insufficiency, hypoestrogenemia, and osteoporosis [7].

Damage to hypothalamic structures is caused by the metabolic/endocrine signal that informs the central links of the reproductive system that nutrients are insufficient for energy supply and locomotor and reproductive functions at the same time [8]. In this regard, the definition of the "triad" was updated in 2007 and included an additional range of dysfunctions associated with a deficiency in the energy supply to the body. In 2014, a working group of the International Olympic Committee suggested taking into account the syndrome of relative energy deficiency in sports (RED-S). Recent studies have found that energy deficiency acts as the primary direct factor in menstrual dysfunction in female athletes of high achievements and potentiates a decrease in bone mineral density [8, 9]. The low availability of energy for female athletes is important because it requires control of weight categories and .aesthetics (gymnastics, cheerleading, cross-country running, cycling, rowing, and martial arts). Thus, in a causal relationship, the active involvement of female athletes and serious physical exertion represent a direct provoking factor in impairment of various functions of the reproductive system along with changes in energy balance.

Female athletes are in the active fertile period of their lives and are potential candidates for reproductive function. However, delayed motherhood and pregnancy planning are typical for female athletes in the peak of their sports career. Sometimes, reproductive health is consciously sacrificed in exchange for a sports career. Such an attitude may be partly caused by the "inconvenience" associated with menstrual bleeding or concerns about the possible negative impact of the menstrual cycle phases on athletic performance [7]. Some athletes are unaware of the current methods of contraception because of

the lack of understanding to the importance of maintaining reproductive health.

Athletes from an early age are characterized by a fairly independent social behavior, facilitated by frequent trips to sports camps and competitions and the company of peers and not family. A. Nattiv et al. conducted a multicenter study to examine the prevalence of behavioral patterns among athletes, including those of reproductive age, which pose a threat to health. The authors revealed that athletes, in comparison with their peers, start their active sex life earlier, have on average a greater number of sexual partners, and use any methods of contraception less often [10]. Hence, athletes have an increased likelihood of an unwanted pregnancy and sexually transmitted diseases. A survey of athletic aged women about the method of contraception showed that 60 % of them use a condom, 35 % practice coitus interruptus, and 25 % combine these methods. According to the survey, the reasons for the rejection of hormonal contraception (combined oral contraceptives, COCs) include the fear of a possible increase in body weight (35 %), excessive hair growth (15%), infertility (15 %), and lack of trust to the method (10 %). Many athletes avoid COCs for fear of performance deterioration [10]. The prejudice against hormonal contraception continues up to the present day, although it formed during the period when first-generation drugs containing relatively high doses of sex steroids, which could cause side effects, were used [11]. The emergence of contemporary low-dose drugs of the second, third, and fourth generations suggests a new approach to solving this issue [12, 13]

Modern accessible literature indicated the acceptability and even preference of using the hormonal method of contraception in athletes [14]. The generally recognized advantages of this method of contraception include high target efficiency, reversibility, and favorable non-contraceptive effect on the body. The metabolic effects of sex steroids should also be considered for female athletes [8]. In particular, with prolonged use, COCs can affect gluconeogenesis in the liver tissue, contribute to the accumulation and conservation of glycogen in the liver and skeletal muscles, and decrease the levels of glucose and insulin in blood plasma [15]. A. Bonen et al. (1991) studied the differences in carbohydrate and lipid metabolism between athletes using COCs and those not using them at rest and during moderate and submaximal physical exertion [16]. The authors revealed no differences in the contents of glucose, insulin, and free fatty acids in the blood at rest between the groups. With moderate physical activity, the glucose concentration decreased and the concentration of free fatty acids increased in the group of athletes using COCs. The difference in the concentration of these substances leveled again with an increase in the load level to submaximal. The authors attributed the results to the fact that sex steroids contribute to the mobilization of free fatty acids during moderate physical exertion characterized by the predominance of lipolysis over the decomposition of carbohydrates. At the same time, under heavy load, glycolysis predominates in both groups, resulting in lactic acid inhibiting the mobilization of free fatty acids. The results of experimental studies should also be taken into account, which show that rats injected with estradiol can tolerate physical activity longer while less glycogen is cleaved in their myocardium [17]. Thus, during exercise, sex steroids exert a carbohydrate-saving effect by influencing gluconeogenesis, glycogen synthesis, and the decomposition and mobilization of free fatty acids [17, 18]. Considering that carbohydrates are the main energy substrate for working muscles, a previous study supposed that sex steroids composed of COCs contribute to some extent to the implementation of long-term physical endurance work [19]. In addition, female athletes taking sex steroid preparations have less soreness and muscle fatigue in the recovery period after heavy exertion, which may be associated with a slight decrease in their blood lactate and ammonia levels compared with athletes who did not take hormonal contraceptives [20].

When taking COCs, the absence of phase fluctuations in hormone levels virtually eliminates the possibility of the effect of phase hormonal fluctuations in the menstrual cycle on the performance indicators of athletes. In addition, a stable and predictable 28-day cycle affects favorably the mental state of a woman. COC intake enables to delay the menstrual bleeding from 7 days to several months, if necessary in connection with the competition. A three-cycle regimen of monophasic drugs is also possible; in this case, a woman has only four episodes of menstrual bleeding during the year. According to the survey, 70% of athletic age women preferred to have menstruation no more than one time in 3 months.

With an estrogen-deficient state in exercise-associated amenorrhea, pronounced bone loss is registered with a critical risk of pathological fractures. In addition, 63 % of Olympic level gymnasts have injuries of the spine; figure skaters,

track athletes, divers, throwers, and rowers are prone to injuries [21, 22]. At the same time, sports experience period is important, as well as aspects of the training regime (excessive physical exertion, high level of competition) and increased/decreased body weight [23, 24]. When combined with the "triad" symptoms, the total risk of pathological fractures increases to 20 % [25]. With a lack of estrogen, the osteoprotective effect of physical activity is lost, and even with adequate treatment, osteoporosis is not completely reversible and has serious consequences for health and a sports career; therefore, early detection of the "triad" and treatment of its manifestations are important [25]. COCs prescribed as hormone replacement therapy help restore bone structure and mass, being in this case a necessary component of the treatment of exercise-associated amenorrhea [25]. Moreover, the intake of COCs can serve as a means to prevent bone loss in athletes because of the protective effect of the estrogen component on bone tissue.

Even among athletes with a regular menstrual cycle, the incidence of disorders such as luteal phase insufficiency (42 %) and anovulation (15 %) [26] is increased, manifested by a high frequency of infertility, miscarriage, and ectopic pregnancy. The fact that low progesterone is associated with a risk of developing breast and uterine cancer must not be ignored. The intake of COCs providing a favorable endocrine profile in this case has a prophylactic effect on cancerous diseases.

Special «sacrificial» situations in sports that have a negative effect on health, including reproductive, develop in an environment of high sports achievements, where any means, natural and specially designed, are often used to achieve super-results, especially in sports with endurance components (cycling, skiing, and long-distance running). Trainers and sports professionals trying to conceal doping technologies and the use of prohibited means have a permanent struggle with anti-doping services that constantly improve and tighten examination procedures and disciplinary sanctions. The sports community must focus on the only historically determined purpose of sports, which is the preservation and restoration of human health with an individual indication of its natural physiological capabilities and the use of competition for motivation. After all, not everyone can draw, dance, or play the violin; thus, the talent associated with labor does not require anti-doping control. Where is the good of overcoming the physical, moreover individual, pronounced abilities of the body with a threat to health, when there is an opportunity to use and develop them adequately? The reserve potential of endurance is manifested to one degree or another in all tissues and organs, especially in the reproductive system of women, which is genetically focused on cyclical and crisis psychological and physical stress. For example, women's reproductive system states (active sex, early pregnancy) are known and practiced to improve considerably the result as "legal doping" before serious competition, especially in those sports where a high result depends on aerobic endurance (running, swimming, cross-country skiing, and rowing). In the strategy of striving for the balance of imitation and natural achievements, the doping/anti-doping confrontation inflicts irreparable damage to the development of sports, human health, and well-being of the family. Without enlightenment, professional culture, and adherence to the honor and dignity of the status of an athlete and without targeted support by the sports community and medical specialists, this vicious «sparring of fighters for justice» cannot be stopped.

In view of the above, the solution to the question of the effect of hormonal contraceptives on sports performance (COCs do not belong to sports prohibited drugs) is of particular interest. Comparative analysis is difficult enough even when only the impact of modern low-dose oral contraceptives of the third and fourth generations is considered because of differences in the composition and dosage of components, dosage form, etc. The most common opinion is that female athletes who take and those who do not take COCs are comparable in terms of physical performance [27, 28]. Changes in some functional parameters of the cardiovascular and respiratory systems have apparently a minimal impact on athletic performance [29]. The authors emphasized that women won medals and set records in any phase of the menstrual cycle and regardless of whether they took hormonal contraceptives or not. On the other hand, ambiguous results of the physical performance of athletes using COCs were obtained using specific assessment criteria [13], such as regarding changes in aerobic capacity in terms of the maximum oxygen consumption [30]. However, the authors presented results focusing on different periods and types of the administration of COCs and in various training modes (aerobic endurance and average level of physical activity). The legitimacy of the attitude of P.N. Mooij et al. [31] should also be admitted, which associate a decrease in maximum aerobic power in athletes

taking COCs with aspects of the characteristics and sympathetic regulation of blood circulation.

The effects of COCs on anaerobic metabolism and muscle strength are not detailed [23]. The authors used a load test and a dynamometric assessment but did not provide data to ascertain the ability of sex steroids to increase muscle strength in female athletes.

Through multivariant analysis, D. Logue et al. [8] emphasized equitably that disagreements about the reasons affecting the health status of athletes of the highest achievements necessitate the standardization of research conditions using universal and contemporary diagnostic methods, including identification of the risk group for RED-S development [9].

Thus, sports should not be considered as contraindications for the use of hormonal methods of contraception. Conversely, the properties of COCs are especially relevant for athletes, such as alleviation of the symptoms of algodismenorrhea, premenstrual syndrome, reduction of the amount of blood loss during menstruation, decrease in soreness and muscle fatigue after training (lowering the levels of lactate and ammonia in the blood), carbohydrate-saving effect (effect on gluconeogenesis, glycogen synthesis, and glycogenolysis), and protective effect on bone tissue.

In consideration of the influence of COCs on a woman's body, this method of contraception, when prejudices are overcome, can be the method of choice for female athletes because sex steroids in COCs contribute to maintaining their reproductive and somatic health. The use of COCs by athletes interested in reliable contraception is the gold standard focused on an additional positive effect in situations of intense training regimen, a high level of sportsmanship, a special diet regimen, verified osteopenia, and osteoporosis.

The present and future health of female athletes depends largely on the level of knowledge and selective strategy of coaches.

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