

# Gender Verification Based on Genetic Research: History and Prospects for Implementation



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**Abstract:** *Sporting achievements are traditionally assessed in terms of the gender and age categories, based on the ideas of the fundamental differences in skeletal, physiological and hormonal characteristics of a person of certain sex and age. Modern ideas about the genetics of sex, medical advances that allow changing gender, along with active lobbying of interests of people who do not meet the binary gender norm or identify themselves with the opposite sex compared to the one of which they were born, require increased attention to the problem of gender identification in high-performance sports. In this context, there are a number of issues that require the implementation of an integrated approach by medical professionals, sports officials, and lawyers. The main one is related to the feasibility of genetic testing of athletes, which is questioned due to the lack of a statistically significant cause-and-effect relationship between abnormalities in sexual development and achieved sports results. This simultaneously raises the issue of the effect of identifying such deviations on admission to competitions, depending on sport activity, the "direction" of mutation (from man to woman or from woman to man), and the possibility of resolving the situation in a medical way. When writing the article, methods of collecting and studying isolated facts; generalization methods; scientific abstraction methods; methods of learning patterns have been used. Upon the results of the study, it is concluded that mass genetic testing is not appropriate for gender verification and that there is a need for an integrated approach to the assessment of an athlete's sex, which cannot be limited by his/her chromosomal characteristics, which follows from the practice of international sports organizations and existing medical approaches to solving this problem.*

**Index Terms:** *gender verification, high-performance sports, genetic testing, transgender people, intersex people, admission to competitions, hormone therapy.*

## I. INTRODUCTION

Due to the interaction of the International Olympic Committee with the International Sports Federation and the Organizing Committee of the Olympic Games, an agreement was reached on the equal admission of men and women to competitions in all Olympic sports.

This approach was a logical consequence of the growing trend in the number of women in such sports that were previously considered exclusively male, such as wrestling, boxing, kickboxing, bodybuilding, weightlifting, and ice hockey. At the same time, taking into account the level of sporting achievements demonstrated at international competitions, there is an issue of ensuring the equality of starting capabilities of athletes of the same sex, especially where the anatomical and biological characteristics of the body, such as height, weight, muscle and skeleton mass, bone density, heart and lungs volume, which differ significantly in average men and women, provide an obvious advantage. As a result, the issue of gender verification, which was first raised in 1936 at the Olympic Games in Berlin with regard to Dora Ratjen from Germany and an American runner Helen Stevens, has become particularly relevant due to their masculine build. In subsequent years, this problem was periodically raised in the sports media that were fully aware of the impossibility of a full-fledged refutation of the published materials without scientific evidence refuting them. Over time, this problem became politicized, since the Olympic Games became another front in the Cold War. In the 1960s, rumors spread that female athletes from the Eastern bloc were men, which could explain their numerous victories [1].

Before the 1966 European Athletics Championships, compulsory gender testing was introduced in the form of a gynecological examination, since international sports officials decided that they could not trust individual nations in certifying femininity. However, the used methods that were based on the assessment of the primary sexual characteristics and did not ensure the reliability of the results obtained, caused much criticism because of the humiliating (in the athletes' opinion) procedures.

Significant progress in genetic research, making it possible, among other things, to obtain reliable information about genetic abnormalities that affect the sexual determination, has given a new impetus to the initiation of the scientific debate. It is fair to ask whether the "direction" of mutation (from man to woman or from woman to man) influences admission to competitions. Can the resulting situation be resolved in a medical way, and if so, in what way and to what extent? This simultaneously generates the need to exercise control over the changes. The problem is exacerbated by medical advances that created the conditions for sex reassignment, as well as by the lack of a universal approach to the use of relevant biological markers [2].

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All this determines the relevance of the study on the problems of gender verification in high-performance sports, the purpose of which is to determine the feasibility of its implementation on the basis of genetic research.

## II. LITERATURE REVIEW

Many scientists were engaged in studying the problems of gender verification; this research is based on the works of researchers who did research into this topic: Ballantyne et al. (2012) devoted their research to gender issues in competitive sports; Bermon et al. (2013) considered in their work some aspects of hyperandrogenism in elite athletes; Dickinson et al. (2002) studied the issues of gender verification of female athletes participating in the Olympic Games; Elsas et al. (2000) also studied the possibilities of gender checks for athletes; Epstein (2014) asked a fair question in his research – what importance the difference in sex had in sports; many scientists had considered these problems in their works. However, insufficient attention was paid to the problems of mass genetic testing for the purpose of gender verification, and the solution to this issue can resolve many practical matters and, therefore, requires an integrated analysis.

## III. PROPOSED METHODOLOGY

### A. General description

The dialectical, teleological, historical, axiological, logical, formal legal and system-structural methods formed the methodological basis of research. The implementation of the dialectical method of cognition, general and universal in nature, made it possible to consider the practice of using genetic research for the purposes of gender identification in close connection with the level of development of science and technology. In the most concentrated form, this idea was implemented through the application of a teleological research method related to the interpretation and study of problematic issues through the prism of goal-setting and taking into account development goals and strategies and ensuring an optimal regime of legal regulation of relations related to genomic research and using their results in high-performance sports. The need to assess the prerequisites for the formation of modern approaches to the use of the results of genetic research on gender verification in high-performance sports has led to the use of a historical research method that allows evaluating factors that influenced the solution of this issue at various times.

### B. Algorithm

Considering that the acquisition and use of genetic information inevitably affect the human right to privacy, the axiological method, which implies the analysis of the above public relations from the standpoint of moral, ethical and social values, was of particular importance in conducting this study. The use of the logical method allowed correlating the diversity of approaches to sex determination with the expediency of giving priority to genetic research, taking into account the actually established international practice. It was supplemented by the formal legal method, which allowed for the prospects for their legislative regulation as a means of improving the legal support of high-performance sports. The implementation of the system-structural approach allowed the authors to raise the issue of the relationship between

abnormalities in sexual development, their identification using various methods and competition results, the presence or absence of which was important for deciding on the feasibility of legal regulation of social relations arising in this area. Taking into account the novelty of the considered topic for Russian jurisprudence, the comparative legal method, which makes it possible to identify the positions formed in foreign practice and in the practice of international sports organizations regarding the possibility and feasibility of using genetic information to decide on the admission of an athlete to participate in competitions, acquires special significance for the study.

### C. Flow Chart

The study was conducted using certain research algorithms, which allowed obtaining the results; the research algorithm is presented in (Figure 1):

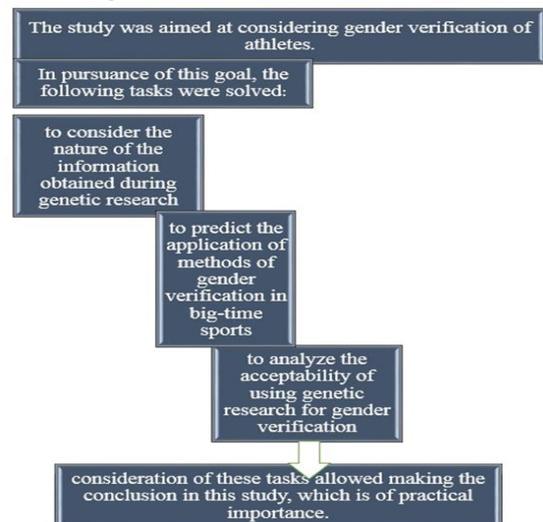


Fig. 1: Research Algorithm

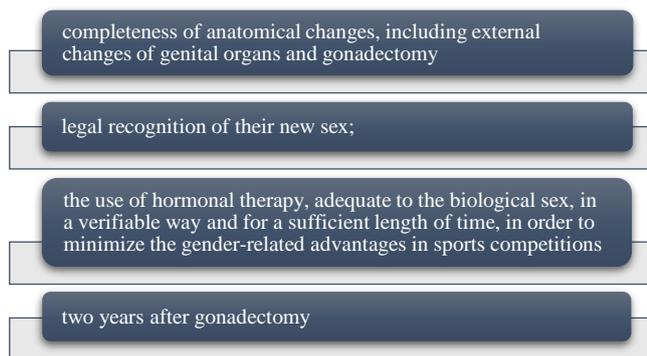
## IV. RESULT ANALYSIS

The practice of using genetic tests to determine the sex of athletes shows the ambiguity of the results obtained.

A decision on gender identification largely depends on which gender features will be taken as a basis and which of them will be given priority, taking into account that the concept of sex is quite ambiguous. Sexual differentiation generally includes a series of sequential processes that allow consistently determining the chromosomal, gonadal, phenotypic and psychological sex [3]. Gonadal sex is the true sex of a person, which is identified by the main indicator of sex – the histological structure of the sex gland [4]. The IOC pursues a policy to address women’s “hyperandrogenism” among Olympic athletes who have an increased level of androgens compared to the rate established for women. In the IOC Regulations on Female Hyperandrogenism, the IOC, recognizing that human biology allows for the forms of intermediate levels between the conditional categories of man and woman, expressed concern that ignoring the increased levels of androgen in female athletes that affected strength, power, and speed, could provide an unreasonable competitive advantage in sports, which, at one time, led to a ban on their use in accordance with the World Anti-Doping Code.

At the same time, the IOC distances itself from the problem of gender verification, emphasizing that nothing in the approved rules is intended to determine sex, focusing on identifying the circumstances in which a particular athlete has no right (according to hormonal characteristics) to participate in women’s competitions, while stipulating that deprivation of the right to participate in women’s competitions does not deprive this athlete of the right to act as a male athlete if he/she qualifies for participating in a men’s sports event [5]. The new policy adopted by the IAAF in 2011 was also targeted at women with hyperandrogenism, since “the difference in athletic performance between men and women was mainly due to the higher level of androgenic hormones in men, which led to increased strength and muscle development”. At the same time, it was recognized that women with hyperandrogenism can participate in women’s athletics competitions in accordance with IAAF regulations, which provide for a three-level examination (IAAF Regulations Governing Eligibility of Females with Hyperandrogenism to Compete in Women's Competition, 2011). Actually, in 2015, its positions were shaken by the decision of the Court of Arbitration for Sport (CAS) on the case of the Indian athlete Dutee Chand, who was banned from competing because of the high level of androgen. The court failed to prove that the women like her had an unfair advantage due to the naturally high testosterone level and suspended the force of developed regulations for 2 years.

Modern medicine, allowing for sex reassignment, has made significant adjustments to the practice of its determination, including for addressing the issue of the possibility of admitting transgender people to competitions [6]. In this regard, the Stockholm Consensus on Sex Reassignment in Sports in 2003 should be noted, where a recommendation was made to recognize the right of those who changed their sex from man to woman (and vice versa) to participate, respectively, in women’s or men’s competitions under the following conditions (Figure 2).



**Fig. 2: Conditions of participation of athletes in competitions in the case of sex reassignment**

Collisions caused by different approaches to sex determination are vividly demonstrated by the story of the Spanish runner-hurdler M. Patino, who was subjected to genetic testing in 1988, as a result of which she was banned from competing. She looked like a woman, did not demonstrate excessive strength and endurance and, therefore, had no reason to suspect that she was not a woman, but medical examinations showed that Patino’s cells had the Y chromosome and that her labia hid the testicles inside. Moreover, she had neither ovaries nor a uterus, which led to

the conclusion that Patino was not a woman and could not participate in the Olympic Games in Spain. Subsequently, she spent thousands of dollars on consulting doctors, who explained that she was born in a state called androgenic insensitivity expressed in the fact that, in the presence of the Y chromosome and the production of a sufficient amount of testosterone, her cells did not respond to it, so that her body began to form according to the female phenotype, which manifested itself in breast growth, waist constriction and hip extension [7]. This circumstance gave grounds for a medical conclusion that Patino was feminine enough to compete on equal terms in women’s competitions. As a result, the International Amateur Athletic Federation (IAAF) restored her status, and by 1992 Patino had returned to the Spanish Olympic team, entering history as the first woman to successfully challenge a decision made on the results of genetic testing. This story shows the ambiguity of a one-sided approach to gender verification based on genetic research. Despite this, the IOC clearly gives them priority, assuming that even if the search for the Y chromosome is not the best scientific method of sex determination, testing should be conducted, as it can reveal the true sex of an athlete. At the same time, the applied methods gradually evolve, making it possible to single out the era of physical examinations and molecular diagnostics [8]. Historically, the Barr body (X-sex chromatin) recognition system became the first test used to identify disorders of sexual development. The Barr body is found only in cells with XX sex chromosomes and is an accumulation of chromatin, which occurs as a result of deactivation of one of the paired sex chromosomes; this allows identifying the absence of the X chromosome in women and the presence of an additional X chromosome in men during express diagnostics [9]. The use of this method did not cause a significant protest in athletes and quickly gave its results: a Polish athlete Eva Klobukowska was disqualified according to the results of the Barr test and stripped off her medals because of revealed XX/XXY mosaicism [10]. However, the application of this technique has created more problems than it resolved, because it does not take into account the complexity of sex determination. On the one hand, it deprived women with complete androgenic insensitivity of participation in competitions due to the presence of the Y chromosome despite the completely female phenotype; on the other hand, it formally gave grounds for participation in women’s competitions for men with Klinefelter syndrome, which is an extremely common pathology that occurs in the male population with a frequency of 0.2% and is characterized by a significant variety of cytogenetic variants and their combinations, which will determine the presence of the Barr body in the cytological analysis. For 20 years, based on the results of these tests, 13 women were banned from participating in sporting events, despite the fact that the identified genetic differences did not give any unusual physical advantages for sports. Experts paid attention to the fact that the applied technique was very imperfect, because it did not allow identifying in men and women such disease as congenital adrenal hyperplasia,

which can actually provide competitive advantages, since it is accompanied by an increase in the concentration of catecholamines (adrenaline and noradrenaline), glucocorticoids (cortisone and its derivatives) and androgens in the blood [11]. Negative assessments of this research method forced sports organizations to abolish the conduct of the sex chromatin test, but not to give up gender verification attempts. Due to this, in 1991, the Barr body analysis was replaced by a polymerase chain reaction (PCR) analysis for the SRY gene locus on the Y chromosome. However, the results obtained by the experts were not impressive. Of more than 2,000 tests conducted in 1992 in Barcelona, only 15 were considered positive and of 3,000 tests conducted during the games in Atlanta in 1996 – eight. Moreover, the androgen insensitivity syndrome was detected in seven of them, when clinical phenotypes range from normal male physique with mild spermatogenesis disorder to a fully female physique, despite the presence of the Y chromosome [12]. Thus, the goal of gender verification – ensuring equal starting opportunities in women’s sports – has been equal discredited. Gender testing was initially welcomed by athletes as a method of preventing “fraud”, but over time it became clear that discrimination against people with similar developmental disabilities was unfair and harmed the sport [10]. Experts have repeatedly noted that gender testing conducted in athletics has never revealed a subject, who deliberately distorted his/her sex [4], and did not provide unequivocal evidence that athletes with any genetic abnormalities had any physically significant characteristics for sports that were not observed in biologically normal athletes [13], which casted doubt on the validity of the decisions made to exclude such athletes from competing. As a result, in June 1999, at the 109th session of the IOC, a decision was made to suspend mandatory gender control. In 2000, at the Sydney Games, it was no longer exercised. In addition, by 2000, 29 of 34 international sports federations had refused to conduct such studies. At the same time, the IOC stipulated the right to demand an individual inspection if there were grounds for this, which was repeatedly confirmed on the eve of the Olympic Games. Therefore, contrary to the claims of some researchers [14], laboratory genetic screening of women in sports did not recede into the historical distance.

In addition, all this cannot redress the possibility of sex reassignment, which has several aspects. Firstly, the achievements of modern medicine, which allow for sex reassignment that entails the possibility of officially obtaining the status of a person of the opposite sex, cannot be ignored. In such cases, there are concerns about the preservation by transgender people of the possibility of physical dominance over women, taking into account the initial natural indicators. Uncertainty in this matter has arisen in relation to the first athlete-transgender Renée Richards, who was born a man and underwent a sex-change operation. At first, she was not allowed to participate in the women’s tournament of the US Open Tennis Championship in 1976, but in 1977 the US Supreme Court officially recognized her as a woman and decided to allow her to participate in the women’s tournament. Secondly, it is important to consider the possibilities of hormonal therapy, which can provide equal opportunities in sports and level fears about the hormonal background affecting personal achievements. The

practice of its application exists, as evidenced by the IAAF documents. In this regard, one should note the apparent easing of the IOC’s policy on transgender and intersex people, which was demonstrated by the discussion of this problem on the eve of the 2016 Olympics in Rio de Janeiro. They were allowed to participate in international sports competitions, including the Olympic Games, with fewer restrictions. The feasibility of applying genetic research for gender verification in high-performance sports has generated a variety of discussions from the very beginning. The starting point for them was the question of the fundamental possibility of reliable determination of the sex of a person, which casts doubt on the possibility of achieving the goals set by the IOC, defending the need for genetic research in this area. Taking into account the research results, it is concluded that the boundaries between the sexes are not defined by the division into two classes (male and female), as is usually assumed by society and sports institutions, since they contain a wide range of intermediate sex indicators that need to be taken into account [15]. The fact is that over the past few decades, the relationship between the social expression of masculinity and femininity and their physical basis has been hotly debated in the scientific and social spheres. Back in 1972, the sexologists D. Mani and A. Ehrhardt defended the idea that sex and gender were separate categories. They have argued that sex refers to physical attributes and is determined anatomically and physiologically. They have considered gender as a psychological transformation of the self – the inner conviction that a man is either a man or a woman (gender identity) and the behavioral expression of that conviction [7] so that scientists cannot propose universal criteria for its determination. The shift in research towards the identification of hormonal abnormalities did not reduce the intensity of discussions regarding the significance of identifying indicators inherent in particular sex to address the issue of admission of athletes to competitions. First of all, a debate is going on with regard to the role of testosterone in improving athletic performance. While there is no doubt about synthetic testosterone, which is doping with anabolic steroids, there is no consensus on natural testosterone generated by one’s own body. At present, two diametrically opposed approaches have emerged. According to the first of them, natural testosterone levels, even if they are elevated, do not provide a competitive advantage, whereby athletes with hyperandrogenic properties must compete as women. According to Karkazis, an anthropologist and bioethicist from the Stanford Center for Biomedical Ethics, despite the general opinion about the existence of a link between endogenous testosterone and the athletic advantage is not proven from a scientific point of view and it will be very difficult to establish it. Due to this, one should proceed from the “legal recognition of women” [5]. Her point of view actually found support in CAS, which, as noted earlier, did not establish any scientific basis for the existence of any prohibitions or restrictions on the participation of such women in sports competitions. Opponents of such assessment of hormonal disruptions note that the process of developing the.

IAAF rules was based on the regular interaction of a working group consisting of three sports doctors and physiologists, four experts on DSD and two legal advisors. Consequently, all issues related to DSD (genetics, endocrinology, gynecology, sports physiology, psychology, ethics, etc.) were widely discussed [17]. Epstein and Dreger argue that testosterone provides a competitive advantage in sports, since, because of it, men are generally heavier and taller than women, have longer limbs in relation to their height, large hearts and lungs, less fat, denser bones, more oxygen-carrying red blood cells, heavier skeletons, narrower thighs, which provide more efficient running. Studies show that the gender gap in Olympic sports has remained stable for decades, and this suggests that women's high-level performances will never be compared to men's performances [18].

However, their criticism of K. Karkazis's position is based on the assumption that the research results, to which she refers, were not sufficiently reliable since it was originally developed for the study of doping, and serum samples were taken after competitions. The doubtfulness of the conclusions made is also related to the fact that the samples were taken from athletes involved in various sports [19].

E. Wiline took a peculiar position on this issue; he did not attach importance to the possible coincidence of testosterone levels in men and women, considering it more important that it "was the best marker for distinguishing men from women" (Laura Geggel). This view is supported by experts [20].

Against the background of similar contradictions that have not yet been resolved, it has been suggested that the level of testosterone in women does not necessarily have to be the center of attention when developing principles of fairness in sport, since human nature is too complex to be presented in one criterion [20]. In addition to genetic features, such are the possibility of full-fledged workouts, healthy nutrition, and other features, and "if sports officials really want to eliminate the essential factors affecting the advantage, they must require that all athletes live at the same place, with the same level of well-being and access to the same resources" [1].

## V. CONCLUSION

According to the results of the study, it is concluded that mass genetic testing is not appropriate for gender verification and there is the need for an integrated approach to assessing the sex of an athlete, which cannot be limited by its chromosomal characteristics, which follows from the practice of international sports organizations and existing medical approaches to solving this problem. Gender control is highly questionable both in terms of accomplishing the task and in terms of compliance with international human rights acts, so it should not be used when admitting athletes to any sports competitions and the Olympics.

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