

# Current opportunities and challenges for scientists in the field of sports biomechanics

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## **Abstract**

**Objective of the study** was to provide the academic community with a brief overview of the current state and development of sports biomechanics.

**Methods and structure of the study.** General research methods are used, such as analysis and synthesis, formalization, deduction, generalization, as well as the historical method. Scopus, Web of Science, Science Direct and Elibrary databases were used for the literature review. We considered publications in which biomechanics appears both from a general theoretical position and from the point of view of its specific applications.

**Results and conclusions.** As a scientific field, sports biomechanics conducts an in-depth analysis of the characteristics and patterns of biomechanical movement of organisms. This is a key aspect for understanding the complex mechanisms of movement in biological systems and for effectively controlling human movements. In this context, the biomechanics of sports promises to achieve even deeper development and provide more advanced theoretical and technical support for human health and physical activity.

**Keywords:** *biomechanics of sports, technical application, healthy lifestyle, possibilities of biomechanics, challenges of biomechanics.*

**Introduction.** In world science, modern biomechanics of sports faces many prospects and challenges. The growth of research devoted to the biomechanics of sports emphasizes the growing importance of this discipline, as shown, in particular, by data from the EBSCO Discovery Service [10]. Indeed, over the past fifty years there has been significant development in motion analysis systems and computer simulations of sports movements [9]. However, scientists in this field face certain problems and challenges. In particular, in the Russian academic environment today there is a decrease in interest in biomechanics [3]. Therefore, discussion of the topic of sports biomechanics is extremely relevant.

Objective of the study was to identify current opportunities and challenges for scientists in the field of sports biomechanics.

**Methods and structure of the study.** General research methods are used, such as analysis and synthesis, formalization, deduction, generalization, as well as the historical method. Scopus, Web of Science, ScienceDirect and Elibrary databases were used for the literature review. We considered publications in which biomechanics appears both from a general theoretical position and from the point of view of its specific applications.

**Research results and discussion.** Biomechanics arose from the human need to quantify the interactions of both endogenous and exogenous forces using mechanical laws and postulates. Since the beginning of the second half of the 20th century, biomechanics has become a fundamental tool and an autonomous discipline with broad research potential [5].

From a conceptual point of view, the biomechan-



ics of sports is a field of kinesiology, which is a set of concepts, laws and principles that reflect biophysical, somatopsychic and didactic mechanisms in human life [1]. The key points in theoretical modeling and simulation calculations in sports biomechanics are the muscle constitutive theory and the calculation of muscle strength [6].

In the context of modern scientific and technological progress and globalization, the field of sports biomechanics is faced with unprecedented opportunities. Thus, the application of sports biomechanics covers a wide range of areas: pedagogical training of future athletes, sports training, rehabilitation medicine, scientific research in the field of sports, design of sports products, sports medicine research. Sports biomechanics is also applicable to improving human health and optimizing athletic performance. Overall, the status and application fields of sports biomechanics are increasingly worthy of attention, and it plays an indispensable role in the development and application of sports science.

It is important to note that the revolutionary change in the field of sports science is the application of technology. Current global trends indicate a continuous expansion in the depth and breadth of sports science research, which is mainly driven by advanced technologies (e.g., 3D motion analysis technology, neuroimaging technology, biosensors and smart devices) [8], the fusion of big data and artificial intelligence [9], increased research into the intrinsic links between health and physical activity, and increased interest in the psychological and social aspects of sport. At the same time, an urgent task for modern sports biomechanics remains the development of methods that make it possible to determine optimal sports techniques for specific athletes. Thus, it has recently been called the “holy grail of sports biomechanics” [7].

It should also be noted that in the context of globalization, the union of international cooperation and competition serves as a driver of scientific research, providing complementarity and playing an important role in the field of knowledge and innovation, which has a positive effect on scientific progress [4]. Overall, international cooperation and competition create a unique dynamic balance in the field of sports biomechanics. This balance stimulates innovation and progress in the field, and provides new perspectives and methods for addressing health and mobility issues at a global level.

However, analysis of current trends in the develop-

ment of sports biomechanics allows us to identify key challenges in this area:

- Challenges of data processing and analysis. The key issues here are data processing, analysis and interpretation. It is also difficult to integrate and interpret data at different levels. To overcome these challenges, it is necessary to continue to develop new data processing methods and use advanced analysis technologies.

- Ethical and privacy challenges. Here, the main task remains the simultaneous protection of the interests of researchers; its solution can be the development of clear licensing and data sharing policies.

- Challenges to traditional beliefs and culture. Traditional sports programs often have a long history and tradition, traditional training methods and skills are deeply ingrained, so the introduction of biomechanics may face challenges in terms of acceptability and adaptation. Studying the cultural characteristics of sports practices can mitigate this problem.

- Increased public awareness and acceptability. An important issue is the need to increase public awareness and acceptance in the process of popularization and dissemination of biomechanics, which makes science education and awareness especially important.

**Conclusions.** Thus, as a scientific field, sports biomechanics conducts a deep analysis of the characteristics and patterns of biomechanical movement of organisms. This is a key aspect for understanding the complex mechanisms of movement in biological systems and for effectively controlling human movements. As G.P. Ivanova noted a decade ago, discussing the development of sports biomechanics, this “doping is not prohibited, but not known to everyone” [2]. In this context, the biomechanics of sports promises to achieve even deeper development and provide more advanced theoretical and technical support for human health and physical activity.

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