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Review Article

Ethical Concerns Regarding Physiological Tests in Sports

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ABSTRACT

Background. The central issue of research ethics is how the potential conflict between scientific goals and the people's interests taking part in the research should be overcome. People must have absolute priority and protection to prevent harm to research participants. **Objectives**. When conducting sports tests at maximum rates, assess all possible risks for research participants. Consider ethical methods of control when conducting various trials related to human life. **Methods**. Diverse literature touches on the moments and aspects of an ethical approach to the problem of conducting maximum tests. **Results.** There is a standard model of procedures in maximal tests performed with athletes. The research and testing model is based on ethical principles disclosed in the Helsinki Declaration. **Conclusion.** Since there are always no rules of behavior applicable to all situations, ethics provides operating principles, norms, and values for action that man will apply evolutionarily, using his reason.

KEYWORDS: ***Exercise Testing Risks, Testing in Sports, Ethical Concerns, Exercise Training.***

INTRODUCTION

Physical exercise has accompanied humanity since its existence. Our need for survival has always been involved in increasingly higher demands, showing body development in several ways, from a significant increase in strength and endurance to improved neuromuscular reactions, increasing the growth of human abilities. During this period, several competitions emerged, where the first records were registered. The desire to win came to accompany our day today. The first training methodologies began to emerge, which took athletes to the highest level of personal performance. At this stage of development, our society is beginning to feel the first signs of the need to create ethical norms and basic rules that allow for reasonable control of the results obtained (1). In the 17th-18th centuries, we observed the birth of several philosophical theories based on different concepts and natural laws – from Kant's theory (which states that people are not to be used to an end and that there are mandatory rights and obligations) to the creation of Deontology, which by themselves were the pioneers in the development of our social behavior and creation of ethical norms. The Code of Ethics was created later, establishing rights and duties based on its mission, culture, and social position (1).

The risk of harming research participants is one of the most challenging issues that all stakeholders must evaluate and weigh in the research process (scientists, sponsors, research institutions, host countries, ethics committees, and research participants) (2). What risks are acceptable to obtain the expected benefits? Who

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should take the risk and why? Who should determine what level of risk is acceptable? In the context of developing countries, facing the challenges posed by these questions is essential to guarantee research ethics.

Faced with the ethical flaws of several well-known medical research studies and the conclusion that unwarranted scientific research cannot be prevented if only the researchers and participants are left to make decisions, research sponsors and regulators are now pushing for a balance between risk and benefit for research participants and research communities, an independent committee specially created for this purpose oversaw (3,4). Various names are known for these committees: Research Ethics Committees (RECs), Subject Rights Committees, Health Institutional Advisory Councils (HIACs), or Independent Ethics Committees. All ethical organizations aim to control the investigation process, not allowing code of ethics breaches. A Code of Ethics – is a document that dictates and regulates the rules that control the functioning of specific organizations and the behavior of their employees and members. In our society, the main ways of regulating behavior, that is, ways of evaluating the actions of individuals, are ethics, morals, customs, rights, and Deontology. Deontology is a treatise on duties and morals, and it is a theory about the choices of individuals, which is morally necessary and serves to guide what should be done. Deontology – is a philosophy that is part of contemporary moral philosophy, which means the science of duty and obligation. The term was created in 1834 by the English philosopher Jeremy Bentham to discuss a branch of ethics in which the object of study is the foundation of duty and norms. Deontology is still known as the "Theory of Duty."

Ethics is responsible for investigating the principles that guide human behavior; its object is distinguishing between good and evil correct and incorrect behavior. Ethics appeals to autonomy, personal judgment, and responsibility. It helps the individual explain the reasons for their actions and assume the respective consequences; that is, it reinforces the individual's need to explain the reasons for their actions and assume the consequences. We live in times of great competitiveness, which creates several challenges for scientists to master and overcome the limits of the human body. In this sense, ethics helps to improve man through action. Since there are always no rules of behavior applicable to all situations, ethics provides operating principles, norms, and values for action that man will apply evolutionarily.

A physical exercise technician in the 21st century, in addition to having technical training and being available for change and continuous improvement, must also be aware of the importance of his role in society. In addition to using technical knowledge, it should also be concerned with the ethical dimension of the conduct. Competitiveness and competition challenge the scientific mind and test human dignity and rights. Ethical awareness concerns the values that should guide the technician's behavior in economic and social aspects. Ethics is responsible for investigating the principles that guide human behavior; it aims to distinguish between good and evil and correct and incorrect behavior.

The Belmont Report (1979) states that research should contribute to generalizable knowledge relevant to discussing ethical concerns. It may preclude practices such as acquiring robust patent banks that include research by others and protecting a company's patents to maximize profits by restricting access to information. The report addresses some "basic ethical principles," which include (1) respect for persons, (2) beneficence, and (3) justice. Respect for persons means that individuals should be treated as autonomous agents, and persons with diminished autonomy are entitled to protection. Additionally, there are inclusion elements regarding informed consent and voluntary participation. As research is to discover information that is not known, the "informed patient" model may not apply. The concept of a "reasonable volunteer" may be more appropriate. The expected outcomes and related statistics will be made available in the usual informed consent process for a procedure.

Research is a vital element in improving the global health system for the World Health Organization. Our dedication to building and applying knowledge to improve human health is rooted in a commitment to ethical principles: research must be conducted ethically and open prospects for raising the standards of everyone's health (5).

In the last two decades, the number of published articles related to the methodology of

the studies used to test athletes has increased, but at the same time, scientists continue to deal with several difficulties that arise during the test. As Hegedus et al. (6) refer, standardization among professionals and clinicians regarding test names and methods is limited. The lack of standardization makes it difficult for clinicians to use the literature to choose an appropriate PPT for evaluating a patient. Analyzing recent literature, Foster (7) reveals the high importance of performing a set of medical and physiological tests to assess athletes' health status, including those in the recovery phase. Today, there are numerous evaluation methods; most used are cardiovascular, respiratory, muscular, biochemical, and biomechanical. These tests can be performed on any athlete. However, the biggest dilemmas for scientists arise now – what are the evaluation criteria? Can we proceed with the test? To what extent is it feasible to continue the test? Who is responsible for the scientist's misconduct? Who should be present at the test? What kind of medical help do we have in an unforeseen event? What ethical principles must we uphold to get the best test result?

These and many more questions and doubts arise daily and accompany scientists in their daily work. This work aims to address these pertinent questions through a narrative literature review.

MATERIALS AND METHODS

We will analyze the entire process from start to finish to provide the answers. First, we analyzed the available literature on the topic addressed. If we were to look at the PubMed search engine with an indication of the topic, we saw that only 54 results appear. Doing a quick review, we saw nothing particular on the subject that addressed the maximum physical tests. Therefore, we need to look for answers from other sources of information.

The success of a scientific process depends on several factors. It is evident that the process itself includes several steps: definition of the topic, elaboration of the study design, assessment of the risks and benefits of the study, obtaining voluntary consent from the participants, specification of medical assistance, clarifying all the duties of ethical principles before the participants, ensure confidentiality, maintain good conduct in processing the data obtained in the tests. Now, we analyze each step of the process in detail.

1. Definition of the theme. The elaboration of a research project indicates to the researcher (or the institutions to which the project is directed) the aspects and questions established concerning investigating a specific theme (8). According to the authors mentioned, the beginning of the project is the elaboration of a document through which the entire research planning is articulated and organized. In other words, we should create a map that we will follow until the end of the process, which helps us maintain order in the sequence of steps.

2. Elaboration of the study design. The concept of study design involves identifying the type of methodological approach that is used to answer a given question, thus implying the definition of specific essential characteristics of the study, such as the population and sample to be studied, the unit of analysis, the existence or not of direct intervention on the exposure, the existence, and type of follow-up of individuals, among others. Based on the essential characteristics of the study, a series of terminological standards have been created that define, from the outset, some of these characteristics and constitute what are called study types or designs. When discussing a study that involves testing the maximum number of athletes, we must be able to justify the benefit of the specific study.

3. Assessment of the risks and benefits of the study. Research in the literature revealed that several authors who analyzed the relationship between the risks and benefits of the study concluded that this relationship could be called "relative." Van Ness et al. (9) reveal that the concept of risk involves an idea of probability. Damage can be predictable to some extent but never controlled with certainty. On the other hand, King (10), when analyzing the benefits of the study, revealed the importance of the gain from the knowledge generated, which can bring more scientific knowledge. With all this, we must reduce the risks as much as possible, creating a highly qualified team that can control all procedures and provide constant technical supervision, always maintaining ethical principles. Adopting these postures can considerably reduce the risks for research participants.

4. Obtaining voluntary consent from participants. The World Medical Association (WMA) developed the Declaration of Helsinki (June 1964) as a statement of ethical principles for medical research involving human subjects, including research into identifiable human materials and data. All research participants must be informed about the research and its risks. Study participants must document and sign all voluntary consent to safeguard the investigator and the institution. The Ethics Committee must have access to all documentation obtained (1).

5. Specification of medical aid. When planning the maximum tests with athletes, we must consider several technical details linked to medical help in the tests. To protect participants and ensure safety, good procedural planning should include a medical team willing to step in and stop the test if they think the athlete is at high health risk. If there is any unforeseen event or the athlete suffers any damage, the Research Ethics Committee must be informed of all adverse effects or relevant facts. Research fins that have suffered damage and comprehensive medical care are entitled to compensation (11).

6. Guarantee ethical principles before the test subjects. Analyzing various literature sources, we can conclude that medicine, from its existence until the mid-60s of the 20th century, was seen as an authoritarian science where the doctor had absolute power. Human rights and ethical principles toward the patient were never analyzed. Only after going through the horrific experience of Nazi doctors throughout the Second World War did humanity reach the point of creating specific rules and defining certain conducts of researchers throughout the tests carried out on human beings. Currently, all scientists and researchers are based on ethical principles. Research ethics is based on three fundamental principles: respect for people, beneficence, and justice. These ethical principles have been described by the International Research Ethics Family Health (12). Respect for people is recognizing a person as an autonomous, unique, and free individual, maintaining and valuing the person's dignity. Individuals must be empowered to make decisions freely and be given all the information necessary to make the right decisions. Conducting a research project in any area of science when some do not have the right or ability to decide is a violation of ethics and human rights. Beneficence means doing good to the people involved. No harm is the standard of this principle, which makes the investigator responsible for the research participant's physical, mental, and social well-being. Furthermore, lastly, we have justice. There are many talks these days about research justice. Justice requires the fair and equal distribution of benefits and risks of participating in a research study. There should not be a discrepancy in benefits in the groups participating in the study. Every day, innovative studies appear in health, where the participants are primarily carriers of certain diseases. These people themselves present a vulnerable category of study participants and cannot be unjustifiably taken benefit.

7. Confidentiality of study results. The origins of professional secrecy are represented in the figure of Hippocrates, who stated that whatever he saw or heard about men's lives, in their professional practice or outside of it, should not be told to the public; he would not divulge and should be, thus kept secret. Therefore, from ancient times, professional secrecy, privacy, and confidentiality for healthcare providers became legal obligations and ethical duties. Throughout any study, the investigator can gather personal information about study participants. This type of information obliges the group of researchers to guarantee the confidentiality of the participants. Results must be presented so that no study participants can be recognized.

8. Good conduct of investigators. ALLEA (All European Academies) (4) describes scientific research as follows – research is the search for knowledge obtained through systematic study, observation, and experimentation. Therefore, the "European Code of Conduct for Research Integrity" applies to research in all scientific and academic fields (13). Good research conduct is based on fundamental principles of integrity (14), which guide researchers in their work and their commitment to practical, ethical, and intellectual challenges (15-18). These principles are presented in Table 1. In addition to integrity principles, there are also several contexts of the conduct of investigators, which can be seen in Table 2.

Table 1. Fundamental principles of integrity

Principle	Description
Reliability	It guarantees a quality of research reflected in the design, methodology, analysis, and use of resources.
Honesty	It is viewed transparently, reasonably, entirely, and impartially in developing, reviewing, and reporting.
Respect	It is valued in the relationship between colleagues, research participants, society, ecosystems, heritage, and the environment.
Responsibility	The research assessed it from idea to publication, training, supervision, guidance, and broader impacts.

Table 2. Contexts of good conduct for researchers.

Description	Responsibility	Objective
Research environment	Research institutions and organizations	Organize and ensure the best conditions for carrying out the research study.
Training, supervision, guidance	Research institutions and organizations, senior researchers	Develop adequate and appropriate training on research ethics and integrity, ensuring all procedures and regulations are followed.
Investigation procedures	The researchers	Obtaining, conducting, analyzing, and documenting the investigation in a careful and thoughtful manner conduct, analyze, and document research carefully and thoughtfully.
Safeguards	The researchers	Recognition and good management of potential damages and risks related to the investigation.
Data management	Research institutions and organizations, researchers	Transparency in accessing or using the data obtained and research materials.
Collaborative work	All partners collaborating on research	Clear and objective communication between all partners collaborating in the investigation.
Publication and dissemination	All authors and editors of the publication	Full collaboration among all participants, disclosure of data, and relevant acknowledgment and intellectual contributions of third parties. Disclosure of possible conflicts of interest.
Review, evaluate, and edit.	The researchers and reviewers	Review and evaluate requests for publication and funding justifiably and transparently. Respect the rights of authors and candidates.

RESULTS

After analyzing several sources of information, we concluded that there is a standard model of procedures in maximal tests performed with athletes. The research and testing model is based on ethical principles disclosed in the Helsinki Declaration (1964) (3). At the same time, a guide is released by the ACSM (American College of Sports Medicine), which can inform us about all the risks involving maximum tests (19). The guide is a document that defines the procedures during physical tests. The First edition was published in 1975. We are going to the 10th edition, which was published in 2017. The document can be called the "Standard of procedures" in physical tests, divided into three categories: studies that do not have risks, studies with low risk, and high-risk studies. This guide also presents a set of medical reports that disclose all the risks during maximal tests, such as the maximal cardiopulmonary exercise test (CPET). The cardiopulmonary exercise test (CPET) has been gaining importance as a method of functional assessment in Brazil and worldwide (20). In its most frequent applications, CPET consists of applying a gradually increasing intensity exercise until exhaustion or until the appearance of limiting symptoms and/or signs. The following parameters are measured: ventilation, oxygen consumption (VO2), carbon dioxide production (VCO2), and the other variables of conventional exercise testing (21).

Another topic that we would like to address in the results of our research that has been following the published articles is the use of active substances to improve the performance of athletes in physical tests. Authors Angell et al. (22) revealed that athletes' use of performance-enhancing and social drugs raises several ethical and health concerns. The World Anti-Doping

Agency was constituted to address both issues and publish a list of testing for banned substances in athletes (23). Despite continuing methodological developments to detect drug use and associated punishments for positive dope tests, many athletes still choose to use performance and image-enhancing drugs. The main concern for this small review is the health consequences of drug use by athletes. Active substances can have a high impact on the performance of athletes, but at the same time, from an ethical point of view, they cannot be considered fair or legal.

DISCUSSION

The various sources of information consulted showed that the available literature on the topic is somewhat scarce, making it challenging to clarify some doubts in more depth. The interpretation of research results implies the search for a plausible explanation. The results revealed that few authors detailed their study on the maximum sports tests. The literature shows that the topic addressed can be interpreted in two ways – challenge and protection (24). All scientists and physical trainers want to know their athletes' abilities, trying to improve them in some way in the future (25). Innovative training methodologies and the most modern equipment have contributed to this challenge. We have also seen that science has been much sought after over the last few decades in this sense. Several authors revealed the extreme importance of the union of technical teams with specialized medical teams when performing maximum tests on athletes and continuously monitoring athletes throughout the seasons. All this work is based on ethical principles and technical knowledge. In our view, there is a need to create a set of technical protocols that would be used by coaches and physical trainers of all sports better to understand the performance of athletes in maximal tests. The importance of protecting athletes should not be overlooked. Unfortunately, sports history knows many cases of athletes dying in the middle of the race.

Based on this, some actions soon emerge. Have all training protocols been complied with? Have all ethical principles been respected in the athlete preparation phase? Were the physical tests well designed, or did they try to devalue some values and markers? That is why the contribution of science, based on ethical principles, to the sporting society is unquestionable, insofar as it makes it possible to improve the quality of preparation of athletes. The studies analyzed also revealed the importance of risk assessment in maximum tests (7,25,26). One should not exclude risk factors, which can influence the test result and show misconduct by scientists. The well-being and safety of athletes will always come first.

CONCLUSION

The Medical Ethics Committee must approve all maximum tests based on the ASCM standard of practice recommendations. Any test where researchers plan to reach the highest levels or study the maximum capacity of athletes must be accompanied by a team of qualified doctors who can guarantee a quick and effective response. Physicians should know all investigational protocols and procedures. At any time, they have the right to interfere with tests and cancel them if they feel that the study's risks outweigh the benefits of the study. Regardless of the outcome, the researchers must guarantee the participants' rights, basing their conduct on the ethical principles described in the Helsinki Declaration.

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CONFLICT OF INTEREST

The authors declare no conflict of interest concerning the authors' contribution and article's publication.

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The author declares no AI usage.

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