Review

The Difficulties of Conducting Research and Transdisciplinary Studies in Sports Medicine in Brazil

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Abstract: This paper aims to list the current challenges in the study of Sports Medicine in Brazil based on a review of the literature and the author's experience as a member of a transdisciplinary team in this field, as well as to discuss methods for establishing an appropriate and organized course of health activities in this context. The authors identified four significant contemporary difficulties in the field of sports medicine in Brazil that, while minor, are complicated. There is a need to publish a greater number of national studies, generate integrated knowledge through transdisciplinary research, propose sports and movement as a tool for the prevention of degenerative conditions, and research and develop better therapeutic options through transdisciplinary research. It is expected that a transdisciplinary approach will reduce divergences between the real world and science, putting an end to dogmatism, prejudice, and theoretical thinking, increasing the scientificity of sports, bringing competitive advantages, improving training, performance, and athlete health management, and contributing to the advancement of sports medicine.

Keywords: sports medicine; transdisciplinary; clinical trials; sports science; thermography

1. Introduction

In recent decades, there has been a massive physical evolution of athletes of all modalities, which has been made possible by two key pillars: science and technology. Ander-Egg best described science, according to Lakatos and Marconi, as "a full collection of rational knowledge, correct or probable, attained methodologically, systematized, and verified, which pertain to things of the same nature"[1].

Technology according to the Portuguese Language Dictionary of Porto Editora, is "the collection of equipment, methods, and procedures that allow the practical use of the scientific knowledge". It has provided real-time data capture of athletes' performance in sports such as drone footage for motion analysis, thermographic images, muscle enzyme dosages, smart watches, communication, and information technology, global system position, and other means; and substantiated decision-making of professionals involved in the conduct and guidance of these athletes' training and recovery [2].

This massive growth of sports medicine has resulted in a considerable increase in the incidence of musculoskeletal injuries, a greater demand for more care with sports training orientation, and a focus on the post-effort recovery period. All of these issues should be treated by sports care

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specialists, in collaboration with the players' preparation crew, which includes physical trainers, physicians, physiologists, physiotherapists, nutritionists, thermologists and psychologists [3].

The function of the physical education professional in this context is to act in the athletes' preparation phase in a preventive manner, qualifying and individualizing the training sessions more and more, allowing greater longevity of the athletes, and reconditioning the athlete in the post-injury recovery phase, in an integrated manner with the guidelines of the staff physicians and physiotherapists [4] .

In terms of nutrition, improper dietary patterns have been observed in some athletic groups, resulting in systematic errors in sports research and highlighting the need for a more rigorous methodology in the application of this instrument, which favors dietary re-education with adaptation to training schemes [5].

As a result, the collaborative activity of diverse specialists from the technical committees highlights the need of putting the notion of transdisciplinarity into practice, where there are no borders between the disciplines associated with an athlete. "The fundamental element in transdisciplinarity rests in the attitude of accepting that there is no privileged cultural place or period that enables assessing and hierarchizing as more right," writes Ubiratan D'Ambrósio (2009) [6] in the book Transdisciplinaridade6. Transdisciplinarity hinges on a more open approach, one of mutual respect and even humility towards myths, religions, systems of explanation and knowledge, rejecting any sort of hubris or arrogance".

Acceptance of this new reality has considerably enhanced the job of sports experts, resulting greater sporting results and increased athletic longevity in high performance.

Historically, the foundations of research connected to physical activity and sports have historical proof of their existence dating back around 5000 years, such as the Chinese detailing a series of exercises for allegedly diabetic patients, as well as nutritional instructions [7].

Therapeutic activities are mentioned in the Vedas, which were written circa 1500 BC in India. Notwithstanding the loss of his original writings, Herodicus, who lived in the 5th century BC, can be regarded as the first person to integrate athletics and medicine. He studied medicine at Cnidos Medical School as a sports teacher. He developed his vision of medicine as well as his theoretical model of health. Poor or weakened health, he believed, was the result of an imbalance between nutrition and physical exercise. It advocated for a rigid diet, consistent physical exercise, and frequent training [8].

Avicenna and Alphonsi Borelli (writers of the earliest work on the physiology of the locomotor system) made significant contributions to the early development of Sports Medicine during the Christian period [3].

Andry considered the pioneer of Orthopedics, emphasizes the need for workouts for children in the 18th century in France (1743). After a century, Edward Hitchcock establishes the first Physical Education School.

Throughout the twentieth century, medical organizations focused on the Olympic Games, particularly after the Winter Games in Montreaux, Switzerland, when the International Federation of Sports Medicine (FIMS) was established [3,9].

In Brazil, the Paulista Society of Sports Medicine (SPAMDE) was founded in 1942, and the Brazilian Federation of Exercise and Sports Medicine, which later became the Society of Exercise and Sports Medicine, was founded in 1962 (SMBEE). It should be noted that, despite technological advances in the field, this medical specialty is still relatively new; it first appeared in Sao Paulo at the end of the 1930s to verify the absence of diseases in athletes, sparking interest in the effect of physical activity and sport on health and thus strengthening the sport and health binomial [10] .

For decades, different techniques for understanding the metabolic responses to physical stress have been researched, mostly in top athletes, using exercise and food programs to create changes in metabolism [11]. In addition, medical thermography is being developed for metabolic evaluation, injury diagnosis, and prevention.

Sedentism and poor eating are the leading causes of mortality, outnumbering smoking. Obesity alone was responsible for around 16.6% of fatalities in the United States in 2000, while smoking was

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responsible for 18.1%. Physical exercise is a challenge for the human body, resulting in integrative changes in the physiological system, particularly the cardiovascular and respiratory systems, which are vital for performance and endurance [12].

Sports medicine is a difficulty for researchers, investigators, and sponsors working in Clinical Research in Brazil in the twenty-first century. According to Resolution No. 196 of October 10, 1996 [13], clinical research refers to any research aimed at gathering data on humans. This therapy is supported by the existing Resolution no. 466 of 2012 [14], which specifies that any research involving human people in their totality or in part, directly or indirectly, including the administration of their data, information, and/or biological materials, must comply with legislation.

In this context, clinical research in sports medicine necessitates the establishment of a research center, a physical space that will be used by a qualified team to carry out the protocol, aiming to meet its requirements and provide assistance to the research participant safely and ethically safe and ethical manner. Good Clinical Practices (BPC) must guide the management of the research center and its team, according to the Guide of the International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use (ICH), E6 (R1 and R2) [15], in which The Brazilian Health Regulatory Agency (ANVISA), the only health entity in Latin America, has been a member of the Management Committee since 2019. It has been noticed that the volume and complexity of meeting such standards have increased since the establishment of the ICH GCP Guidance. Sponsors are less interested as a result of the resultant increase in related expenditures and investment. To these difficulties, one might add the challenge of portraying the theme's interdisciplinary and integrality of health professionals in sports medicine clinical research procedures.

A gathering held on the grounds of the Olympic Golf Course in Barra da Tijuca, Rio de Janeiro, on May 6, 2022, marked a significant milestone in this area. This seminar, led by one of the authors (P.C.F.A.), brought together physiotherapists, thermologists, nutritionists, pharmacists, physical trainers, and physicians from several specialties: anesthesiologists, orthopedists, and traumatologists, to discuss the goal of discussing this issue for three hours. The first goal was met: the availability of a physical space for clinical research, the establishment of an institute focused on sports medicine, health, and innovation, and their consequences appear to be a reality, but this is only the beginning of the trip.

The goal of this article is to list the current challenges in the study of Sports Medicine in Brazil based on a review of the literature and the author's experience as a transdisciplinary team in this field, as well as to discuss ways to establish an appropriate and organized course of health activities in this context.

2. Materials and Methods

This study is a qualitative and explanatory literature survey on the issue. Internet platforms such as Google® Academic, PubMed®, MEDLINE®, Lilacs®, BVS® (Virtual Health Library), and Scientific Electronic Library Online (SciELO®, books, and experiences lived by the professionals participating in this research were utilized for data collecting.

During the search for publications and course conclusions, the following descriptors were used as inclusion criteria: sports medicine, transdisciplinarity, clinical research, and sports science, with 10 years period span (2012 to 2022). This study was conducted from May 6, 2022, until September 16, 2022.

The data acquired were analyzed by selecting relevant information, reading and interpreting the data, and considering relevant themes that matched the ethical requirements, scientific methodology, and significance in the Brazilian present scenario. Articles featuring animal experiments and publications published by researchers living outside of Brazil were excluded from the exclusion criteria.

Table 1 summarizes the inclusion and exclusion criteria.

Every literature discovered was discussed in person and remotely by the authors in a transdisciplinary manner.

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Table 1. Inclusion and Exclusion Criteria.

Inclusion criteria	Exclusion Criteria
Having the descriptors: sports medicine, transdisciplinarity, clinical research, sports science	Experimental studies in animals
Be in the 10-year range (2012 to 2022)	Articles published by researchers residing outside Brazil

3. Results

The bibliographic review yielded 54 scientific publications and five related books. 34 of them were rejected because they met the exclusion criteria, which included: there were ten papers classified as animal experiments and 34 foreign publications, leaving just ten items that met the inclusion requirements.

From 2012 to 2022, ten papers were reviewed in the context of sports medicine in Brazil (Table 2). Four of these articles link Sport to Health, three address the issue of transdisciplinary teams, and three study a specific sport: rhythmic gymnastics, ballet vs volleyball, and jiu-jitsu.

In addition to the found literature, the authors presented certain difficulties and challenges in Sports Medicine that they thought were significant in Brazilian contemporary times and classified them into four categories, which are shown in Chart 1.

Table 2. Articles in the context of sports medicine in Brazil (2012-2022).

Area	n	Articles
Sports and Health	4	• The effect of the protective face mask on cardiorespiratory response during aerobic exercise , Prado DML et al, 2021 [10] • Six-minute walk test as a resource for prescribing high-intensity physical training for patients with chronic obstructive pulmonary disease , Rodrigues ALL., 2016 [27] • Building a new concept in metabolic studies in exercise science , Bassani A, Cameron LC, 2014 [9] • Immediate effects of whole-body vibration exercise on hemodynamic, hormonal parameters and oxidative biomarkers in sarcopenic elderly: a randomized controlled clinical trial , Paula FA de, 2021 [26]
Transdisciplinary teams	3	• Paraense athletes' perceptions of abuse: a qualitative study in three countries with lower resources , Rutland EA et al, 2021 [23] • Effects of Concurrent Training on Obese Elderly Women Participating in an Interdisciplinary Health Program , Costa BVPL, 2013 [24] • Brazilian sports governance challenges: the case of the National Training Network , Almada VE et al, 2017 [25]
Specific sport *rhythmic gymnastics, ballet versus volleyball, and jiu-jitsu*	3	• Risk behaviors for relative energy deficiency in sport in high-performance young Brazilian rhythmic gymnasts, Marques IL et al, 2021 [14] • Cortical processing patterns in spatial cognitive task performed by individuals with different perceptual-motor training (ballerinas x volleyball players) , Daronch C, 2016 [15] • Effect of sports training on residents of areas of social vulnerability: a study using heart rate variability (HRV) and biofeedback , Silva Junior RM da, 2020 [16]

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1.	Publication of the largest number of national studies.
2.	Production of integrated knowledge.
3.	Propose sport and movement as a prophylaxis tool.
4.	Study and develop better therapeutic options.

Chart 1. Problems and challenges in Sports Medicine.

4. Discussion

Because there were few publications on the topic chosen for this research, which focused on papers published in Brazil, it was important to incorporate books and discussions based on the authors' actual experiences.

The number of topics presented as problems in the field of sports medicine was few, but they were complicated. The first stage in creating health initiatives that will affect not just patients and health professionals, but the entire Brazilian community, is to create a list of challenges.

4.1. Publishing of the Greatest Number of National Studies Possible

When it comes to the difficulty of promoting more national publishing of research, it is vital to divide the topic according to the provenance of these studies. In the country, there are two sorts of health-related scientific research. The first experimental, with companies such as University of São Paulo (USP), FioCruz, and University of Campinas (Unicamp), which, despite little resources, contributes considerably to global scientific output, with in vitro and in vivo work in animals, with no major ethical or financial barriers to execution of its ideas.

The largest issue emerges when these theories are translated into practice, with in vivo research applied to the daily lives of physicians, physiotherapists, and physical trainers. There are still financial constraints that directly interfere with the results in the public universe of service provision, where research information is extracted, such as the time between injury, imaging examination, diagnosis, and surgery, the quality of the material used for the procedure, and the quality of rehabilitation resources. However, in the private world, it is common for patients to be prejudiced against undergoing studies because they are already "paying for a certain procedure," in addition to a lack of interest for those who use this system solely for financial gain, not to mention the interested bias that may also exist.

Only public colleges encourage additional income for scientific production or obtaining a master's or doctorate, restricting this crucial stimulant to the researcher. Increasing public-private cooperation, particularly between private colleges and government agencies, might help to reduce these roadblocks. These remunerations remain low, putting the country in danger of brain drain, or brain drain to countries where research is promoted [17].

The absence of uniformity of data gathering methods is also implied in this item, but it merits more examination because it is the foundation of everything. A manager can examine the characteristics and shortcomings in his company's service and productivity using an Application Programming Interface (API), which is beneficial for hospitals, health centers, and laboratories. The notion of health decentralization in the Brazilian Unified Health System (SUS), in which towns, states, the Federal Government, and universities do not speak the same language, makes standard data collection impossible, decreasing inter-institutional partnerships and making all of this work herculean. In other words, we are dealing with self-referential health systems that are still unable to confront each other in their social contexts [18-20].

Certain health plans are already reinventing the management paradigm using White Label APIs, enhancing service quality, and even allowing work to be generated in this line. It still needs to bring this to the SUS in a more thorough manner.

Concerning Medical Ethics Committees, this is mostly an issue in hospitals that lack a researcher profile or a link with colleges and institutions. There is frequently a requirement to submit a project to more than one committee, or small disputes over the issue cause publication to be delayed and the

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researcher's stimulus to be removed. The major problem for these Committees is to ensure that research is conducted by ethical principles while not impeding their progress [21].

Lastly, there is a bias between Brazilian scholars and the national output itself in this difficulty of national publishing. Brazilians are only infrequently mentioned in the literature [22]. The Impact Factor (IF) is the most generally used metric to assess the quality of a scientific publication, and it is based on the citation of its works in other research as positive feedback that raises the quality with which they are acknowledged, both the published work and the cited work. Disillusionment with the quality of resources, discontent with public health policy, or simply the belief that "what comes from outside is better" can all contribute to this bias. But, to increase the quality of Brazilian scientific papers, this culture must begin to shift. It is vital to respect the nation's hard effort

4.2. Development of Integrative Knowledge

It is difficult to produce integrated knowledge through an interdisciplinary or even transdisciplinary team. The development of a Care Group or even a Transdisciplinary Research Group involves a complicated set of steps, all of which need effective communication among team members [3]. Regarding the origins of the term "communication", stems from Latin communication, which means something like "to make common", yet, it would also be ascribed to the meaning "the act of sharing, dividing, distributing".

Bringing this concept of making common and sharing, the great difference in structuring a Transdisciplinary Group would be related to the member's ability to contribute to all projects together, with intense communication, interaction, and the absence of hierarchical castes among the members, except for the group leader. When considering various multidisciplinary or interdisciplinary organizational structures, the members typically have unique and separate actions, creating an analogy, as if each member constructed a piece of the puzzle, eventually attempting to fit everything together in a desirable conclusion.

The scientific literature lacks proof for the transdisciplinary notion, however, some writers highlight significant elements in the establishment of a health research group that may be generalized to transdisciplinary functioning. According to Bakheit (2009) [21], group composition and work climate are extremely important, as large research groups in the health field, where individuals have diverse skills and age groups, tend to be more productive, probably because they provide opportunities for contacts and stimuli, adapting the possible calm and experience of some to the impulsiveness of others.

Bland & Ruffin IV (1992) [22] compiled a list of topics for the proper functioning of the group and an environment conducive to research: clear objectives for project coordination; positive group climate; assertive leadership participation; decentralized organization; frequent communication between members; accessible human resources; group sufficiency in terms of intellectual diversity and training areas, age groups, and several researchers; appropriate remuneration. While considering these subjects, two themes emerge: the necessity of communication and engagement, as well as intellectual variety and age groupings. These are the triggers that would lead to the formation of a Transdisciplinary Group.

Although there are various gears to fit together to achieve a shared goal, it is up to each researcher or health service provider to share each project's progress and discuss with the group, with humility and respect, as the Transdisciplinary Group will only operate with synergism and companionship. Rutland et al, 2021 [23] explored the athlete's dilemma in a transdisciplinary context, to achieve the goal of a safe, inclusive, and equitable sport. According to Costa, 2013 [24], integrated health monitoring improves the quality of life, psychological symptoms, and behavioral composition of older and obese women. According to Almada, 2017 [25], the study of sports in Brazil is a highly complex environment that requires reinforcements in public administration as well as specialized forums for monitoring and development.

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4.3. Suggest Athletics and Exercise as a Preventive Measure

The Pelé Law, an essential prophylactic mechanism, is in effect to encourage and increase the goal of encouraging and increasing performance in sports activities. It is crucial to note that each modality involves distinct training and preparation, in addition to historical, sociological, economic, and geographic challenges and conflicts of interest, which will impact the growth and relevance of particular modalities in disease prevention. [25]

Prophylaxis is the root of the term Sport and Health. Several Brazilian writers wrote dissertations or articles on this issue in this context. Bassini and Cameron (2014) [9] investigated the human body's ability to defend the central nervous system against harmful hyperammonemia during acute and chronic exercise. Such a study was conducted using simulations and resulted in a database that may be accessed since it covered several methodological gaps between systems biology and translational medicine.

In his dissertation, Paula (2021) [26] investigated the effect of physical activity by whole-body vibration exercise in individuals with and without sarcopenia. In patients with sarcopenia, randomized crossover research yielded rapid benefits. This technique caused considerable heart rate fluctuation in both groups.

4.4. Investigate and Create Improved Therapeutic Choices

Rodrigues ALL (2016) [27] utilized the six-minute walk test to prescribe high-intensity exercise for patients with chronic obstructive pulmonary disease who had favorable findings in the following questions: lung function (spirometry), exercise capacity, dyspnea, body composition, and inspiratory muscle strength. All criteria considered the patient's condition before and after 12 weeks of training three times a week.

For the first time, Gomes et al. (2005) [28] revealed a link between infrared imaging and ultrasonography technologies in the topographic detection of musculoskeletal injuries in athletes. They demonstrated the significance of combining functional assessment modalities such as thermography in the early detection of injuries that cannot be documented by ultrasonography.

Because the creatine kinase (CK) biochemical marker cannot detect the anatomical site of the lesion muscle, Bandeira et al. [29] proposed utilizing thermographic images in conjunction with CK to evaluate the amount and location of post-training muscle damage.

The sports scientist's mission is to foster innovation in the hope that it would result in a competitive advantage for our country, but the transfer of scientific knowledge to practice is still quite poor. Certain physiotherapy, psychology, and nursing situations have minimal effect on clinical practice decision-making. It is necessary to reduce this distance by placing professionals and educators in clinical settings to experience daily life, exchange, and exchange of experiences between professionals/educators and field professionals, and to encourage continuing education in the workplace to develop better therapeutic options.

Problem-based learning and evidence-based practice are two of the most effective techniques to promote. Coaches must also be aware of the significance and applicability of sports research in the rehabilitation of athletes who are resuming activities. The main barriers highlighted by the trainers are the lack of direct access to researchers. Countries such as Australia, Canada, and China stand out as being at a higher level of sports science and the everyday lives of coaches and athletes than Brazil, but still, confront constraints in the practical application of scientific information.

5. Conclusions

In Brazil, it is clear that scientific research on sports is only proved when used to improve the quality of life in patients with impaired health, and it is still very limited in numerous sports modalities for the improvement of high-performance athletes and even injury prevention.

Sports science and medicine aid in understanding human functioning and physiology, as well as how to work on physical fitness in various situations, such as after an accident. However, it is expected that with a transdisciplinary approach, the divergences between the real world and science

will be reduced, bringing an end to dogmatism, prejudices, and theoretical, increasing the scientific nature of the sport, bringing competitive advantages, improving training and performance, and managing the athlete's health, all of which will contribute to the development of sports medicine.

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