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The Ethical Compass: Establishing Ethical Guidelines for Research Practices in Sports Medicine and Exercise Science



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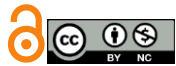
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ABSTRACT

Objective: Research in sports medicine and exercise science has experienced significant growth over recent years. With this expansion, there has been a concomitant rise in ethical challenges specific to these disciplines. While various ethical guidelines exist for numerous scientific fields, a comprehensive set tailored specifically for sports medicine and exercise science is lacking. Aiming to bridge this gap, this paper proposes a comprehensive, updated set of ethical guidelines specifically targeted at researchers in sports medicine and exercise science, providing them with a thorough framework to ensure research integrity. **Methods:** A collaborative approach was adopted, involving contributions from a diverse group of international experts in the field. A thorough review of existing ethical guidelines was conducted, followed by the identification and detailed examination of 15 specific ethical topics relevant to the discipline. Each topic was discussed in terms of its definition, consequences, and preventive measures.

Results: The research in sports medicine and exercise science has grown significantly, bringing to the fore ethical challenges unique to these disciplines. Our comprehensive review identifies 15 key ethical challenges: plagiarism, data falsification, role of artificial intelligence chatbots in academic writing, overstating results, excessive/strategic self-citation, duplicate publications, non-disclosure of conflicts of interest, image manipulation, misuse of peer review, ghost and gift authorship, inadequate data retention, data fabrication, falsification of IRB approvals, lack of informed consent, and unethical human or animal experimentation. For each identified challenge, we propose practical solutions and best practices, enriched by the diverse perspectives of our collaborative international expert panel. This endeavor aims to offer a foundational set of ethical guidelines tailored to the nuanced needs of sports medicine and exercise science, ensuring research integrity and promoting ethical responsibility across these vital fields.

Conclusion: This article represents a seminal contribution to the establishment of essential ethical guidelines specifically designed for the fields of sports medicine and exercise science. This article charts a clear course for researchers, clinicians, and policymakers by integrating these ethical principles at the heart of our scholarly and clinical activities. Consequently, it envisions a future where the principles of research integrity and ethical responsibility consistently inform every scientific discovery and every clinical engagement.

Keywords: Academic Integrity, Authorship Standards, Publication Ethics, Research Misconduct, Sports Medicine Ethics, Transparency in Research

1. Introduction

Scientific research in sports medicine and exercise science is foundational to our understanding of human physiology, performance, and overall health (1). Over the past decades, this discipline has witnessed substantial growth, leading to transformative discoveries, new instrument validations (2) and innovations (1). These advancements have reshaped athletic training, rehabilitation, and preventive care (3) and have influenced global public health policies and guidelines.

The rise of academic research in sports medicine and exercise science has brought a set of ethical challenges (3-5). Up to the February 2024, numerous ethical guidelines have been established for different scientific fields, but there is a clear lack of coverage in some areas of the literature (3-5). However, there is a lack of comprehensive guidelines tailored to sports medicine and exercise science that address the specific ethical challenges encountered by the researchers in this field. Scientific fraud and misconduct, although consistent across various disciplines, have been particularly concerning in sports medicine and exercise science research. While researchers are often aware of such misconduct, they often refrain from reporting it, further exacerbating the issue (6, 7). The reasons for committing fraud can range from personal ambitions and financial interests to external pressures for promotion and competition (6). The importance of ethical integrity in research cannot be overstated. Ethical breaches, whether intentional or inadvertent, undermine the credibility of findings, erode public trust, and, in some cases, harm participants. For sports medicine and exercise science, where research often directly impacts health and performance, the stakes are even higher (8).

The Committee on Publication Ethics (COPE) has been a cornerstone in establishing standards for research integrity across diverse disciplines (9, 10). Since its establishment in 1997, COPE has offered vital advice to editors and publishers on all facets of publication ethics. Their guidelines have served as a reference point, ensuring that the broader scientific community upholds the highest ethical standards. However, while COPE's principles provide a robust starting foundation, the unique nature of sports medicine and exercise science research necessitates custom-designed guidelines (11, 12). The dynamic interplay among athletes, patients, coaches, medical professionals, managers, and researchers presents various scenarios that general ethical guidelines may not fully encompass (13).

To address these shortcomings, the authority and involvement of Institutional Review Boards (IRB) and other key stakeholder bodies in sports medicine and exercise science should be strengthened. Indeed, clear operational policies to address research misconduct, coupled with a research culture based on integrity, openness, and honest work, are imperative (6). On the other hand, excessive and superfluous ethical guidelines may pose further burdens on the research process and the advancement of knowledge. These guidelines must therefore be carefully reviewed and assessed to balance firm scientific standards with flexible regulations, as ethics permit.

While foundational principles exist, such as those set forth by COPE (14, 15) and others (3, 4), there is still a distinct gap in updated guidelines specifically tailored to sports medicine and exercise science. In this collaborative effort, we review the current ethical standards, addressing the unique challenges of the field in a holistic manner, considering a wide range of aspects that other guidelines might have overlooked. Our objective was to provide researchers with a clear framework, ensuring integrity and respect throughout the research process, from participants to policymakers. Marking a pioneering effort in the field of sports medicine and exercise science, we sought to introduce a comprehensive set of ethical guidelines targeted at researchers in this field.

2. Methods and Materials

2.1 Literature review

A comprehensive literature review was undertaken to identify and analyze current ethical guidelines, challenges, and best practices in sports medicine and exercise science. Utilizing databases such as PubMed, Scopus, and Web of Science, a combination of relevant keywords and Boolean operators was applied to refine the search, covering studies up to March 2024. The selection of keywords comprehensively included 'ethics,' 'sports medicine,' 'exercise science,' 'research integrity,' 'academic honesty,' 'plagiarism,' 'data fabrication,' 'peer review,' and 'conflict of interest,' among others. This review included only peer-reviewed articles and institutional documents, to identify established ethical principles and confront challenges in their application.

2.2 Formation of an expert panel and authorship

An international panel of experts in sports medicine and exercise science was formed. These experts, who are also co-authors of this manuscript, were invited based on their significant contributions to the field and their vast experience in sports medicine and exercise sciences. Representing a diverse range of regions (North America,

Europe, Asia, Africa), specialties (biomechanics, exercise physiology, sports psychology, nutrition, sports medicine, sports performance and athletic training), and sex, each expert was invited to ensure a holistic perspective on the ethical challenges in the field (Table 1). In adherence to COPE's guidelines on authorship, every expert made substantial contributions to the conception, design, and revision of the work.

Table 1. Distribution of expert panel members by region, specialty, and sex

Category	Subcategory	Frequency
Region	America	9
	Europe	11
	Asia	9
	Africa	11
Specialty	Biomechanics	7
	Exercise Physiology	8
	Sports Psychology	8
	Nutrition	2
	Sports Medicine	9
	Athletic Training	6
	Sex	Male
	Female	5

2.3 Quasi-qualitative development of the guidelines

The formulation of the guidelines was a carefully managed, quasi-qualitative process involving a group of international experts in sports medicine and exercise science. The main objective was to create guidelines that were comprehensive and applicable across different areas of expertise and geographic regions.

Each expert received a detailed brief at the start, outlining the project's objectives and the breadth of the ethical guidelines. This brief also provided clear directions on effective contribution, urging experts to pinpoint existing gaps, bring forward ethical challenges unique to their experience, and suggest feasible solutions. Emphasis was placed on the importance of constructive feedback and the iterative nature of refining the guidelines.

The engagement of experts followed a stepwise approach to ensure a deep and inclusive review of contributions. Initially, experts had two weeks to review a preliminary draft and provide initial feedback. This stage led to virtual discussions, facilitating real-time idea exchange and

consensus on more complex issues, with experts dedicating approximately 8-10 hours to this endeavor.

Subsequent phases saw iterative feedback rounds on revised drafts, each lasting about one week. This structure allowed for continuous refinement based on collective input, ensuring the guidelines evolved to be more representative and actionable.

From the start to the final consensus, the process took about five months. This period was crucial for thorough review, discussion, and step-by-step improvements, culminating in guidelines that were both detailed and practical. The final consensus meeting, where the expert panel formally agreed on the guidelines, marked the conclusion of a process characterized by structured collaboration and shared commitment to ethical clarity in sports medicine and exercise science research.

3. Results

The literature review, combined with the insights from the expert panel, led to the identification of 15 key ethical challenges that require careful consideration when conducting research in sports medicine and exercise science.

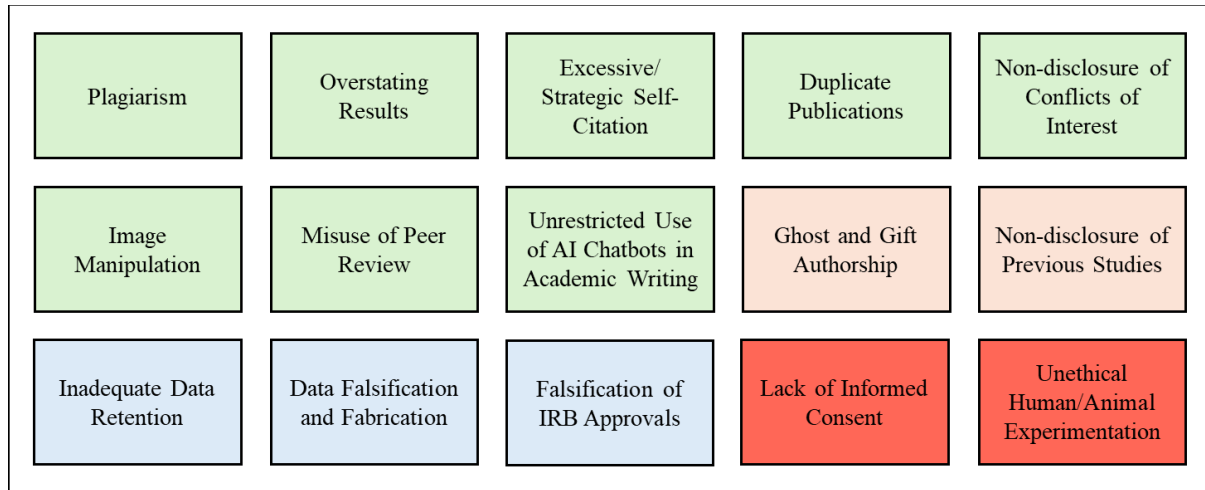


Figure 1. Summary of the ethical challenges in sports medicine and exercise science research as identified by the expert panel

Figure 1 presents these challenges, color-coded to indicate their frequency of occurrence: green for the most common, followed by orange, blue, and red for the increasingly fewer common issues.

These challenges include issues that compromise academic writing and publishing integrity, such as plagiarism, overstating results, excessive or strategic self-citation, duplicate publications, undisclosed conflicts of interest, image manipulation, peer review misuse, and the unregulated use of artificial intelligence (AI) chatbots in academic writing. Challenges related to authorship principles, like ghost and gift authorship and not disclosing previous studies, were also identified. Concerns in research methodology governance, such as insufficient data retention, data falsification and fabrication, IRB approval falsification, and undisclosed conflicts of interest, were highlighted. Additionally, ethical challenges concerning participant rights and welfare, including the lack of informed consent and unethical experimentation on humans or animals, reached a consensus among experts.

4. Discussion

In this section, we will discuss each ethical challenge in detail, focusing on its definition, consequences, and potential solutions or recommendations.

4.1 Plagiarism

Plagiarism is a significant concern in all academic disciplines, and sports medicine and exercise science are no exception. It involves using someone else's work, ideas, or findings without proper acknowledgment (16-18). Given the high stakes in sports medicine and exercise science research,

accurate and original materials form the backbone of evidence-based practices that guide clinicians, trainers, and athletes in their daily decisions and routines. The consequences of plagiarism in this field are, potentially, various and numerous (17, 19). Beyond the immediate academic repercussions, such as paper retractions and reputational damage (20), there is a broader impact on the scientific community. Plagiarized work can mislead other researchers, leading to wasted resources on redundant or misguided studies (17).

To prevent plagiarism, it is essential to emphasize the importance of proper citation practices from the earliest stages of academic training (21, 22). Institutions and journals can employ plagiarism detection tools to screen submissions, ensuring the originality of published work (23). Moreover, fostering a culture valuing original thought and rigorous academic honesty is crucial (24). Researchers should seek guidance when unsure about citation practices or when using sources as foundational material for their work.

To further mitigate the risk of plagiarism, establishing clear, actionable guidelines is crucial. Among the foremost measures is defining explicit citation rules. Researchers should be acquainted with the correct methods of citing different types of sources, such as articles, books, and digital content. Equally crucial is the instruction on proper paraphrasing techniques. Researchers must understand that paraphrasing involves more than merely altering a few words from the source material; it requires a comprehensive rephrasing and restructuring of the original text while retaining the original intent and meaning, coupled with the necessary citation. The application of quotations also demands attention. Researchers should be instructed on the

judicious use of direct quotes, integrating them into their texts with proper acknowledgment, and limiting their usage to instances where the original wording is critical to the conveyed message.

Incorporating plagiarism detection software as a standard part of the research submission process is recommended (23), not as a substitute for careful review, but as an additional check. However, it is pivotal for researchers and institutions to critically interpret these software findings, acknowledging the limitations and the potential for false positives (25). Moreover, the promotion of educational initiatives such as workshops, seminars, and access to online resources focused on research ethics and proper citation practices is fundamental in adopting a culture of academic honesty. Awareness of institutional policies on plagiarism is another cornerstone; researchers must be well-informed about the policies governing their conduct, with institutions making these guidelines easily accessible.

Addressing the issue of self-plagiarism is also essential; researchers must understand that repurposing their previously published work without appropriate citations is unethical. Guidelines on how to reference prior works correctly can help mitigate this issue. Finally, adherence to publication ethics plays a crucial role. Researchers should opt for reputable journals with clear policies against plagiarism and unethical practices, ensuring that their work contributes to the field's integrity.

4.2 *Overstating Results*

The accurate presentation and interpretation of research findings are crucial for the advancement of knowledge in sports medicine and exercise science (26). When results are accurately reported, they can inform best practices, guide clinical decisions, and shape training protocols. However, there is a growing concern about the tendency of some researchers to overstate the significance of their findings, often termed as "overhyping" or "overstating" (27).

Authors in the scientific community, by overstating their findings, may inadvertently skew the perceived body of knowledge and unduly affect clinicians, policymakers, the media, and the general public, even without the intention of doing so (27). Overstating can manifest in various ways. For instance, a study might find a marginal improvement in muscle recovery with a specific intervention, but the authors might present it as a revolutionary breakthrough. Similarly, preliminary or exploratory studies might be portrayed as definitive evidence, even when further research is warranted.

The implications of overhyping are multifaceted. For athletes and practitioners, it can lead to the adoption of ineffective or suboptimal strategies, potentially compromising performance or recovery (28). For the scientific community, it can skew the perception of evidence, creating a distorted research landscape (29). Moreover, when overhyped results fail to be replicated in subsequent studies, it can erode public trust in scientific research (27).

To address this issue, it is necessary to promote a culture of cautious interpretation and balanced reporting. Journals can play a pivotal role by ensuring rigorous peer review, where reviewers are vigilant about potential overstatements. Additionally, training researchers in responsible communication, emphasizing the distinction between exploratory and confirmatory research, understanding the implications of using causal language, and encouraging transparency about the limitations of a study can reduce the propensity to overstated results.

4.3 *Excessive/Strategic Self-Citation*

Self-citation consists of authors referencing their own previous works in new publications (30). While self-citation is not essentially unethical and can be appropriate in many instances, excessive or strategic self-citation to inflate citation metrics is problematic (31, 32).

In sports medicine and exercise science academic research, researchers consistently expand upon their previous findings, contributing to a cumulative body of knowledge. Striking a nuanced balance becomes imperative in this process, necessitating the acknowledgment of prior work while concurrently avoiding any manipulation in the citation practices (32). This equilibrium is vital for adopting academic integrity and ensuring that the evolution of knowledge in these fields remains transparent and credible.

Excessive self-citation can lead to skewed citation metrics (33), giving a false representation of the impact or relevance of a researcher's work. This can mislead readers, other researchers, and institutions that rely on citation metrics for evaluations. Furthermore, it can introduce potential bias in literature reviews, as researchers might prioritize their own findings over others, leading to a narrow or skewed representation of the field (34).

To address the challenge of excessive self-citation, incorporating transparency in conflict-of-interest disclosures with specific constraints on self-citation practices becomes essential. While authors should reference their prior work

when it offers critical context or relevance, implementing a cap, such as not allowing self-citations to exceed 10% of total citations, could serve as a preventive measure against undue self-referencing. Moreover, using metrics that exclude self-citations, akin to the h-index variant available on platforms like ResearchGate, provides a more accurate assessment of a researcher's impact, untainted by self-citation practices. This approach, coupled with robust educational initiatives on the ethical dimensions of self-citation and the importance of engaging with a broad spectrum of scholarly work, will ensure research in sports medicine and exercise science is evaluated on its true merit.

4.4 Duplicate Publications

Duplicate publication, colloquially referred to as "salami slicing," (35) involves publishing the same research in multiple journals or dividing a single study into multiple papers to increase the number of publications (36). In sports medicine and exercise science, this practice can be particularly problematic. For instance, a researcher might divide the results of a single intervention study on athletes into multiple papers, each focusing on a different outcome measure, even if they could be effectively presented in a single comprehensive article. However, when a study results in a substantially large database, it is often problematic and sometimes impossible to publish all the results in the same manuscript. Duplicate publications pose inherent risks and potential harm to both research participants and clinicians involved in the study. Firstly, redundant dissemination of similar findings can mislead clinicians by creating a false sense of robust evidence. This can result in inappropriate clinical decisions, impacting participants adversely. Secondly, participants may be exposed to unnecessary risks if data duplication leads to the overestimation of treatment effects or safety measures. Moreover, it compromises the ethical foundation of research, eroding trust in the scientific process. Clinicians relying on duplicate publications may inadvertently subject patients to interventions based on flawed or exaggerated data. The cumulative impact extends beyond individual studies, influencing systematic reviews and meta-analyses, further distorting evidence-based practices in sports medicine and exercise science. Addressing these concerns requires stringent editorial examination and ethical oversight to safeguard the integrity of research and the well-being of participants and clinicians alike. In this case, authors should declare that in the multiple papers resulting from the study by transparently informing

the readers of the multiple papers associated with the same database.

The consequences of such practices are multifaceted. Duplicate publications can create a misleading impression of a researcher's productivity and contribution to the scientific community. When similar findings are disseminated across multiple publications, it may give the appearance that the researcher has conducted more diverse and extensive research than is genuinely the case. This inflation of perceived research output can lead to an overestimation of the researcher's impact and expertise. Consequently, they may receive more credit and recognition than warranted, potentially influencing academic evaluations, funding decisions, and career advancement. This may compromise the integrity of academic metrics and distorts the allocation of resources and opportunities within the scientific community. Addressing this issue requires a process towards recognizing and rewarding the substantive and original contributions of researchers rather than merely the quantity of their publications. Additionally, it can lead to potential copyright issues, especially if the same data is presented in different journals without proper cross-referencing. More significantly, segmenting related data into different publications diminishes the overall quality of the research. This practice may result in incomplete and potentially inaccurate interpretations of findings and conclusions.

To combat the prevalent issue of duplicate publications or "salami slicing" in sports medicine and exercise science, we propose an innovative set of guidelines that use AI and advanced technological solutions (37). By adopting AI-assisted tools similar to plagiarism detection software, these guidelines aim to access submissions for duplicated research designs, methodologies, and participant demographics, thus identifying potential instances of unethical publication practices. Furthermore, the guidelines advocate for the mandatory disclosure of comprehensive datasets and previously published works derived from the same research, facilitating editorial and peer review processes in assessing the submission's originality and ethical compliance. Encouraging the publication of extended data supplements online and the development of multi-study research articles offers a viable solution for presenting large-scale research findings comprehensively, addressing the challenge of extensive datasets. Additionally, the introduction of mandatory ethics statements on data segmentation by authors would provide justification for any separate articles arising from a single study, ensuring transparency and upholding the integrity of scientific contributions.

4.5 Non-disclosure of Conflicts of Interest

Conflicts of interest arise when personal, financial, or other considerations have the potential to compromise or bias professional judgment and objectivity in research (38, 39). In the field of sports medicine and exercise science, these conflicts can manifest in various ways. For instance, a researcher might have financial ties to a company that produces a particular supplement or piece of sports equipment being studied. Such affiliations can inadvertently influence the design, conduct, or reporting of research.

The repercussions of undisclosed conflicts of interest can be severe. Biased research outcomes can mislead clinicians, athletes, and the general public, potentially resulting in suboptimal or even harmful interventions. Moreover, when conflicts of interest come to light, they can erode public trust in research, tarnishing the reputation of the researchers, institutions, and journals involved (40).

To mitigate the risks associated with conflicts of interest, transparency is paramount. Researchers should be required to disclose all potential conflicts, whether they are financial, personal, or professional. Journals and conferences can enforce this by requiring detailed disclosure statements from all authors and presenters. Additionally, third-party audits can be conducted to ensure disclosed conflicts are appropriately managed and do not unduly influence research outcomes.

4.6 Image Manipulation

Visual representations, including images, graphs, and figures, are integral components of research articles in sports medicine and exercise science. They offer a concise way to present complex data sets, biomechanical analyses, or physiological changes, aiding in the reader's comprehension. Given the reliance on these visuals, their authenticity and accuracy are of utmost importance.

In the context of sports medicine, a focus on distinctive imaging becomes important due to the nuances of human physiology and performances are extremely complicated (41). Visualizations, such as human images, provide a deep understanding of the physical aspects of athletes. Further exploration revealed that visual representations illustrating the process of injury healing, such as a magnetic resonance imaging (MRI) displaying the recuperation of a previously injured anterior cruciate ligament (ACL), became crucial in comprehending the dynamics of rehabilitation. Exploring the field of muscle analysis using sophisticated methods such as MRI and dual x-ray absorptiometry (DEXA) offer

an unmatched viewpoint on muscle thickness and composition, which is essential for refining accurate training regimens. Furthermore, the importance of being vigilant and addressing concerns such as picture modifications that could affect diagnostic accuracy is highlighted by the necessity to pay attention to potential manipulations in these photos. The act of modifying a graph that depicts the physiological reaction to a particular workout program has the potential to result in inaccurate training suggestions, which may inhibit an athlete's performance or delay their recovery process. Nevertheless, there have been occurrences in which researchers, whether unintentionally or deliberately, have made alterations or distortions to photographs (42). Such modifications might involve enhancing certain features, omitting unwanted data points, such as excessive minorizing, or even duplicating sections of an image to present a more favorable outcome.

To ensure the authenticity of visual data, it is essential for journals in the field to establish and enforce strict guidelines regarding image submission. This might include requiring raw data or original images, stipulating the types of permissible adjustments, and using software to detect potential alterations (43). Furthermore, educating researchers on the ethical implications and potential consequences of image manipulation can foster a culture of transparency and integrity in the presentation of visual data.

4.7 Misuse of Peer Review

The peer review process is a cornerstone of academic publishing, ensuring the quality, validity, and relevance of research before it reaches the broader scientific community. In sports medicine and exercise science, where findings can directly influence clinical practices and athletic performance, the integrity and the credibility of the peer review process is fundamental.

However, there have been instances where this process has been manipulated or misused. Some authors might attempt to influence the selection of reviewers to get favorable feedback. Others might submit fake reviews under pseudonyms to expedite the acceptance of their manuscripts (44). There are also cases where reviewers, due to conflicts of interest, provide biased feedback, either overly positive due to personal relationships or unduly negative due to competitive reasons.

Such manipulations compromise the quality of published research. If flawed or biased studies get published, they can mislead clinicians, trainers, and athletes, leading to

suboptimal or even harmful practices. Furthermore, the trust in the scientific process erodes when the community perceives that the peer review process can be easily manipulated.

Additionally, conflicts of interest can significantly compromise the integrity of the research process during the peer review process. These conflicts can be multifaceted, ranging from financial ties to personal biases. One of the primary concerns is the potential for biased peer reviews. A reviewer might have undisclosed financial ties to a company that stands to benefit from the acceptance or rejection of a manuscript. Additionally, intentional delays in the review process, where a reviewer, due to a conflict of interest, might intentionally delay their review to give a competitive edge to their own research or to hinder the publication of competing findings. Such delays can be detrimental, especially in fast-evolving fields where timely publication is crucial. Another concern is the potential for "friendly reviews." Here, a reviewer might have a personal relationship with an author and, as a result, provide a less critical assessment of the manuscript than warranted. This compromises the objectivity of the review process and can lead to the publication of subpar research. On the other side, there is the risk of "hostile reviews." A reviewer might harbor personal animosities or professional rivalries and provide an unduly harsh review, seeking to block the publication of a deserving manuscript (44).

To address the multidisciplinary challenges related to sports medicine and exercise science, journals can significantly enhance the peer review process by adopting strategies that adopt transparency and accountability. The adoption of open peer-review systems, where both authors and reviewers are identified and their comments made publicly accessible, represents a pivotal step toward mitigating biases, though it is not without its limitations. Further transparency can be achieved by publishing reviewers' names alongside articles, reducing the chances of overly favorable reviews. Moreover, requiring detailed conflict of interest disclosures from both reviewers and authors ensures the identification and appropriate management of potential biases. Should conflicts of interest emerge post-publication, journals must be prepared to implement corrective measures, such as publishing errata, retracting publications, or imposing submission bans on those found in breach of ethical standards. Given the multidisciplinary nature of sports science and exercise medicine, it is crucial that journal editors exert additional effort in selecting reviewers. One effective strategy, as practiced by publishers,

such as MDPI, involves offering incentives such as open access vouchers to encourage experts within specific disciplines to undertake review tasks, thereby ensuring more informed and relevant evaluations. Furthermore, it is vital to empower and educate researchers on the importance of declining review invitations when the manuscript falls outside their expertise.

4.8 Unrestricted Use of AI Chatbots in Academic Writing

The integration of AI into academic research has been a transformative development (26, 45, 46). Specifically, AI chatbots have been used as tools in academic writing, offering assistance in various tasks (46, 47).

AI chatbots can be particularly beneficial for researchers for whom English is not their first language. They can assist in improving fluency, rephrasing sentences, and ensuring the clarity of the content (43, 48-52). Additionally, these tools can aid in generating keywords, suggesting ideas that might be overlooked, and streamlining various tasks to improve the quality of academic writing (50, 53-56). This assistance can be invaluable in ensuring that research is presented with clarity and effectively.

However, while the benefits are evident, it is essential to approach the use of AI chatbots with caution. The primary concern remains the potential generation of non-original content. Given that these tools rely on broad databases of existing content, there is a risk of producing outputs that closely resemble existing publications. This can unintentionally verge on plagiarism, even if not an exact replication. It is important to note also that AI chatbots should be utilized for tasks involving generating keywords, rephrasing sentences, and streamlining the workflow, but never for writing the substantive content of academic papers, a nuance that many authors may not fully understand.

To ensure academic integrity and transparency, it is advisable for researchers to declare the use of AI chatbots in their work, especially if they have significantly influenced the content. While there might be resistance to such declarations currently, it is anticipated that this will become a standard practice in the near future. As research evolves, transparency about the tools and methods used will be crucial in maintaining trust and credibility. Additionally, editors, journals, reviewers, and academic institutions can play a pivotal role in mitigating the misuse of AI chatbots in academic writing. They could employ AI chatbot detectors or instruct reviewers to be vigilant for certain lexicons indicative of AI chatbot use, especially if not disclosed by

the authors. Such disclosure should be mandatory even for tasks that do not involve writing the entire content. Furthermore, journals and academic institutions could establish guidelines similar to those for plagiarism, wherein the manuscript is screened for AI usage; if the AI-generated content exceeds a certain threshold, such as 10%, it could be flagged for potential ethical review, treating excessive AI dependence akin to plagiarism. This collective approach would reinforce the integrity of academic publishing, ensuring that AI aids the research process without compromising the authenticity of scholarly work.

4.9 Ghost and Gift Authorship

Ghost and gift authorship are two practices that misrepresent the contributions of individual(s) to a research paper (30). Ghost authorship occurs when an individual who made a significant contribution to the research is not listed as an author (57), while gift authorship is when someone is listed as an author without having made a meaningful contribution to the work. The consequences of these practices can be profound. Misrepresentation of contributions can lead to a lack of accountability, especially if issues arise with the research. It can also lead to conflicts of interest, especially if authors are added for strategic reasons, such as increasing the chances of publication in a particular journal. Furthermore, it undermines the trustworthiness of the publication process and the integrity of academic research.

To prevent these practices, it is essential to have clear criteria for authorship. COPE and International Committee of Medical Journal Editors (ICMJE) provide guidelines on this matter. According to COPE (15), for an individual to be considered an author, they should meet specific criteria, including making a substantial contribution to the conception or design of the work, or the acquisition, analysis, or interpretation of data; drafting the work or revising it critically for important intellectual content; giving final approval of the version to be published; and agreeing to be accountable for all aspects of the work. To curtail the unethical practices of ghost and gift authorship in sports medicine and exercise science, this proposal recommends implementing a mandatory authorship disclosure statement that details the roles of each contributor. Additionally, it suggests a verification process whereby journals directly confirm the contributions of all listed authors. The establishment of a public database to document authorship contributions is also advocated. Furthermore, the

development of mandatory educational programs on ethical authorship for researchers is essential. These measures should be complemented by clear sanctions for violations of the guidelines.

4.10 Non-disclosure of Previous Studies

The foundation of scientific research is built upon the cumulative knowledge of previous studies. In sports medicine and exercise science, referencing prior research provides context, validates methodologies, and ensures that new findings are placed within the appropriate framework of existing knowledge. However, there's an emerging concern regarding the omission or non-disclosure of relevant previous studies in some research publications (58).

Such omissions can occur for various reasons. Some researchers might unintentionally overlook pertinent studies due to oversight or limited literature search scope (58). In other instances, there might be a deliberate choice to exclude studies that contradict or diminish the impact of the current research (59). This selective reporting can lead to a skewed understanding of the research landscape and might result in unnecessary repetition of studies or the propagation of incomplete or biased narratives (58).

The consequences of non-disclosure are significant. It can lead to wasted resources as researchers unknowingly replicate existing studies. More critically, it can mislead practitioners and athletes who rely on the latest research to inform their practices and decisions. If they are unaware of prior conflicting or supporting evidence, they might adopt strategies or interventions based on incomplete information (59).

To counteract this issue, it is crucial to emphasize the importance of comprehensive literature reviews in the research process. Researchers should be trained to conduct exhaustive searches, using multiple databases, and considering studies from related disciplines. Journals can also play a role by requiring authors to provide a rationale for the inclusion and exclusion of studies in their literature reviews.

4.11 Inadequate Data Retention

Data retention is a critical aspect of scientific research (60), especially where replication and validation of results are essential. When researchers conduct experiments or clinical trials, they generate vast amounts of raw data, protocols, and other research materials. Preserving research data is vital for result verification and building upon prior

findings. However, it is essential to recognize that such preservation might affect the author's privacy and their right to conduct additional analyses. Maintaining equilibrium between data transparency and individual privacy is a delicate task in the scientific community. Researchers must navigate ethical considerations and respect authors' rights while upholding the principles of reproducibility and data sharing. The responsibility lies with journals, editors and the broader scientific community to establish guidelines that protect both the integrity of research and the rights of authors. However, there have been instances where researchers fail to preserve raw data and other essential research materials (61). This failure can be due to various reasons, including lack of storage resources, negligence, or even intentional deletion to hide questionable results. When data are not adequately retained, it becomes challenging to replicate or verify results, leading to potential mistrust in the published findings (62).

To mitigate these challenges, researchers and institutions can establish clear data retention policies that specify the duration and format for preserving research materials. Promoting the use of data repositories, where researchers can deposit their raw data for public access, can also enhance transparency and trust in the research process. Regular audits to check adherence to these policies can further ensure that data is appropriately preserved, allowing for continued advancement in the field of sports medicine and exercise science.

4.12 Data Falsification and Fabrication

Data falsification and fabrication involve altering or inventing data in research (63, 64). This unethical practice can lead to deceptive findings resulting in ethical implications (64), which, in the context of sports medicine and exercise science, can, conceivably lead to false decision-making in practice, having direct implications on the health and performance of athletes and the general population.

The consequences of data falsification and fabrication are severe (65). Beyond the potential harm to athletes or patients, researchers who engage in this misconduct risk the retraction of their papers, reputational damage, and, in some cases, legal repercussions might also arise, especially if the falsified data leads to harm or financial losses.

Preventing data falsification and fabrication requires a multi-faceted approach (66). Regular audits of research data, transparent data sharing, and promoting a culture of honesty are essential steps in this direction. Researchers should be

encouraged to maintain meticulous records of their data collection and analysis processes, making it easier to verify the authenticity of their findings.

For guidelines, it is suggested that institutions implement strict data management protocols, ensuring all raw data and analysis scripts are preserved for a set period (67). This allows for the replication of studies and may serve as a deterrent against potential falsification. Journals can also play a role by requiring the submission of raw data alongside manuscripts, allowing for independent verification of results such as EXCLI journal (see example (68)). Continuous training on the importance of data integrity and the potential consequences of breaches can further reinforce the value of honest and transparent research. Journal editorial board members should be aware of this, with prior evidence of the erroneous acceptance of completely fabricated data and articles (69). Also, data falsification might be indirectly encouraged by some practices from journals through rejecting negative results, or by a superficial review process. On the other hand, researchers may decide in some cases to exclude outliers or values outside some particular range. It is important to distinguish these exclusions from data falsification. Nonetheless, these exclusions and data manipulations should be transparently reported with the proper justification, elucidating the extent to which these data modifications changed the direction and the power of the results. Awareness of such practices is crucial in encouraging and prompting a scientific environment that prioritizes research integrity and reliability.

4.13 Falsification of IRB Approvals

IRB approvals are essential in ensuring that research involving human participants is conducted ethically and responsibly (70). Falsifying these approvals is a serious ethical misconduct (71) in sports medicine and exercise science, where interventions can have a direct impact on health and performance of athletes. For instance, a study that investigates the effects of a new supplement, training regimen, psychological intervention, if conducted without sufficient ethical clearance could expose participants to unforeseen risks.

At the forefront is the potential harm to study participants who might be exposed to unvetted interventions. Ethical violations of this magnitude can lead to the retraction of research papers, reputational damage to individuals and institutions (9), concomitant to the risk of legal recourse,

especially if participants suffer harm due to the lack of genuine ethical oversight.

To prevent the occurrence of falsified IRB approvals, rigorous verification processes should take place. Journals can mandate the disclosure of IRB documentation during the manuscript submission process, ensuring that the approvals are honest and up to date. Institutions, on the other hand, should maintain a centralized database of all approved projects, allowing for easy cross-referencing and verification.

In terms of guidelines, it is proposed a standardized format to be adopted for IRB approvals that unifies and respects the specifications of each of the specialties that study sports medicine and exercise science (e.g., including QR code for verification), making it harder to forge or alter documents. "To avoid falsified IRB documentation, journals may always require the IRB approval number associated with the institution information that can facilitate straightforward verification. Incomplete or general unspecified statements of the ethical approvals, such as "this protocol was approved by the local IRB committee" should no longer be accepted. Additionally, regular training sessions emphasizing the importance of honest ethical clearances and the potential consequences of breaches can instill a culture of responsibility and integrity among researchers.

4.14 Lack of Informed Consent

Informed consent is a foundational principle in research ethics (72). It ensures participants are fully aware of the nature, purpose, risks, and benefits of a study before they agree to participate (73). In sports medicine and exercise science, obtaining informed consent is crucial, especially when interventions or assessments could impact an individual's health, performance, and/or well-being. For instance, athletes participating in a study testing a new training technique should be fully informed of potential (i) harms, such as injury risks, and (ii) benefits, such as improved performance. Most harms associated with sports medicine research are akin to what participants confront in their regular training and competitive experiences. It is the responsibility of the researcher to inform the participants with the measures implemented to minimize these risks.

When informed consent is not obtained or documented properly, it poses significant ethical and legal challenges (74, 75). Participants might be exposed to risks they were unaware of, leading to potential harm. This oversight not

only violates the trust placed by the participants in the researchers but also can lead to legal repercussions for the later. Moreover, the integrity of the research is compromised, as participants might not have been genuinely willing or might have been coerced into participation (76).

To ensure informed consent is always obtained, researchers should adhere strictly to consent protocols. This includes providing participants with detailed information about the study, allowing them ample time to consider participation, and ensuring full understanding of all aspects of the research. Consent forms should be clear, concise, and free from jargon; ensuring participants fully grasp the implications of their involvement. Given the complexity of protocols and lengthy testing procedures often involved in sports medicine research, the practice of obtaining both verbal and written informed consents is encouraged.

In addressing the critical issue of informed consent within sports medicine and exercise science research, it is essential to implement rigorous guidelines to prevent unethical practices such as coercion or the falsification of consent documents. Enhanced verification processes, where journal editors and review boards can request evidence of consent, alongside the adoption of digital consent platforms, can offer transparent and verifiable means of ensuring voluntary participant involvement. Furthermore, researchers must provide comprehensive accounts of their consent procedures, including measures to ensure voluntariness and participant rights, within their study protocols and publications. Mandatory training for researchers on ethical consent practices, coupled with whistleblower protections and regular independent audits of consent documentation, will reinforce the ethical foundation of research in these fields.

4.15 Unethical Human or Animal Experimentation

The ethical treatment of animals and humans in research is of extreme importance (3). In sports medicine and exercise science, research often involves human participants, and occasionally, animal models (38). Ensuring the welfare and rights of these subjects is not only a moral obligation, but also crucial for the validity and acceptance of the research.

Unethical experimentation can manifest in various ways. For human participants, it might involve not obtaining proper informed consent, exposing participants to undue risks without clear benefits, or not providing adequate care or follow-up. For animals, it might mean not ensuring their welfare, using more animals than necessary, or not adhering

to the principles of the 3Rs (Replacement, Reduction, and Refinement).

The consequences of such unethical practices are notable. Beyond the immediate harm or distress caused to the subjects, there is a broader impact on the scientific community and public trust. Research based on unethical practices is likely to be rejected by reputable journals, and even if published, it risks retraction. Moreover, legal and professional repercussions can follow for the researchers involved.

To prevent such scenarios, a multifaceted approach rooted in ethical principles and oversight mechanisms must be applied. First and foremost, robust ethical review processes, such as IRB for human studies and Animal Care and Use Committees (IACUCs) for animal research, play an essential role. Researchers must adhere to established ethical guidelines and obtain informed consent from human participants while ensuring humane treatment of animals. Transparent reporting of methods and results allows scrutiny by peers and the scientific community. Education and training programs in research ethics foster awareness and adherence to ethical standards among researchers. Collaboration with ethicists and regular updates to ethical guidelines help align research practices with evolving ethical considerations. Stringent editorial policies and peer-review processes further reinforce ethical conduct, while whistleblower protection mechanisms encourage reporting of unethical practices. Legislative frameworks and international agreements provide a legal foundation, promoting ethical research practices globally.

5. Limitations

The present study, in its attempt to establish comprehensive ethical guidelines for sports medicine and exercise science research, is not without its limitations. One of the primary constraints is the scope of expertise. Despite our concerted effort to incorporate insights from a diverse array of experts in sports medicine and exercise science, it remains reasonable that we might not have encompassed the entirety of perspectives spanning all sub-disciplines within this vast field. There are areas that might necessitate specialized ethical considerations, which could potentially have been overlooked in our study.

Furthermore, the dynamic nature of ethical considerations in research means that what is considered appropriate today might evolve or change in the future. Our guidelines, while current as of 2023, might require periodic

revisions to stay relevant and effective. It is also worth noting that the application and interpretation of these guidelines might vary based on regional, cultural, or institutional differences. What is considered an ethical norm in one region or institution might differ in another, and our guidelines might not account for all these nuances.

Another constraint derives from the natural challenges linked to varied viewpoints and perspectives into a cohesive framework of principles. While we aimed for a consensus, there might be areas where opinions diverged, and the final guidelines might reflect a compromise rather than a unanimous agreement.

The inclusion of AI chatbots in academic writing, though addressed, is a rapidly evolving domain (46, 47). The pace at which technology advances might outstrip the guidelines we have proposed, necessitating frequent updates over the course of this area.

Lastly, while we have made recommendations based on current best practices and expert opinions, the actual implementation and adherence to these guidelines will require concerted efforts from researchers, institutions, journals, and governing bodies. The effectiveness of these guidelines, in the real world, remains to be seen and will be contingent on their widespread acceptance and application.

6. Conclusion

This paper proposes a paradigm in which ethical vigilance is incorporated as an essential component of research. This paradigm is supported by a compilation of identified ethical challenges in the field of sports medicine and exercise science and, consequently, their respective recommendations. The array of challenges highlighted in this paper spans across ethical considerations in academic writing integrity, authorship and attribution principles, research methodology governance, and participant rights and welfare.

The data presented in this paper offer reliable guidelines that can be considered for establishing best practices and ethical standards in the field of sports medicine and exercise science. The development of these guidelines was a collaborative effort, leveraging the expertise and skills of distinct scholars in the field, thus enhancing the depth and scope of the recommendations provided.

Authors' Contributions

I.D., L.B.E., and N.G. initiated the drafting of the manuscript. H.B.S., J.M.G., and A.E.O. played key roles in

critically revising the content for significant intellectual substance. Further enhancements and refinements to the draft were contributed by O.T., N.C., and M.T.

All remaining authors, including H.G., O.T., H.B.S., A.E.O., N.C., M.T., A.B., M.B.A., K.T., A.A., M.M.B., M.S., Ö.E., C.C.T.C., K.P., W.D., L.B., L.F.R.S., H.R.E.S., L.L.P.D., M.R., R.A.H., J.A.W., S.S., O.M.A., L.J.M.D.S., N.Z.A., H.İ.C., H.D., N.L.B., B.K., S.S., P.Z., H.C., and K.C., contributed by reviewing, offering feedback, and giving final approval of the manuscript version to be published, in accordance with COPE's guidelines for authorship.

Declaration

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Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

Ethical standards, including fair use of information and proper citation, were strictly adhered to, maintaining the integrity of the review.

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