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INVITED COMMENTARY

Writing High-Quality Case Studies in Sport Science

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Purpose: Sport-physiology and -performance research often relies on group designs that compare experimental and control groups and/or preintervention and postintervention results. This commentary highlights the key elements of a high-quality case study and provides clear guidelines for readers and authors of the *International Journal of Sports Physiology and Performance*. We propose 4 essential components. First, case studies should offer relevant and original insights by tackling novel issues and defining a clear purpose. Second, they must employ rigorous methodology, encompassing careful participant selection, comprehensive data collection from diverse sources (eg, interviews, surveys, physiological tests, training diaries, competition data), and deliberate data analysis that explicitly addresses factors influencing performance changes. Third, they should be well structured and engagingly presented to reach both academic and practical audiences. Finally, bridging the science–practice gap is vital, requiring and strengthening collaboration between researchers and practitioners to enable data-driven decision making and spark new hypotheses. ***Conclusions:*** Although case studies traditionally rank low in the research evidence hierarchy, high-quality examples can significantly bridge the gap between research and practice. By working closely with the sporting community and strategically sharing findings, case studies can enhance evidence-based training strategies and amplify the real-world impact of sport science.

Keywords: elite athletes, research, coaching, training

Sport-physiology and -performance research both typically rely on group designs comparing experimental and control groups or preintervention and postintervention results. However, in the world of elite sports, the focus shifts to individual adaptation and performance rather than group averages. In this context, single-subject or case-study research designs provide unique and valuable insights by evaluating the effectiveness of an intervention for an individual or small group of athletes. One advantage of case-study designs is their ease of integration into practical settings, as they offer the flexibility to adapt to the evolving needs of individual investigation.[1] Case-study methodologies are highly relevant to contemporary research and rapidly evolving high-performance environments, offering quick and accessible insights to the applied sports science community.[2] Case studies can highlight the physiology, training, and performance of truly elite and hard-to-recruit athletes. Such data are seldom available in the public domain or often buried among group averages in published research.

The *International Journal of Sports Physiology and Performance* (*IJSPP*) has consistently emphasized the value of case studies, and numerous editorials have encouraged researchers to conduct and submit such work to the journal.[2–5] Case studies have been described as informative and interesting means of reporting observational findings or experimental data of interest to readers.[2] However, an important question arises: What defines a high-quality case study? We consider that it is essential to address this question and provide clear guidelines to *IJSPP* readers and authors on writing high-quality case studies.

We propose and discuss 4 key characteristics. First, the case study should provide *relevant and unique real-world insights* that advance the scientific field while offering practical knowledge applicable to sport settings. Second, it must *employ high-quality methodology* in the collection and analysis of data. Rigorous and systematic approaches ensure the reliability and credibility of the findings, enabling the study to contribute meaningfully to both research and practice. Third, the case study should be *well-written and effectively promoted*. Clear, engaging communication is essential to make the findings accessible to both academic and practical audiences. Finally, a strong case study should *bridge the science–practice gap* by translating research into actionable knowledge, fostering collaboration, and driving impact in sports science and practice.

Providing Relevant and Unique Real-World Insights: Defining a Clear Purpose

Case studies should advance our understanding of sports physiology, training, and performance by exploring novel issues, clarifying problems, or exploring contemporary topics in real-world contexts.[2] A good case study must be engaging, informative, and practical presenting compelling scenarios with actionable insights. For instance, individualized training programs and continuous assessments of elite athletes' adaptations can provide valuable guidance for coaches and practitioners working with aspiring athletes.[4]

The first step for authors considering a case study is the target audience, both scientific (journal publication) and practical (sporting community). A case study should detail a unique and impactful scenario that addresses novel or difficult-to-study phenomena. The study should also be relevant and contribute meaningfully to advancing scientific knowledge, irrespective of study outcomes. A recent commentary provides insights into world-class endurance training based on the perspectives, experience, and knowledge of an expert panel of 25 applied sports scientists. The main areas expected to drive future improvements were associated with more

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extensive use of advanced technology for monitoring and prescribing training and recovery, more precise use of environmental and nutritional interventions, better understanding of athlete–equipment interactions, and greater emphasis on preventing injuries and illnesses.[6] High-quality case studies can be a valuable tool for exploring these emerging areas.

A clear purpose is crucial for shaping the entire case study process. The book *Case Studies in Sport and Exercise Science*[7] proposes 3 research models to help define a purpose: the reactive, predictive, and proactive models. *The reactive model* is utilized to provide solutions to preexisting problems. An example of this is a report on the outcomes of long-term low-carbohydrate, high-fat diet in a world-class long-distance triathlete to solve repeated, debilitating and performance-limiting gastrointestinal issues during Ironman competition.[8] The case demonstrated that the low-carbohydrate, high-fat diet neither resolved the issues nor improved performance, and negatively impacted the athlete's well-being. *The predictive model* focuses on providing solutions for events that are predicted to occur. For example, another case study on the above-mentioned world-class triathlete described his typical recovery and training plans for successful participation in back-to-back Ironman and Xterra Triathlon World Championships occurring within 8 or 14 days of each other.[9] *The proactive model* involves providing ongoing support and development within interdisciplinary teams. For example, a case study described the factors associated with underperformance in the world's best female cross-country skier, and the multidisciplinary process and supportive actions taken to facilitate her return to sustainable success.[10]

High-Quality Methodology

Although case studies are often descriptive and involve only one or a few participants, it is equally important they are conducted with high methodological quality involving appropriate selection of participant(s) and rigorous data collection and analysis.

Selection of Participants

Case studies are appropriate to analyze small, hard-to-recruit populations, such as world-class, injured, or severely overtrained athletes.[1] Success depends on selecting athlete(s) and/or topic that are both unique and supported by high-quality data. The chosen case should feature compelling narrative and measurable results, often involving an athlete with exceptional performance or unique circumstances. McKay et al[11] emphasize the importance of specifying the participant(s)' tier and rarity. For tier 4 (elite/international) and tier 5 (world-class) athletes, who are likely to have reached maximal training adaptations, even minor performance improvements are important. Consequently, a case study should focus on either unique, high-quality data on a high-performing participant (eg, a tier 5 athlete,[12,13] a record-breaking athlete,[14,15] a serial winner[16–18]), a particularly innovative method, technology, or intervention applied on a lower level athlete,[19] or a research area with a clear gap in the literature (eg, female athletes).[20,21]

Before starting a case study, it is essential to secure permission from all stakeholders, including athletes, coaches, teams, federations, and relevant institutions. When dealing with identifiable individuals or sensitive data, explicit consent and transparency are crucial to ensure the study does not negatively impact the athlete or their team. If a potentially disadvantageous situation for the athlete/team is expected, it might be necessary to delay the timing of publication in agreement with all relevant stakeholders, including a possible embargo period (eg, waiting until after the next Olympic/Paralympic Games or the athlete's retirement). Maintaining trust among athletes, coaches, organizations, and researchers is always a guiding principle.

Data Collection

Conducting a good case study requires the collection of all relevant data and information about the case. Data can come from various sources, such as interviews, surveys, test results, competition, training diaries, coach notes, or other accessible forms of information. These data collection methods should be applied purposefully and combined strategically. A series of case studies on the world's most successful female cross-country skier exemplifies this approach.[10,16,22,23] The leading author's personal knowledge of the sport, stemming from her own experience as an international-level cross-country skier, allowed for a deep understanding of the athlete's training and performance, yielding insights from a combination of interviews, physiological tests, and in-depth analyses of training data, all of which enabled a detailed exploration of the athlete's long-term training and performance. Training data were carefully analyzed and systemized within a clearly defined framework, including descriptions of intensity zones and session designs, allowing for accurate comparisons with other studies.

Because athletes often find it difficult to alter their training plans to accommodate testing or monitoring, ongoing performance tracking may be more suitable than relying on preintervention and postintervention testing. For example, Hagiwara et al[24] demonstrated this approach during a repeated sprint training in hypoxia intervention initiated by fencing athletes 2 months before the Tokyo 2020 Olympic Games. Given the impossibility of conducting a planned posttest, power outputs from each training session were plotted, confirming progressive improvement and evaluating the effectiveness of the intervention.

Data Analysis

Single-subject research designs in elite athletes include, but are not limited to, the classical AB design, ABA designs and their extensions, multiple baseline designs, and alternating treatment designs.[1] Despite the challenges inherent in single-subject research, such as serial dependency, which are often encountered in high-performance sports settings, sports scientists can utilize these designs. This is crucial for understanding the effectiveness of an intervention, such as a specific training method, and for predicting performance in individual athletes. The descriptive AB design represents the most fundamental single-subject research design and can determine if an athlete improved from test to test using the SD of the athlete's scores to establish a threshold for meaningful change. It is also important to explicitly document the factors that influence the nature of performance changes, both those that facilitate and those that hinder them.[25] This approach should include both the athlete's training history, current training context and periodization phase.

Whenever possible, authors are encouraged to perform training studies in periods when peak performance is expected, to avoid overestimating the impact of a given intervention, which could be the case in the early season, for example. The use of a lead-in period prior to an intervention is also recommended, as well as comparing observed changes with values from previous seasons. Using a control participant can strengthen a case study by isolating the effects of an intervention. For instance, in Rønnestad et al,[26] a control cyclist maintained stable test results during an elite cyclist's

overload and taper period, confirming the reliability of the tests and attributing observed changes in the elite athlete to the intervention. Similarly, multiple case studies like Gustafsson et al[27] on burnout in Swedish skiers, or comparing a single subject with peer groups,[28] can highlight both common and unique individual elements, enhancing the study's depth and reliability.

Writing and Promoting the Case Study

Case studies should appeal to practitioners, researchers, and coaches by exploring the case in depth, addressing existing issues, and/or developing innovative theoretical insights. In contrast, unsuccessful case studies are often overly descriptive, lacking a theory-driven approach, methodological rigor, or conclusive findings.[3] A theoretical framework is needed that contextualizes the findings, promotes a deeper understanding of the phenomena, and connects theory to practice. The writing should be clear, engaging, and concise to ensure accessibility for both researchers and practitioners. Incorporating quotes or testimonials can make the case relatable by demonstrating the impact of the intervention or methodology. Visual aids, such as charts, graphs, and images enhance clarity and appeal, making the information more digestible and impactful.

Case studies can benefit practitioners by providing a structured platform for reflecting on philosophical and theoretical approaches, implementation methods, and overall effectiveness. They should clearly demonstrate how authors have drawn intelligently from the literature to conduct, explain, and evaluate their work. Key decisions should be justified, adhering to a core philosophy, maintaining a coherent narrative, staying focused on case study goals, avoiding "retrofitting" literature to fit the data, and ensuring careful use of simultaneous interventions.[29] Seeking feedback from colleagues, study participants, and coaches can be useful and is therefore recommended.

The impact of a case study extends beyond publication, requiring effective promotion to reach the target audience. Online strategies include sharing through social media, websites, blogs, infographics, and newsletters, while offline methods involve lectures and presentations. Publishing in open-access journals or paying an open-access fee for subscription-based journals ensures broader accessibility. A combination of these approaches maximizes reach and impact.[30] However, online tools like social media require careful use to avoid misinterpretation, particularly with case studies, which focus on specific instances rather than generalizable findings.[31] Proper handling ensures insights are accurately conveyed and contribute meaningfully to the field.

Bridging the Science–Practice Gap

We believe close collaboration with the practice field is essential in producing high-quality case studies. When this collaboration is built on mutual respect, it can benefit both parties. Coaches and athletes can gain an objective analysis of their data and a professional review of their training philosophy. This cooperation can provide confidence in the training process while also discovering potential areas for further development. Researchers, on the other hand, gain valuable insights into practical contexts and stay updated on the key questions coaches and athletes care about.

Coaches and athletes often represent an underutilized resource in sports science, frequently surpassing researchers in their application of key training elements.[32] Coaches and athletes should be encouraged to either write case studies themselves or collaborate with researchers who can assist with data collection or retrospective analysis of field-based data. Regardless of the approach, the primary focus must always remain on making the best choices for the athlete to achieve optimal outcomes. In this approach, high-quality data collection plays a dual role, both supporting immediate decision making while also enabling detailed, retrospective analysis. The combination of high-quality research and a very concise presentation is important.[3] High-quality data leads to informed decisions, which, in turn, create compelling and impactful case studies.

A key advantage of case studies is that they provide more practical and relatable information for coaches and athletes, making it easier for them to apply the knowledge. Case studies also provide practitioners with a platform to share their experiences and contribute to knowledge transfer thereby improving the connection between research and practice. This can in turn make elite athletes, coaches, and their environments more accessible to researchers, generating new hypotheses, and accelerating the knowledge development. Although case studies are ranked lowest in the research evidence hierarchy, they can be incredibly impactful when they successfully bridge the gap to practice.

Practical Applications

When writing high-quality case studies, we emphasize the importance of 4 essential components. First, case studies should be relevant and original, addressing novel and meaningful issues while clearly defining their purpose to provide valuable insights that advance the field. Second, they must demonstrate methodological rigor through careful participant selection, comprehensive high-quality data collection from different sources, and deliberate data analysis that explicitly considers factors influencing performance changes. Third, the presentation of the study should be well-structured and engaging, ensuring it resonates with both academic and practical audiences, making the findings accessible and impactful. Finally, bridging the gap between research and practice is critical, requiring strengthened collaboration between researchers and practitioners to enable evidence-based decision making and development of new relevant research questions. By integrating these elements, case studies can make significant contributions to both scientific knowledge and practical applications.

Conclusions

Although case studies traditionally rank low in the research evidence hierarchy, high-quality examples can significantly bridge the gap between research and practice. By working closely with the sporting community and strategically sharing findings, case studies can enhance evidence-based training strategies and amplify the real-world impact of sport science.

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