

Sport Science the Panacea for Sportsmen: A Systematic Review

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Abstract

The future of sports science relies on collaboration among researchers, athletes, and practitioners. Researchers can use technology to create effective training programs, while athletes gain personalized feedback, and practitioners enhance safety in their methods. This teamwork will fully unlock sports science's potential, enabling athletes to exceed their limits. As technology evolves, we can anticipate innovations like AI-powered training assistants, personalized nutrition plans, and virtual reality simulations. These advancements will not only strengthen and accelerate athletes but also deepen their understanding of their bodies and minds, fostering a healthier, performance-driven sports environment that captivates audiences for years to come.

Keywords: sport science; technology; physical fitness; mental health; social health; exercise; fatigue; energy regulation; health promotion; sports coaches

Introduction

The advancement of sports science technology in the past four decades highlights areas for further research, fostering collaboration among scientists, coaches, and athletes. This research is crucial for strengthening these partnerships and promoting a future where science and sport support one another (Wijaya et al., 2024). Sports are decisive activities in augmenting our health and contribute significantly to reducing morbidities and mortalities (Tézier et al., 2025). Besides, they are not only a source of income but a multibillion-dollar industry. Injuries are the consistent nemesis to sportsmen. A study of elite athletes who had participated in the London Olympics reported an injury rate of 128.8 per 1,000 athletes. Injuries result in significant socioeconomic costs, including direct medical expenses and absenteeism. A study of elite athletes at the Rio Olympics found an injury rate of 9.8 per 100 athletes, with injuries being particularly common in recreational sports (Bae, 2024).

The notion of the "best" sportsperson in the world is subjective and varies based on personal opinions, the specific sports involved, and criteria such as achievements, skills, and influence (Mookherji, 2021). However, some athletes are frequently mentioned among the best across various sports. Lionel Messi, Austin Okocha, Ronaldo, Ronaldinho, Pele, Diego Maradona, Marta, Aitana Bonmati, Asisat Oshoala, Birgit Prinz is often regarded as the greatest soccer/football players, renowned for their incredible skills, awards and achievements. In basketball one

name stands out, Michael Jordan although the likes of LeBron James, Shaquille O'neal, Magic Johnson the among dominant basketball players of all time. Roger Federer, Serena Williams, Novak Djokovic, Naomi Osaka is considered the most successful tennis players. Eliud Kipchoge, Usain Bolt are considered the greatest runners/athletes and Tom Brady widely regarded as one of the best in NFL history are just but among the greatest footballers and athletes of all time (Jankowski, 2019).

Sports science research has proven vital in providing knowledge and evidence-based strategies to help everyone exercise or train optimally while minimizing risks (Bartlett & Drust, 2021). Physical fitness is a vital cornerstone of overall health for all ages, shaping our longevity and enriching the quality of our lives (Casamichana et al., 2025). It is either the field/gym or the chemist for all internal and external body parts, organs, tissues and cells to function properly as they are supposed to function. Better be an enthusiast of the former than the latter.

Physical fitness tests are commonly utilized to evaluate fitness levels, with various tests designed to measure specific physical fitness components. (Klein et al., 2025). Technological advancements are profoundly impacting society, changing traditional lifestyles and social interactions. The physical activity and sports sectors are also adapting, leading to significant innovations. Technology's role in sports is growing, enhancing equipment design, monitoring performance, and improving the daily routines of all

sports stakeholders. (Oviedo-Caro and Sánchez-Trigo, 2024).

According to (Maneiro et al, 2025), gender significantly influences sports participation, leading to social stigma and reduced involvement. Understanding the differences and similarities between men and women in sports is essential for promoting gender equality and recognizing the benefits of physical activity (Tézier et al., 2025).

The environment has a role in sportsmanship (Kessel, 2016). It is not coincidental that the best athletes come from a certain region. We need more epidemiological sports science research evidence on race and tribe to support the theories. Findings as reported by (Maneiro et al, 2025), indicated that, women are more vulnerable to the negative effects of failure in competition. There is also agreement that physical activity positively impacts attention, academic performance, and social relationships. In football, differences in players' personalities have been demonstrated based on their level of experience and gender.

As (Kubayi et al., 2019) deduced that, enhancing technical skills can significantly reduce the likelihood of injuries, offering not only greater safety but also a more confident and proficient performance.

The analysis of the study by (Ghorbani and Sadeghi, 2025) highlights the effectiveness of commonly used physical fitness tests, such as the 30-second Sit-to-Stand (30s-STs), Timed Up and Go (TUG), and Five Times Sit-to-Stand (5XSTS). These tests have been validated and proven to be reliable across various settings, making them valuable tools for assessing physical fitness, especially in older adults and individuals with health conditions. Consequently, these tests are particularly useful for tracking the outcomes of home-based exercise programs for older adults, as they demonstrate measurable improvements in strength, balance, and mobility. Their versatility also makes them ideal for telehealth and remote monitoring, ensuring continuity of care during periods of restricted mobility.

A sports science researcher should be guided by a philosophy that aims to produce useful findings to enhance the development of athletes and coaches. This development is closely linked to a well-integrated research-practice model. It is essential for sports scientists and coaches to collaborate in order to integrate research into practice and effectively address coaching challenges (Kubayi et al., 2019).

According to (Kubayi et al., 2019), many coaches are often unfamiliar with research methodology, statistics, and the terminology used by sports scientists. Additionally, they may lack the foundational knowledge of sports science necessary to interpret research findings and apply the latest information to their coaching practices. If the results of sports science research are not presented in a clear and understandable manner, they cannot be effectively used to address practical issues in sports coaching. Therefore, there is a need for better translation and dissemination of sports science information so that coaches can easily comprehend it. This can be accomplished by organizing workshops, seminars, and short learning courses specifically designed for both sports scientists and coaches.

As remote health monitoring evolves, there is a valuable opportunity to develop and validate reliable, user-friendly physical fitness tests that can thoroughly assess all components of physical fitness. By focusing on the standardization of remote delivery, we can promote its widespread adoption in both clinical and research environments, ultimately enhancing the effectiveness of health monitoring for everyone (Klein et al., 2025).

Biological, psychological, and social factors all influence the occurrence of sports injuries and the process of rehabilitation (Bae, 2024). Sport science is vital for maximizing athletic performance, ensuring safety, and advocating for health and well-being in both competitive and recreational sports. Its impact is undeniable and serves as the foundation for success in the athletic realm.

Challenges can be addressed through enhanced funding, faculty development, standardized curricula, research support, infrastructure improvements, advocacy, collaboration with sports organizations, continuing education, diversity and inclusion, public-private partnerships, international cooperation, community outreach, and mentorship programs (Abdullahi & Okuneye, 2024).

Methodology

This study was conducted through a systematic review of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method (Figure 1). Article searches were carried out using a comprehensive strategy on Scopus research journal databases. The keyword used was "sports science" AND "technology". 1.129 articles from SCOPUS

were mined on February 20th, 2025. The inclusion criteria were documents and articles written in English and published within the last 10 years. Meanwhile, the exclusion criteria in this study were documents that were not written in English and those published more than 10 years ago. There were 31 articles selected as the most cited and relevant articles which were selected for this systematic review. The researcher used the screening feature on the SCOPUS

website to determine the articles with the most citations and relevance. The annotation method was also carried out to ensure that the selected articles were following the research topic. The researcher used the annotation method also because some of the identification results showed research that was not relevant to sports, for example, only in the field of technology without any relation to sports.

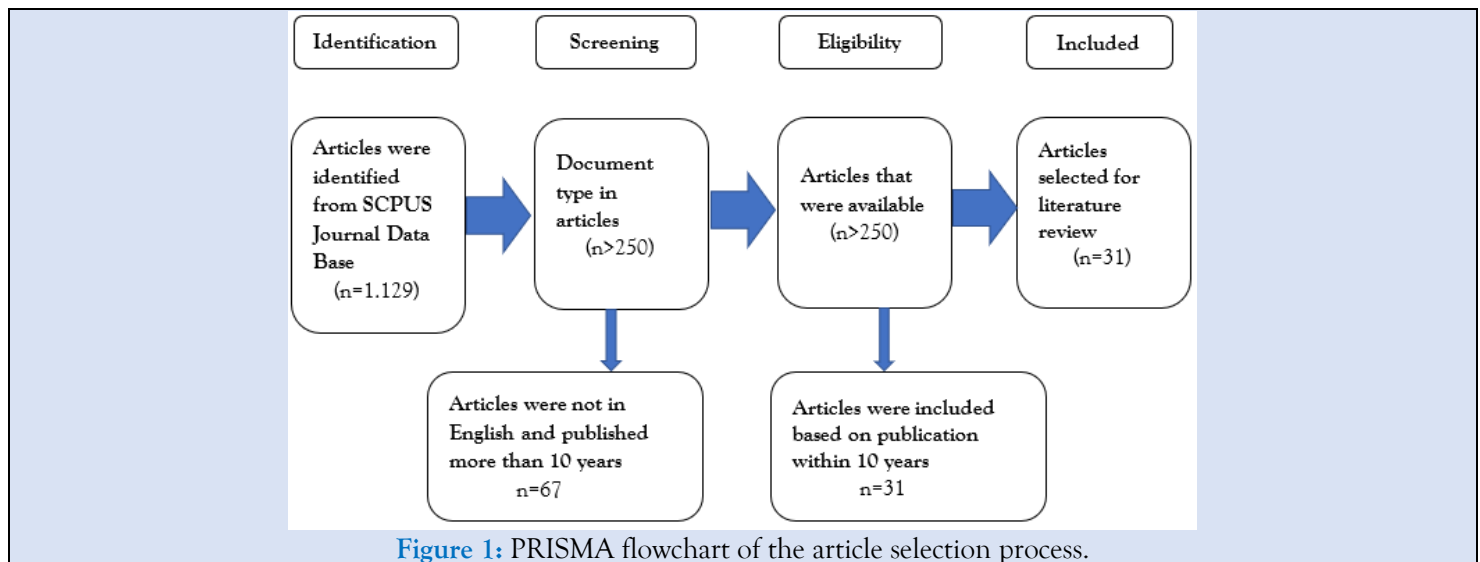


Figure 1: PRISMA flowchart of the article selection process.

Biomechanics

Biomechanics is the study of the mechanical principles governing human movement and the forces that act upon the body during physical activity. It combines elements of physics, engineering, and biology to analyze how muscles, bones, tendons, and ligaments work together to produce motion (Bae, 2024). Understanding biomechanics is essential for optimizing athletic performance, as it allows coaches and athletes to assess and refine movement patterns. By examining the kinematics which is the motion of bodies and kinetics that is the forces causing motion, biomechanics provides insights into how athletes can improve their efficiency and effectiveness in their respective sports (Casamichana et al., 2025).

There are notable differences in body shape and function between track and field training teams and the general population. Long distance runners exhibit the strongest adaptability to load, followed by sprinters and then jumpers, while ordinary people are more adversely affected by quantitative load (Jing et al., 2025). Comparisons of anthropometric characteristics showed significant differences in body height, mass, muscle mass, chest girth, limb length, ankle circumference, calf length, and Achilles tendon

length among players in different positions. (Sun et al., 2025). One of the key applications of biomechanics in sports is the analysis of technique. For instance, in sports such as sprinting, swimming, or gymnastics, even the smallest adjustments in form can lead to significant improvements in performance (Oviedo-Caro and Sánchez-Trigo, 2024). Biomechanical analysis often employs high-speed cameras and motion capture technology to evaluate an athlete's movements in detail. By identifying inefficiencies or potential injury risks in an athlete's technique, coaches can make informed recommendations for adjustments. These changes can enhance speed, power, and overall performance while reducing the likelihood of injuries caused by improper biomechanics (Ghorbani and Sadeghi, 2025).

A previous study found that goalkeepers (GKs) had significantly greater body height than players in other positions, enhancing their reach and ability to prevent goals. Similarly, central defenders (CDs) also tend to be taller and heavier than other players. (Sun et al., 2025). Similar to the previous study, in this study, GKs and CDs presented significantly greater body heights than players in other positions did and

presented significantly greater body masses than CMs, EMs, and FWs did. Players who have a greater body height and mass are more suitable for meeting the requirements of the GK and CD positions.

According to (Sun et al., 2025), significant differences ($p < 0.001$) in body height, mass, muscle mass, chest girth, lower limb length, calf length, and Achilles' tendon length were observed among the six playing positions (GKs, CDs, EDs, CMs, EMs, FWs), reflecting varying anthropometric characteristic needs.

Furthermore, biomechanics plays a crucial role in injury prevention and rehabilitation. By understanding the forces acting on joints and tissues during various movements, practitioners can identify risk factors for injuries (Bae, 2024). For example, biomechanics can reveal how improper landing techniques in sports like basketball or volleyball can lead to knee injuries. This knowledge allows for the development of targeted training programs that focus on improving strength, flexibility, and movement patterns to mitigate these risks. Additionally, during rehabilitation, biomechanical assessments can guide therapists in creating individualized recovery plans that address specific movement deficiencies, ensuring athletes return to their sport safely and effectively. Overall, biomechanics is an essential element of sports science that significantly enhances athletic performance and injury management.

Exercise Physiology

Exercise physiology is the study of how the body responds to physical activity and the physiological changes that occur during and after exercise. This field examines various aspects of human performance, including cardiovascular, respiratory, muscular, and metabolic responses to different types of physical exertion. Fatigue is one of the most common and complex issues, affecting up to 55% of individuals with chronic conditions. (Barakou et al., 2025). Previous research indicates that psychological factors significantly influence the participation, performance, and health of soccer players and practitioners. There has been increased attention in this area over the past two decades, particularly during FIFA Women's World Cup years and the UEFA Women's Euro (Gredin et al., 2023). Coach-related factors contributing to elevated anxiety and stress levels include lack of coaching support, insufficient competence, inadequate leadership styles, and performance pressure, including selection procedures. Understanding these responses helps

exercise physiologists create tailored training programs to enhance athletic performance, improve fitness, and optimize recovery. This knowledge is valuable for athletes, enabling effective training, goal achievement, fatigue management, and injury reduction.

Soccer is an intermittent team sport that requires various physiological and biochemical factors to influence a player's performance. A soccer match consists of repeated bouts of high-intensity sprinting, interspersed with brief periods of low-to-moderate-intensity activities (Liu et al., 2024). Their findings indicated that a higher frequency of sSIT reduces its effect on residual changes in male soccer players but maintains adaptation consistency over 6 weeks. Strength and conditioning coaches should consider more sessions with shorter durations to enhance performance with lower perceived exertion. Fewer repetitions of sSIT per session may be more beneficial than higher repetitions, promoting uniform adaptations. This study offers anthropometric and physical profiles of Chinese male youth soccer players, aiding coaches in understanding characteristics across different age groups and positions. This information can help optimize individual training for player selection and recruitment (Sun et al., 2025).

Exercise physiology involves assessing the energy systems used during physical activity, which include the phosphagen system, anaerobic glycolysis, and aerobic metabolism. High-intensity, short-duration activities like sprinting primarily use the phosphagen system, while prolonged, moderate-intensity activities such as distance running rely more on aerobic metabolism. By understanding these systems, exercise physiologists can create targeted training regimens to enhance athletic performance across different sports. The 6-min walk test (6MWT) is a common exercise capacity test in oncology, correlated with other walking tests like the 2-min and 10-m tests in cancer patients (Reinmann et al., 2025).

The integration of sports science and practice is essential for the development of competitive sports in China. However, differences between sports science and practice, as well as between sports scientists and coaches, create barriers to this integration. Recognizing these differences and overcoming obstacles are crucial for successful merging. Sports science should be informed and guided by practical training (Li, 2020). The concept is essential for recovery and adaptation to training. After intense activity, the body repairs muscles, replenishes energy

stores, and clears metabolic waste. Exercise physiologists examine factors like nutrition, hydration, and rest to help athletes optimize recovery. They also study how the body adapts to training, enhancing strength, endurance, and fitness. This knowledge enables the creation of periodized training programs that incorporate progressive overload, helping athletes improve performance while reducing the risk of overtraining. Ultimately, exercise physiology plays a crucial role in enhancing athletic performance through understanding the body's responses to exercise. In their study, (Reinmann et al., 2025) found that improvements in walking capacity and fatigue were noted in cancer patients who completed the hospital-based physical activity program, with greater benefits seen in those with lower walking capacity and higher fatigue.

The findings of a study by (Sun et al., 2025) indicated essential anthropometric and physical profiles of Chinese male youth soccer players, empowering coaches to comprehensively understand the characteristics across various age groups and positions. With this knowledge, coaches can effectively optimize individual training, enhancing player selection and recruitment strategies.

Injury Prevention

The partnership between sports scientists and physiotherapists is crucial in sports medicine, enhancing athlete performance, reducing injury risks, and prioritizing overall well-being (Abdullahi & Okuneye, 2024). Injury prevention in sports science focuses on reducing injuries among athletes through various strategies, including proper training techniques, conditioning programs, and protective equipment. A key approach is implementing strength and conditioning programs that target specific muscle groups, enhancing performance while building resilience in the musculoskeletal system. Educating athletes on proper biomechanics and techniques further reduces the risk of injuries from improper form (Raiola et al., 2025).

A key aspect of injury prevention is the importance of warm-up and cool-down routines. Dynamic warm-ups increase blood flow, flexibility, and joint mobility, reducing the risk of strains and sprains. Cool-downs with static stretching aid in muscle recovery and prevent stiffness. Additionally, incorporating rest and recovery into training schedules is crucial, as overtraining can lead to fatigue and a higher likelihood of injury. There is a notable difference in the locus of control between non-athletes and

athletes. Non-athletes, regardless of gender, tend to have an external locus of control. In contrast, athletes both in combat sports and non-combat sports, regardless of gender demonstrate an internal locus of control (Marwaha et al., 2025).

When discussing sports injuries, it's essential to examine the musculoskeletal, cardiovascular, and nervous systems. Additionally, consider the psychological aspects of injured athletes, including emotions, cognition, motivation, and perceptions. Attention should also be given to the team's atmosphere, culture of risk, and available social support (Bae, 2024).

As Marwaha et al., (2025) reported, monitoring and analyzing injury data is essential for understanding injury patterns and developing effective prevention strategies. Sports scientists and trainers use data analytics to identify common injuries in specific sports and demographics, leading to targeted interventions like tailored training programs and improved equipment. Encouraging open communication among athletes, coaches, and medical staff about injuries promotes early intervention and better management, enhancing athlete health and performance.

Addressing sports injuries from a biopsychosocial perspective is becoming increasingly common. Key factors affecting the occurrence of sports injuries include sex, team sports, neuroticism, previous injuries, postpartum factors, sleep, academic and social load, and mental health. For return to play, factors like self-reported knee function and psychological readiness are crucial. Recognizing these biopsychosocial influences can aid in injury prevention and recovery (Bae, 2024).

By prioritizing injury prevention, the sports community can improve athlete safety and longevity. When addressing sports injuries, it is important to identify the relevant biological systems, including the musculoskeletal, cardiovascular, and nervous systems. It is also crucial to consider the psychological aspects of injured athletes, such as their emotions, cognition, motivation, and perception. Furthermore, attention should be given to the team atmosphere, risk culture, and the availability of social support (Raiola et al., 2025).

Injury Recovery and Rehabilitation

Injury recovery and rehabilitation are vital for athletes aiming to return to peak performance after injuries. The process starts with an accurate diagnosis by a medical professional, often using imaging techniques

like MRI or X-rays. Once diagnosed, a personalized rehabilitation program is created, focusing on pain management, mobility exercises, strength training, and functional drills to meet the athlete's specific needs (Barakou et al., 2025).

In Italy, a notable legislative change has occurred with the establishment of scientific-disciplinary groups (SDGs) and the revision of academic disciplines (ADs) along with their respective declarations. The goal was to eliminate the overlaps between the scientific declarations of SDGs and the updated ADs by providing clearer definitions of scientific, cultural, and educational domains. However, rather than diminishing, these overlaps have indeed increased, highlighting a critical issue that needs to be addressed (Raiola et al., 2025).

The relationship between sports science and physiotherapy is very close, as both fields focus on athlete health and performance. They collaborate in areas such as injury prevention, biomechanics, exercise prescription, and performance enhancement. This collaboration is strengthened by interdisciplinary training, research, and a patient-centered approach (Abdullahi & Okuneye, 2024).

Improved health-related quality of life (HRQoL) is associated with decreased fatigue, greater pacing engagement, and better self-regulatory skills, particularly in the physical domain. Higher perceived risk of overactivity and device-based physical activity also contribute to better social well-being. These findings emphasize the importance of effective fatigue management for enhancing overall HRQoL and well-being (Barakou et al., 2025).

Rehabilitation is a multifaceted process that emphasizes not only physical recovery but also psychological well-being. Athletes often experience emotional challenges during recovery, including frustration, anxiety, and fear of re-injury. Therefore, mental conditioning and support are integral to the rehabilitation process. Techniques such as visualization, goal setting, and working with sports psychologists can help athletes maintain motivation and a positive mindset throughout their recovery journey. Additionally, the role of nutrition cannot be overlooked. A well-balanced diet plays a crucial role in the healing process, providing the necessary nutrients to support tissue repair and overall health (Abdullahi & Okuneye, 2024).

As Barakou et al., (2025), observed, that as athletes progress in their rehabilitation, the emphasis shifts toward functional training and sport-specific drills.

This phase is vital for ensuring that the athlete can perform at their previous level of competition. Rehabilitation professionals often incorporate progressive overload principles to gradually increase the intensity and complexity of exercises. Monitoring performance indicators and using technology, such as motion analysis and strength testing, can help in assessing readiness to return to sport. Ultimately, a successful return to athletic activity involves a collaborative approach among medical professionals, rehabilitation specialists, coaches, and the athletes themselves. This comprehensive strategy not only fosters optimal recovery but also minimizes the risk of re-injury, enabling athletes to return stronger and more resilient.

Numerous sports science and physiotherapy programs in Nigeria face challenges due to inadequate funding, which may restrict access to essential resources, faculty development initiatives, and research opportunities. The presence of insufficient and outdated infrastructure, including laboratories, classrooms, and sports facilities, can significantly impede the practical training and research capabilities of both students and faculty members. Furthermore, there is frequently a lack of experienced and qualified faculty, which can adversely affect the quality of education and the overall research output (Abdullahi & Okuneye, 2024). The availability of sports medicine facilities, including rehabilitation centers and clinics, may be insufficient, limiting opportunities for practical training and clinical experience. Establishment of research grants and funding opportunities specifically for sports science and physiotherapy research.

Nutrition and Diet in Sports

The field of sports nutrition is really picking up momentum! With more and more academicians and practitioners diving in, there's a heightened focus on exploring and scrutinizing this fascinating area. The insights emerging from this research are essential for optimizing performance and enhancing overall athlete health (Abdullah et al., 2024). Nutrition is crucial in sports science, greatly affecting an athlete's performance, recovery, and health. Essential macronutrients carbohydrates, proteins, and fats fuel athletes during training and competition. Carbohydrates serve as the main energy source for high-intensity activities and are stored as glycogen in muscles and the liver. Proteins are crucial for muscle repair and growth, especially for strength training. Fats provide energy during prolonged, lower-intensity exercise and support overall energy balance and

nutrient absorption (Mancin et al., 2025). Micronutrient's vitamins and minerals are crucial for athletes, supporting immune function, energy production, and muscle contraction. Calcium and vitamin D are crucial for bone health, while iron is important for oxygen transport. Athletes should maintain a diverse diet with fruits, vegetables, whole grains, lean proteins, and healthy fats to meet their nutritional needs.

Exercise and sports are integral to many lives, and proper nutrition is vital for peak athletic performance. This importance encourages current and future researchers to explore sports nutrition further (Abdullah et al., 2024). Due to higher activity levels, athletes often need more of certain nutrients, highlighting the importance of a balanced diet rich in fruits, vegetables, whole grains, and lean proteins. Tailoring nutritional strategies to individual needs based on sport type, training intensity, and personal goals can enhance performance, reduce injury risk, and promote effective recovery.

According to (Brocherie & Beard, 2021), the evolution of professional sports requires better communication based on trust and respect among coaches, management, and the team. By relocating research facilities closer to the field, we can strengthen their connection to real-world applications and promote evidence-based, performance-oriented practices.

Moreover, Hydration is vital for sports nutrition and optimal performance. Even mild dehydration can hinder physical abilities, cognitive function, and endurance. Athletes should recognize their individual hydration needs, which vary with climate, exercise intensity, and duration. Additionally, electrolytes are important for fluid balance and muscle function during prolonged exercise, making electrolyte-rich beverages beneficial in some cases (Abdullah et al., 2024).

Dietary fibers are essential for maintaining microbiome diversity and gastrointestinal health. Consuming adequate fiber can help athletes support gut function while meeting other nutritional needs for training and performance (Mancin et al., 2025). An athlete's diet is shaped by various external and internal factors that can affect exercise-induced food intolerance or allergy symptoms. Common diets like gluten-free, vegetarian, and lean are adopted for health, ethical, and religious reasons. The rise in celiac disease cases has made gluten-free diets popular, particularly for athletes with the condition. Sports

nutrition is crucial for enhancing performance in athletes and active individuals, with personalized plans key to maximizing result (Abdullah et al., 2024). Wheat allergy or gluten intolerance can improve health and enhance performance. Nutrition is crucial for athletes, providing the energy needed for training and competition. A balanced diet with carbohydrates, proteins, and fats helps sustain energy, recover, and build muscle. Carbohydrates are the main energy source for high-intensity workouts, while proteins aid muscle repair and growth. Fats also play a key role in energy, especially during prolonged, lower-intensity exercise. Nutrition is essential for athletic performance, particularly postworkout, as it significantly impacts recovery and adaptation. A well-designed recovery strategy can enhance muscle function, improve exercise tolerance, and address fatigue. Monitoring diet and ensuring the right quality and quantity of food are crucial for restoring an athlete's physical fitness (Abdullah et al., 2024).

According to Mancin et al., (2025), while dietary guidelines for athletes include recommendations on carbohydrate intake, they lack specific advice on daily fiber intake. However, fiber manipulation is common in sports nutrition to enhance gastrointestinal comfort during exercise or to manage body mass and composition. Additionally, fiber's impact on overall health is significant, especially when considering the higher protein needs of athletes. It's essential to assess an athlete's regular fiber consumption. Food choices are dynamic and can vary based on time, place, and the circumstances athletes face when selecting their meals (Abdullah et al., 2024). Establishing personalised guidelines for dietary fibre intake in athletes is warranted (Mancin et al., 2025).

Mental Health and Fortitude

There is currently a lack of research exploring coaches' perceptions and insufficient insight into athletes' views on the importance of evidence-based practice (EBP). Additionally, little is known about the value athletes place on various aspects of sports performance, such as mental, physical, tactical, and nutritional factors, as well as their preferences regarding practitioners. Gaining this understanding could help address the barriers to effectively implementing EBP (Schwarz et al., 2021).

Mental health in sports science is an increasingly recognized area of study, as it plays a crucial role in the overall performance and well-being of athletes. Athletes face unique pressures, including the demand for high performance, the risk of injury, and the

scrutiny of public attention. These factors can contribute to anxiety, depression, and other mental health issues. Sports scientists and psychologists are working together to better understand these challenges and develop strategies to support athletes in maintaining their mental health. The integration of mental wellness into training programs is essential, as it can lead to improved focus, resilience, and ultimately, performance (Jing et al., 2025).

Evidence-based practice (EBP) is a pedagogical approach that combines experience, values, and research to guide decision-making in fields like medicine and education. In sport science, EBP involves integrating athlete and coach values, practitioner expertise, and research evidence to enhance performance through effective planning, delivery, and reflection. This collaborative process benefits scientific and applied stakeholders in sports organizations, helping them improve individual and team performance outcomes (Schwarz et al., 2021).

Understanding the mechanics of movement and the body's response to stress can help in developing strategies to prevent injuries. Sport scientists can analyze techniques and training loads to minimize the risk of harm (Kubayi et al., 2019).

In their study, Schwarz et al., (2021), indicated coaches and athletes reported that the most desirable qualities in a practitioner are excellent knowledge of the sport, relevant experience, and strong communication skills. This includes the ability to deliver concise key messages and translate scientific information into practical language. Practitioners can enhance their effectiveness by specializing in specific sports or, when transitioning between sports, investing time to educate themselves within that particular environment, such as by attending additional sessions or meetings with coaches and players. Similarly, academic institutions should ensure that communication skills are a key component of the sport science curriculum so that graduates are well-prepared to operate effectively in high-performance sport settings.

With the improvement of people's health awareness and living standards, physical exercise has become an indispensable part of their daily lives. In higher education institutions, physical exercise is not only an important way for students to maintain physical health, but also an effective means to cultivate their physical and mental qualities and enhance their teamwork spirit (Jing et al., 2025)

As reported by Zhou et al., (2024), physical fitness (PF) is crucial for the physical and cognitive development of children. There is a growing interest in the connection between physical fitness and executive function. A positive relationship has been observed: better performance in speed, agility, and lower limb strength is associated with improved inhibitory control

In their findings, Marwaha et al., (2025) found that participating in sports positively impacts psychological well-being and social outcomes in adults. Team sports, in particular, yield better results than individual sports or other physical activities. Our findings support previous research and contributed to our 'Mental Health through Sport' model, outlining how sports participation can affect mental health. The stigma surrounding mental health in sports often discourages athletes from seeking help due to a culture of toughness and invulnerability. However, this is changing as more athletes and organizations advocate for mental health awareness. Initiatives like screenings and access to professionals are becoming common, fostering an environment that encourages athletes to seek help, leading to healthier coping mechanisms and better overall well-being.

According to kubayi et al., (2029), the emphasis on cultivating a positive relationship with athletes highlights the significance of creating strong professional bonds between coaches and athletes. This approach prioritizes interpersonal skills as essential aspects of effective coaching, alongside scientific knowledge, in the development of athletes. Sports blend enjoyment and competitiveness, making them vital to life. They play a significant role in culture and society, promoting physical fitness and benefiting mental health. Many sports include some level of aggression, which can vary in form. Experts disagree on the role of violence in sports, with some believing that positively directing aggression can enhance athletic performance (Marwaha et al., 2025). The mental aspect of diet and nutrition is vital for athletes, affecting motivation, concentration, and mood. Nutrient-dense foods improve cognitive function and recovery, leading to better training and competition results. Healthy eating fosters a positive relationship with food, supporting overall well-being and career longevity. Prioritizing diet and nutrition is essential for athletic performance and mental health, helping athletes reach their goals (Zhou et al., 2024). The collaboration among stakeholders in any sports organization is essential for success. Practitioners

must work alongside coaches and players towards the shared goal of optimizing athlete health and improving team performance (Schwarz et al., 2021). In addition to providing individual support, research in sports science is increasingly focusing on the effects of team dynamics and coaching on mental health. Positive relationships with coaches and teammates can enhance an athlete's sense of belonging and self-esteem, both of which are crucial for mental resilience. Conversely, negative experiences, such as bullying or excessive criticism, can worsen mental health issues. Sports scientists are investigating how factors like team culture, communication styles, and leadership approaches can impact the mental health of athletes. By fostering a supportive and inclusive environment, sports organizations can help alleviate mental health challenges, foster a culture of well-being that benefits both athletes and the broader sports community (Jing et al., 2025).

AI and Advanced Technology in Sports Science

The analysis of sports science reveals a significant increase in publications and citations, highlighting its growing importance. Over the past four decades, sports science has transformed from classical methods to advanced technologies like big data and virtual reality in sports (Wijaya et al., 2024). These innovations enhance our understanding of human performance, optimize training, prevent injuries, and improve athlete health. Studying trends in sports science technology helps guide future research and fosters further innovations that can shape the future of (Brocherie & Beard, 2021).

Artificial intelligence (AI) and advanced technologies have transformed sports science by enhancing athlete training, competition, and recovery. AI systems analyze data from wearables, video analyses, and performance metrics to deliver insights for athletes and coaches. This data-driven approach identifies patterns to improve performance, personalize training, and assess injury risks, moving sports organizations beyond traditional coaching to a more analytical athlete development strategy (Arzehgar et al., 2025).

One of the most notable applications of AI in sports science is performance analysis. Advanced computer vision techniques enable coaches to analyze athletes' movements in real time, identifying strengths and weaknesses in their techniques. For instance, AI algorithms can track player movements during a game, providing insights into their positioning, speed,

and decision-making processes. This level of analysis helps coaches tailor training programs to address specific areas for improvement, ultimately optimizing performance during competitions. Additionally, biomechanical analysis powered by AI assists in refining athletes' techniques, ensuring they perform at their best while minimizing the risk of injury (Abdullahi et al., 2024).

Sensor-based motion analysis is transforming sports injury management by providing objective, real-time insights for athletes and clinicians. Sports-related injuries significantly impact performance and well-being, making it essential to understand movement biomechanics for early detection and effective rehabilitation. Traditional analysis methods often rely on subjective visual assessments by trained professionals, which can miss critical movement details. In contrast, recent advancements in sensor-based technologies deliver quantifiable data that enhance injury assessment and recovery strategies (Arzehgar et al., 2025).

As Bartlett & Drust (2021), reported, injury prevention is another critical area where AI and advanced technology play a significant role. Predictive analytics can evaluate an athlete's training load, physical condition, and injury history to identify risks. AI systems can alert coaches to adjust training programs or implement preventive measures. Wearable technology, like smart sensors and fitness trackers, provides real-time data on physiological metrics, enabling timely interventions to prevent overtraining and ensure optimal competition readiness.

Understanding the intricate elements of sports has given rise to a field called sports science. This discipline merges scientific principles with practical aspects of athletics to enhance performance, prevent injuries, and optimize the health of athletes (Wijaya et al., 2024). The evolution of technologies like sensors, computer simulations, and tech-based rehabilitation has transformed sports in training, competition, recovery, and injury prevention. Wearable devices allow real-time monitoring of athlete performance and health, offering valuable data for informed decision-making (Brocherie & Beard, 2021).

Computer simulation and virtual reality offer coaches and athletes the ability to practice various scenarios safely, aiding competition preparation and strategy development. Additionally, rehabilitation technology, including robotics and augmented reality, provides

more effective methods for injury recovery, allowing athletes to return to peak performance more quickly. It's important for sports science researchers and practitioners to keep exploring and adopting these innovative technologies. Collaboration among engineering, medicine, and computer science will drive innovations in sports (Matagi, 2023). This interdisciplinary research will enhance our understanding of human performance and lead to more effective technological solutions. With support from academic institutions, industry, and government, sports science technology can thrive, benefiting athletes and improving public health. The future of sports science is promising, with unlimited potential for innovation to push the boundaries of human capabilities in sports (Wijaya et al., 2024).

Personalized training programs are made more effective through the use of AI, as these systems can adapt to an athlete's progress and recovery. Machine learning algorithms analyze individual performance data to adjust training loads, exercise selection, and recovery protocols (Matagi, 2023). This personalized approach helps athletes maximize their training efficiency and achieve their specific goals more effectively. Virtual coaching platforms powered by AI provide athletes with real-time feedback and suggestions, allowing for a more interactive and engaging training experience. As a result, athletes can train more intelligently, optimizing their efforts and reducing the likelihood of burnout or injury (Abdullahi et al., 2024).

While the benefits of AI in sports science are clear, challenges like data privacy and high costs remain. Collecting sensitive athlete data presents ethical concerns about consent and security, and smaller teams may struggle to access these technologies. However, as technology advances and becomes more affordable, AI's role in enhancing athlete performance and health will likely grow. Future collaboration among sports scientists, coaches, fans, and tech developers will be essential for optimizing athletic performance (Wijaya et al., 2024).

The marriage of sports and technology has created a dynamic and transformative force in the realm of athletics. From meticulously analysing performance metrics to providing real-time feedback through wearable devices, technology has become an indispensable partner in optimising training, maximising performance, and minimising the risk of injuries. This synergy extends beyond the physical world, with advancements in virtual reality offering

immersive training experiences and data visualisation tools providing deeper insights into athletic potential (Abdullahi et al., 2024).

Modern professional and elite sports have become increasingly focused on developing athlete-centered structures, which incorporate state-of-the-art sports science facilities and resources for optimizing performance (Brocherie & Beard, 2021). However, issues can arise if certain groups within the club or federation are resistant to new, innovative ideas and evidence-based practices aimed at enhancing player performance and health.

Conclusion

In conclusion, sports science is essential for enhancing athletic performance, preventing injuries, and promoting well-being. It integrates knowledge from physiology, biomechanics, psychology, and nutrition, helping athletes and coaches make informed decisions about training, recovery, and nutrition for better results and longevity in sports. Beyond elite athletes, sports science benefits recreational enthusiasts and those looking to improve health through physical activity. Insights from this field assist in creating effective exercise programs for diverse populations, including those with specific health conditions. As technology progresses, sports science will evolve with advanced performance analysis, injury prevention, and rehabilitation techniques. Overall, its significance lies in bridging theory and practice, enabling individuals to reach their potential while fostering healthier lifestyles. Continued research and education in sports science will benefit athletes, coaches, and the wider community, ensuring safer and more effective participation in sports. Sports science combines these components to help athletes enhance their performance and longevity in their sports.

Declarations

Disclaimer (Artificial Intelligence)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGpt, COPILOT, etc.) and text-to-image generators have been used during writing or editing of this manuscript.

Consent

It is not applicable.

Data Availability Statement

The data supporting this study's findings are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Competing Interests

The author has declared that no competing interests exist.

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