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Embracing the ‘digital athlete’: How AI and digital technology can improve sports injury management: A Thematic review

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Abstract

Engaging in physical activity and exercise is essential for maintaining a healthy lifestyle and is a key factor in preventing and enhancing health. However, certain sports and physical activities may present an inherent risk of injury. Some intrinsic, extrinsic, mutable, non-mutable and initiating events may contribute as causes of injury in sports.

This thematic review will provide an overview of the mechanisms that lead to sports injuries and the various elements that influence them. It will also explore the effects of sports injuries, how technology and innovation can be used to manage these risks and injuries, the significance of early risk analysis, and finally, future trends and directions in artificial intelligence research to reduce the risk of sports injuries and the strategies for managing them.

By amalgamating the current state of knowledge within this field, the author aims to enhance our comprehension of the complex interplay and intricate relationship between the mechanisms of sports injuries and the prevention, management, and treatment of such injuries using emerging and evolving technologies.

It's essential to emphasize and underscore that advanced technologies should be seen as a complement and augmenting the role of healthcare professionals rather than substituting them, given the recognized limitations of the current system and the imperative necessity for personalized and tailored treatments that can vary from one athlete to another.

Keywords: Sports injury, management, technology, innovation, artificial intelligence, digital athlete, healthcare, review, prevention, treatment

Introduction

Sports Injuries

Sports injuries are a common occurrence that can have major repercussions on an athlete's everyday life. In this article, we will explore the various risk factors that may contribute to causing an injury. Sports injuries, in particular, are influenced by a complex interplay of these multiple risk factors.

When it comes to sports injuries caused by isolated events, the term 'Sports Injury' refers to any loss of bodily function or structure that is observed during clinical examinations. On the other hand, 'Sports Trauma' is defined as the immediate feeling of pain, discomfort, or loss of function that athletes themselves evaluate. Lastly, 'Sports Incapacity' is the situation when an athlete is sidelined due to a health assessment made by a reputable sports authority, resulting in a loss of time. When health service professionals observe excessive bouts of physical exercise causing impairment, it is referred to as 'Sports Disease' or 'Overuse Syndrome'. When athletes self-evaluate their condition, it is known as 'sports illness', and when recorded as time loss in sports participation by a sports body representative, it is called 'sports sickness' (Timpka *et al.*, 2014) ^[1].

Defining the ‘Digital Athlete’

An individual engaging in digital athleticism leverages technology and data to elevate their performance and safeguard against injuries.

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The methods used comprise the utilization of wearable devices, virtual reality training, and AI-powered analytics to monitor and enhance their physical capabilities. In this article, we will delve into the realm of the "digital athlete" and the ways in which technology, AI, computer vision, and related concepts enable athletes to unlock their full potential.

There are numerous benefits to being a digital athlete, such as:

- Digital athletes can enhance their performance by closely monitoring and analysing data, enabling them to identify specific areas for improvement. With this valuable insight, they can make targeted alterations to their training regimen, resulting in significant progress.
- Technology has revolutionized injury prevention for digital athletes. By enabling the monitoring of their body's response to training, potential injury risks can now be identified ahead of time. With this advanced tool, athletes can safeguard themselves from injuries before they even happen.
- Digital athletes have the advantage of utilizing technology to monitor their recovery progress and modify their training regimen, expediting a prompt and secure return to the game.

When discussing progress in sports biomechanics related to the technological advancements for the digital athlete, significant technological advancements can be seen in areas such as three-dimensional (3D) body scanning, *in-vivo* imaging, and innovative methods for motion capture and data analytics. Deep learning neural networks are quickly closing the gap between lab-based and field-based applications. Additionally, the rapid growth in hardware and computer processing power has led to the rise of the individualized 'digital athlete'. This grand concept enables the seamless fusion of various technologies, enabling the instant gathering, analysis, and presentation of real-time biomechanical data to provide immediate biofeedback (Alderson & Johnson, 2016) [2].

Rationale for the Review

The primary objective of this article is to emphasize how recent technological innovations are fundamentally reshaping the approach to injury prevention and management among athletes. By delving into the emergence of what is commonly referred to as the 'digital athlete' and elaborating on the advantages of employing technology and data to enhance performance, the article offers profound insights into the potential of artificial intelligence (AI), wearable devices, virtual sports environments, and AI-driven analytics in the context of preventing and managing sports-related injuries. To illustrate the practical utility of these technologies and how they can help with major injuries like ACL, the article cites real-world examples from professional sports leagues such as the NBA and NFL (Dodson *et al.*, 2016) [3].

Ultimately, the article underscores the future possibilities in the arena of sports injury management, as technology continues to evolve and offers transformative potential. In essence, the central aim of this review article is to educate readers about the revolutionary influence of AI and digital technology in elevating the practice of sports injury management, enabling athletes to optimize their performance (Vivek *et al.*, 2022) [4] while minimizing the risks of injury (The CARE Consortium Investigators *et al.*, 2021) [5].

The Escalating Importance of Sports Injury Management:

The domain of sports injury management is rapidly gaining prominence, primarily due to the surging participation in sports and athletic pursuits. Given the profound consequences that injuries can have on athletes' careers and well-being, the imperative for effective management cannot be overstated (Claudino *et al.*, 2019; H. Dhillon *et al.*, 2017; Eichner, 2023; Escher & Barkley, 2022; Hootman *et al.*, 2007; Klein *et al.*, 2018; Weightman & Browne, 1975) [6-12].

Strides in Technological Advancement and Artificial Intelligence:

Recent years have borne witness to remarkable strides in the realm of technology and artificial intelligence. These advancements hold the potential to profoundly reshape the landscape of sports injury management, offering innovative solutions and methodologies that are poised to revolutionize the field (Debarba *et al.*, 2018; Majumdar *et al.*, 2022) [14, 15].

The Potential to Revolutionize Injury Prevention and Rehabilitation:

The promise of technology and AI lies in their capacity to significantly enhance strategies for injury prevention through predictive analytics and to elevate the rehabilitation process by employing personalized, data-driven approaches. These innovations stand to substantially mitigate the risks of injury and shorten recovery times (Rigamonti *et al.*, 2020) [16].

The Imperative for an All-Encompassing Examination:

While research at the intersection of technology, AI, and sports injury management is burgeoning, there exists an unmet imperative for a comprehensive analysis of this evolving body of work. Such an analysis is critical to delineate prevailing trends, confront obstacles, and evaluate the overall state of knowledge in this nascent field (Bullock *et al.*, 2022; Mizels *et al.*, 2022; The CARE Consortium Investigators *et al.*, 2021) [17-19].

Immediate Practical Implications for Athletes and Sports Experts:

The understanding of how technology and AI can revolutionize sports injury management is not merely academic but bears direct, tangible consequences for athletes, coaches, sports medicine professionals, and the broader sports industry. This review, therefore, serves as a resource to empower these stakeholders to make well-informed decisions and integrate forward-thinking practices into their work.

Bridging the Gap in Knowledge:

Through this comprehensive review, our foremost objective is to bridge the gap between the lightning-paced progress of technology and AI and their practical application in the field of sports injury management. Such knowledge stands to be of immense value in harnessing the full potential of these tools.

Charting the Course for Future Research Initiatives:

As the final facet of its contribution, this review will function as a compass, guiding forthcoming research endeavours. It will pinpoint areas necessitating in-depth exploration, delineate potential challenges, and underscore emerging opportunities within the domain of digital athlete management.

In summation, the rationale underpinning this review is rooted in the swiftly increasing importance of sports injury management, the monumental strides made in the realm of technology and AI, the transformative potential of these innovations in injury prevention and recovery, the pragmatic

benefits they hold for diverse stakeholders, and the pressing need to furnish an all-encompassing exposition of this field. Ultimately, this review serves as both a scholarly and pragmatic guidepost, shaping the trajectory of future research and practical implementation within the realm of the digital athlete.

The injury mechanism

Overview

Sport-related injuries rank as some of the most prevalent injury types, constituting a notable challenge in the realm of public health. Historically, the focus in injury management has disproportionately centred on symptom alleviation, often overlooking the intricate physiological responses that ensue post-injury. However, the significance of comprehending these physiological processes has been steadily amplifying. In recent decades, exhaustive research have delved into the mechanisms of tissue regeneration following injuries and degenerative conditions, underscoring the imperative of attaining a profound understanding of the fundamental physiological underpinnings of sports injuries. (Hamlin & Draper, 2013) ^[20]. In the comprehensive strategy known as the 'sequence of prevention' for sports injuries, several key steps are involved. Initially, a thorough understanding of the extent and nature of sports injuries is essential. Subsequently, the identification of contributory factors and mechanisms responsible for these injuries is imperative. The third phase entails implementing preventive measures grounded in the etiological factors and mechanisms recognized in the second step. Lastly, the effectiveness of these measures is assessed by revisiting the initial data collection. The severity of sports

injuries can be assessed using six criterion: the injury's nature, treatment duration and type, time away from sports, work hours lost, permanent damage, and associated costs (van Mechelen *et al.*, 1992) ^[21]. Behaviourists have also elucidated their approach to injury risk factors by examining an athlete's behavioural tendencies (Verhagen *et al.*, 2010) ^[22].

As a result, the overarching importance of this multifaceted approach in sports injury management, and the exploration of its intricate interplay with anatomy, physiology, epidemiology, behaviour, and the contemporary integration of AI and technology, underscores the essential nature and central focus of this research article.

Component of Influence

The subject of injury mechanisms in sports has been extensively explored in various studies that have put forth models for understanding sports injuries. These models include the Complex Systems Approach, the Reductionist Approach, and others (Bittencourt *et al.*, 2016) ^[23]. The Multifactorial Model propounded by (Meeuwisse, 1994) ^[24] which has advocated for the use of this multivariate approach, holds the potential for more accurate prediction of athletic injuries and offers valuable insights for effective injury prevention strategies. This Multifactorial Model suggests that considering multiple factors can better predict and prevent sports injuries. It's now common to categorize injury risk factors as either coming from within the athlete (Intrinsic) or external factors (Extrinsic), along with considering the event that triggers the injury (Inciting event) (Sigurdson & Chan, 2021) ^[25].

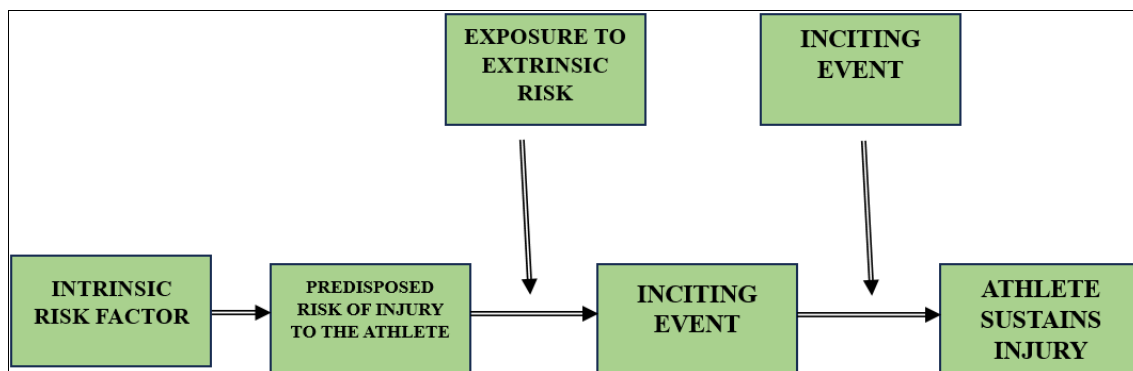


Fig 1: Multifactorial interplay of risk factors

Detrimental Effect on Athlete

In a broad context, 'sports injury' encompasses injuries commonly occurring during sports or exercise. These injuries may result from accidents, inadequate training, suboptimal equipment, poor conditioning, or a lack of warm-up and stretching, as discussed in the previous multimodal approach section. While sports or exercise can lead to injuries affecting various parts of the body, the term 'sports injury' typically pertains to musculoskeletal issues, involving muscles, bones, and associated tissues like cartilage.

Injuries have both physical and psychological consequences on an athlete's health. Studies indicate that injured athletes often experience heightened tension, hostility, depression, uncertainty, fatigue, and confusion compared to their non-injured peers (Pearson & Jones, 1992) ^[26]. Those with musculoskeletal injuries are at a higher risk of developing future depression. Additionally, female athletes tend to report more depressive symptoms than their male counterparts (Marconcin *et al.*, 2023) ^[27].

Fortunately, many sports injuries can be effectively treated, enabling individuals to return to a satisfactory level of physical activity. It's worth noting that sports and exercise-related injuries aren't confined to elite athletes but are prevalent at all levels of participation. While any physical activity carries some injury risk, the overall health benefits of staying active far outweigh this risk (Bhardwaj, 2013) ^[28].

Discussion

There is a scarcity of conclusive evidence for precise and reliable injury prediction. Progress has been achieved in identifying individuals at potentially greater risk and in recognizing opportunities for implementing preventive measures to reduce these risks. Extensive research is dedicated to comprehending and addressing the adverse impacts of sports injuries across different population groups and implementing various rehabilitation techniques (M. S. Dhillon *et al.*, 2012; Finch *et al.*, 1999; Griffin *et al.*, 2020; Hootman *et al.*, 2007; Kallinen & Markku, 1995; Klein *et al.*,

2018; Mattson *et al.*, 2022; H. Naik & Trojian, 2021; van Mechelen *et al.*, 1992) ^[29-37], encompassing physical consequences, psychological effects, and psychosocial harm among both adults and adolescents (Fernandes *et al.*, 2014; Haraldsdottir & Watson, 2021; Marconcin *et al.*, 2023; Passer & Seese, 1983; Pearson & Jones, 1992; Verhagen *et al.*, 2010; Von Rosen *et al.*, 2017; Wiese-bjornstal *et al.*, 1998) ^[38-45].

The current state of research warrants enhancement, with an emphasis on the future potential of artificial intelligence and evolving technology for sports injury prevention and management, deserving increased attention and significance.

Integration of artificial intelligence & technology

Overview & Historical Advances

Artificial intelligence (AI) stands as one of the most promising domains in healthcare, holding immense potential for enhancing well-being. The present era of digital health provides a multitude of opportunities for elevating healthcare standards. The utilization of self-learning algorithms or AI is still in its initial phases of advancement.

AI methodologies have been employed to address various aspects of team sports, including forecasting match outcomes, tactical decision-making, player investment strategies, and injury prediction (Beal *et al.*, 2019) ^[46]. (Adesida *et al.*, 2019) ^[47] analyzed and examined a review to gain deeper insights into the utilization of wearable technology in sports for performance enhancement and injury prevention. When considering the substantial costs and harm associated with injuries in athletics, injury prevention emerges as a domain with significant promise. Nevertheless, it is noteworthy that this potential remains largely untapped when compared to other areas of focus.

How Can Technology & Innovation Help

AI and digital technology possess the capacity to amass vast datasets related to both athletes and consumers, including metrics like activity levels, movement patterns, and heart rate. Furthermore, cutting-edge technologies now have the capability to record essential health indicators such as blood pressure, oxygen saturation, and physiological data. This wealth of information is leveraged for the proactive identification of individuals at elevated injury risk and for the formulation of personalized training regimens aimed at supporting recovery and rehabilitation.

Traditional sports have undergone a substantial transformation due to technological integration. Technology has seamlessly woven itself into the fabric of training and competition for a multitude of athletes, offering an array of tools, from wearable devices designed to monitor performance to sophisticated video analysis software.

To illustrate, consider the sport of football, where players don GPS tracking devices to record and assess metrics like speed, distance covered, and heart rate during both training sessions and actual games. This data is then subjected to rigorous analysis to evaluate performance and refine training programs. In the realm of tennis, players leverage video analysis software to dissect the movements of their opponents, thereby enhancing their own strategic acumen.

As technology progresses, the potential for sports injury management becomes boundless. Looking ahead, we anticipate the emergence of increasingly sophisticated wearable devices, virtual reality training modules, and AI-driven analytics that will play a pivotal role in maintaining athletes' well-being and optimizing their performance. Technology now empowers athletes to diligently track their

physical condition, proactively prevent injuries, and expedite their recovery processes.

With the growing adoption of the 'digital athlete' lifestyle, we envisage a decline in injuries and a surge in athletic performance across various sports. This transformative trend is set to enhance the overall health and competitiveness of athletes.

Artificial Intelligence & Technology in Sports Injury Management

Wearable Devices

Wearable devices like fitness trackers and smartwatches are increasingly popular among athletes. They monitor various metrics such as heart rate, steps, and sleep patterns, providing athletes with insights into their overall health and guiding training adjustments. Wearables can track real-time physiological data over extended periods, helping monitor performance and detect signs of fatigue or injury. Progress in technology has enabled individual endurance athletes, sports teams, and medical practitioners to closely observe functional movements, workloads, and biometric markers in order to enhance performance and minimize the risk of injuries. Monitoring is facilitated through various types of sensors, such as pedometers, accelerometers/gyroscopes, and global positioning satellite (GPS) devices, which track movement. Furthermore, physiologic sensors like heart rate monitors, sleep trackers, temperature sensors, and integrated sensors contribute to a comprehensive understanding of an individual's physical condition.

Furthermore, consistent use of wearables allows continuous and remote data collection, contributing to a comprehensive understanding of an athlete's well-being. In terms of injury management, these devices can help identify injury risks by monitoring an athlete's body. For instance, if an athlete's heart rate remains consistently high during training, it may indicate overtraining and potential injury risk. Detecting these early signs enables athletes to adapt their training to prevent injuries (Adesida *et al.*, 2019; Chidambaram *et al.*, 2022; Li *et al.*, 2016; Preatoni *et al.*, 2022; Seshadri *et al.*, 2017, 2021; Willy, 2018; Zadeh *et al.*, 2021) ^[48-54].

Computer Vision and Real Time Video Analysis

Computer vision is currently harnessed for analysing video footage of athletes to detect subtle changes in their movements, potentially signalling injury risks. This technology is equally valuable for swiftly identifying athletes who have sustained injuries, aiding in prompt triage and identifying conditions like concussions (B. T. Naik *et al.*, 2022; Wang & Jiang, 2021; Zhu, 2021) ^[55-57]. The data gathered can then be employed to quantify training load, adapt training regimens, or recommend additional rehabilitation exercises. Recent advancements in video analysis and computer vision, driven by deep learning, have significantly enhanced these capabilities. Computer vision, a rapidly evolving technology within the realm of artificial intelligence, continues to broaden its application areas.

Additionally, the use of Wireless Sensor Networks, which deploy spatially distributed sensors to monitor real-time physical conditions like temperature, vibration, or motion, generates sensory data (Senouci & Mellouk, 2016) ^[58]. In tackle-collision sports, video analysis is employed to objectively track, detect, and recognize athletes' movements and actions during matches, even from a distance (Martin *et al.*, 2021) ^[59]. Combined with an improved understanding of injury causation and skill execution, these tools augment our

comprehension of how injuries occur and facilitate match-day injury management.

Artificial intelligence (AI) and biomechanics are instrumental in the development of training programs designed to either maintain or restore tissue health. The vitality of tissues hinges on the dynamic mechanical conditions they encounter during daily activities and rehabilitation processes, which stem from the intricate interplay of tissue motion, loading, biological factors, and morphological characteristics. Sustaining or rehabilitating musculoskeletal tissues necessitates the pursuit of 'ideal' *in vivo* tissue mechanics, attainable through the use of real-time biofeedback. Current research indicates that biofeedback technologies can enhance their efficacy and precision by integrating personalized neuromusculoskeletal modelling, driven by real-time motion capture and medical imaging data. Achieving model personalization is a pivotal factor in generating physically and physiologically accurate forecasts of tissue biomechanics. Furthermore, ensuring real-time model execution involves code optimization techniques and artificial intelligence methodologies.

Recent developments have also revealed that laboratory-based motion capture and biomechanical modelling can be extended beyond traditional laboratory settings, utilizing wearable sensors and artificial intelligence technologies. The next stage of advancement lies in the integration of these cutting-edge technologies into user-friendly products designed to guide individuals in real-world settings, facilitating the preservation or restoration of tissue health (Lloyd, 2021) ^[60].

Digital Twins and AI Powered Analytics

Digital Twins are playing a pivotal role in the transformation of the healthcare industry, facilitating a shift toward healthcare that is more personalized, intelligent, and proactive. This innovative concept has become feasible thanks to advancements in the Internet of Things (IoT) and the analysis of vast datasets (Ma & Pang, 2019) ^[61]. Digital twinning has already found practical applications in complex systems and in the field of medicine, providing a structured framework for generating virtual representations of individuals by integrating data from digital devices, omics, imaging, and electronic medical records. A digital twin serves as a parallel representation of a person's physical state prior to any medical intervention, enabling both retrospective and real-time monitoring of a wide spectrum of parameters. In the context of contact sports, the utilization of wearable technology to create a digital twin, based on an athlete's baseline health data, holds the potential for objective data collection, facilitating remote monitoring and assessment. It's noteworthy, however, that ethical considerations regarding this technology are still developing and evolving (Barricelli *et al.*, 2020; Bruynseels *et al.*, 2018; Sahal *et al.*, 2022) ^[62-64].

As per the National Safety Council (NSC), there were around 468,000 exercise-related injuries in 2019, even before the pandemic hit. Without appropriate guidance, this number is likely to rise. Hence, there is a growing need for systems that can monitor exercise performance, both in the short and long term, to prevent injuries. AI-powered analytics are gaining popularity in the realm of sports. These tools employ machine learning algorithms to analyse data and offer insights into an athlete's performance. By tracking various metrics, such as speed, power, and agility, AI-powered analytics enable athletes to pinpoint areas needing improvement and make targeted adjustments to their training routines (Flores *et al.*, 2021) ^[65].

Regarding injury management, AI-powered analytics prove

valuable in monitoring an athlete's physical condition and identifying potential injury risks. For instance, a decrease in a soccer player's speed and agility over time could indicate an underlying injury. Detecting these warning signs early empowers athletes to adapt their training regimens and prevent injuries. Research laboratories worldwide are investing in new technologies, evaluating both their technical and clinical validity. A burgeoning field seeks to supplement traditional assessment biomarkers used in monitoring sports-related concussions, incorporating novel technologies like biomarkers and wearables to expedite the recovery process after injury (Agarwal, 2023; MOSELE, 2018; Rathi *et al.*, 2020; YAN, 2022) ^[66-69].

Real World Examples

- The National Basketball Association (NBA) has been a pioneer in leveraging technology to enhance sports injury management. In 2016, the NBA collaborated with Catapult Sports, a company specializing in sports analytics, to equip players with wearable devices for tracking their movements during games. The data collected from these devices is subsequently employed to monitor player fatigue and recognize potential injury risks. Additionally, the NBA has introduced a "rest and recovery" initiative that utilizes data from these wearables to ascertain when players require breaks from training and games. This proactive approach has led to a reduction in the number of injuries and an enhancement in player performance (Ambler, 2021; Dowsett, 2022) ^[70, 71].
- The National Football League (NFL) has embraced technological advancements in sports injury management. In 2018, the NFL collaborated with STRIVR, a tech company, to introduce virtual reality training for its players. This innovative technology allows players to engage in game-like scenarios without physical contact, aiding in skill improvement and maintaining sharpness during injury recovery. In addition to virtual reality (VR), the NFL has incorporated Augmented Reality (AR), Mixed Reality (MR), and Simulated Reality (SM) technologies. SM, in particular, allows American football players to engage in practice games without injury risks, which can be highly beneficial for Quarterbacks, enabling them to make split-second decisions without the fear of being tackled or harmed. The NFL has a longstanding commitment to player safety and has introduced impact-tracking technology as a significant advancement. This technology employs sensors integrated into helmets and shoulder pads to measure the force of collisions on players. This data aids medical personnel in assessing the severity of injuries sustained during gameplay (1p21.admin, 2022; How the NFL Uses Virtual Reality for Training | DDINC, n.d.; Virtual Reality Training Helps Transform the NFL, n.d.) ^[72-74].

Looking Ahead to the Future

With the ongoing advancement of technology, the possibilities for sports injury management are virtually boundless. Looking ahead, we anticipate the utilization of even more advanced wearable devices, virtual reality training programs, and AI-powered analytics to support athletes in maintaining their health and optimizing their performance.

However, amid this technological progression, it's crucial to note that sustainability often takes a back seat in comparison

to technical, economic, and user experience considerations. In the sports arena, there is an opportunity to encourage sustainable practices and cultivate sustainable 'norms' through innovative formats that address the ethical issues arising from technological developments.

The rise of the digital athlete has spurred innovation in the sports industry. Virtual reality technology has opened up new horizons for training and competition, while wearable devices continue to advance and enhance their accuracy. As technology continually progresses, we can anticipate even more innovations in the realm of sports.

To address these matters, there's a specific need for the centralization and creation of an ecosystem for data, reducing the knowledge gap and increasing awareness regarding health and sports performance. This approach could equip both players and the public with more comprehensive information on aspects like nutrition, training load, and rehabilitation.

This might lead to increased opportunities for digital athletes, with virtual reality technology becoming more accessible and affordable, and wearable devices becoming more sophisticated. Additionally, the landscape of traditional sports may witness a transformation, with the incorporation of virtual elements to enhance the fan experience and make sports more interactive and engaging.

Methodology & data availability

- The authors meticulously performed comprehensive searches across various databases, including Google Scholar, PubMed, Science Direct, MDPI, Google Books, IEEE Xplore, and SCOPUS.
- The theme and sub-themes of the current conference stated "Nurturing the future in medical care NFMC – Medicon – 23" were of main importance for guiding the research idea of this thematic review.
- Search terms included sports injury, artificial intelligence, digital athlete, wearable technology, sports injury management and prevention, computer vision, AI powered Analytics, Case Study.
- The sharing and availability of data does not apply to this article, as no datasets were created or examined as part of this research synthesis. This is due to the inherent nature of the study.

Conclusion

In the realm of sports, injuries are an inevitable part of the game, ranging from sprained ankles to torn ligaments and concussions. Yet, the evolving landscape of technology, alongside the advent of the 'digital athlete,' is reshaping how we approach sports injury management. This thematic review delves into the application of AI and digital technology in optimizing athlete well-being.

Recent years have witnessed a remarkable transformation in the world of sports. The fusion of technology and the growing popularity of virtual sports has given rise to a novel athlete archetype - the digital athlete. These individuals harness technology to elevate their competitive prowess, displaying adaptability in navigating the ever-evolving tech and AI landscape. Embracing the concept of the digital athlete offers a multitude of advantages for individual athletes and the broader sports industry. Achieving excellence as a digital athlete necessitates a keen awareness of cutting-edge technology and adeptness in utilizing it effectively, including staying attuned to developments in virtual sports and wearable technology. ;Several types of sports injuries, such as muscle strains, lend themselves to efficient treatment and prevention

when identified early or when the likelihood of their occurrence can be forecasted. The utilization of AI and digital technology in athlete monitoring and injury prevention is still in its embryonic stages, but the advantages are clear. By accumulating and analysing extensive datasets, AI and digital technology hold the potential to pinpoint individuals at heightened risk of injury before it materializes. They can also facilitate the creation of personalized training regimens for both injury prevention and post-injury recovery. Furthermore, these technologies stand poised to revolutionize how athletes prepare, respond to, and recuperate from injuries, with a specific focus on diversity, sustainability, and equity to ensure that the benefits are evenly distributed.

The emergence of the digital athlete marks a transformative juncture in sports injury management. Thanks to technology, athletes can now meticulously monitor their bodies, avert injuries, and expedite their recovery. As more athletes embrace the 'digital athlete' lifestyle, a decline in injuries and an upswing in performance are anticipated across all sports. This emergence represents a proactive approach in the realms of sports medicine and sports injury prevention and rehabilitation. It engages athletes, trainers, coaches, fitness experts, physiotherapists, sports medicine specialists, developers, and more in a collaborative effort to make necessary adjustments to training programs, thus reducing the risk of injuries.

AI algorithms, by analysing athlete data and performance history, are capable of identifying weaknesses, imbalances, or areas in need of improvement. Subsequently, these systems offer personalized recommendations and exercises to enhance strength, flexibility, and overall performance while mitigating the risk of re-injury. Through the analysis of medical records, imaging studies, and patient data, AI systems provide evidence-based insights and recommendations that aid clinical decision-making, culminating in swifter and more accurate diagnoses, as well as personalized treatment plans that expedite athletes' recovery.

AI algorithms are adept at scrutinizing data to identify trends, patterns, and best practices in injury prevention and management. This data-driven approach empowers evidence-based decision-making, leading to more effective treatment strategies and optimized training protocols. By evaluating muscle strength, range of motion, and functional movements, AI systems supply objective metrics for assessing the efficacy of rehabilitation programs. These metrics, in turn, enable healthcare professionals to make informed decisions, ensuring a secure and timely return to sports. AI algorithms can analyse extensive datasets from diverse sources, such as clinical trials, research studies, and athlete performance data, unveiling fresh insights and trends. This knowledge serves as the foundation for the development of new techniques, technologies, and interventions designed to enhance sports injury prevention and management.

In summary, the integration of AI and sports medicine brings forth a multitude of benefits in sports injury management. These include improved injury prevention, personalized training and rehabilitation regimens, enhanced diagnostic and treatment procedures, real-time monitoring and feedback, data-driven decision-making, rehabilitation oversight, and the stimulation of research and innovation. Collectively, these advantages contribute to superior athlete care, reduced injury vulnerabilities, and elevated sports performance.

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