

# **Mental Wellbeing Technologies in High-Performance Sport: Current Knowledge and Future Directions**

by

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## **Abstract**

This research explores the intersection of high-performance sports and the evolving landscape of mental wellbeing technologies, situated within the context of shifting paradigms regarding wellbeing within the sporting realm. Primary research was conducted through digital interviews to understand the perceptions and attitudes surrounding mental wellbeing in sports and how the emergence and adoption of technologies contribute to this discourse. The acquired insights, derived from both primary and secondary research sources, were subsequently synthesized and organized using Curry and Hodgson's (2008) Three Horizons tool. This futures analysis framework was employed to explore the current state of mental wellbeing and technology integration in high-performance sports, an initial vision of the future as imagined by key stakeholders, the necessary near-term changes to materialize this desired future, strategic recommendations to propel the field forward, and an overview of select technologies that can be harnessed to bolster elite athlete mental wellbeing. This study centers its attention on technologies that encompass two important domains in elite sports: mental health and the development of mental skills.

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# Table of Contents

- Introduction..... 6
- Project Structure: Overview of Three Horizons Model ..... 8
- Methodology ..... 9
- Overview of Stakeholders..... 11
- Horizon 1: Describing the Current State..... 17
  - Context ..... 17
  - Where Do Pain Points Exist in the Current State? ..... 22
- Horizon 3: The Hoped-For Future ..... 30
- Horizon 2: How May We Reach the Hoped-For Future? ..... 33
- Strategic Recommendations..... 42
- Environment Scan of Wellbeing Technologies ..... 44
  - Applications of Wellbeing Technologies ..... 44
  - Overview of Wellbeing Technologies..... 46
- Conclusion ..... 53
- References..... 54
- Appendix A: Example Interview Questions ..... 67

# Introduction

The high-performance sports industry is experiencing a profound transformation at the intersection of culture, science, medicine, and technology. Advancements in biometrics, wearable devices, and healthcare infrastructure, along with substantial investments in sporting technology, are propelling the sector into an era of unprecedented opportunities. While extensive research has traditionally focused on enhancing athletes' physical performance, there is a growing recognition of the pivotal role that mental health and psychology play in achieving peak performance. However, these fields have often operated independently, lacking integration and collaboration, thus instigating this inquiry.

This project delves into the evolving relationship between wellbeing technologies, high-performance sports, and athlete mental health. It addresses a broad audience, including athletes, coaches, supporting service providers such as sports psychologists, psychiatrists, mental skills coaches, and trainers, administration leadership, and wellness technology and performance companies. As the boundaries between performance contributors continue to blur, understanding the holistic nature of athlete health becomes increasingly important.

The relevance of this work is emphasized by the current cultural shift towards a deeper value of mental health and overall wellbeing, particularly in the wake of the COVID-19 pandemic (World Health Organization, 2022). Society has embraced a more profound understanding of the need for improved mental wellbeing, leading to a reevaluation of factors contributing to wellbeing. This shift in cultural discourse emphasizes the importance of mental health education and accessibility, and holistic perspectives on wellbeing. In elite sports, where athletes often experience heightened stress, mental health and overall wellbeing have become universal priorities, especially in relation to understanding peak performance. Athletes represent a unique demographic for mental health interventions, given the competitive nature and pressures of elite sports.

High-profile athletes, including Michael Phelps, Clara Hughes, Mardy Fish, Kevin Love, Simone Biles, and Naomi Osaka, have openly shared their mental health challenges, becoming advocates for mental health both within the sports world and beyond (Forrester, 2021; Kliegman,

2022; Hicks, 2011; Love, 2018, Elliott, 2021). These athletes' experiences have spotlighted the critical intersection of mental wellbeing with athlete health and performance. Their stories have challenged and reshaped the long-standing stigma associated with mental health in sports, underscoring the urgency of addressing these issues.

This research project seeks to contribute to the growing discourse around wellbeing and mental health in sports. It investigates the complex athlete ecosystem and explores how emerging technologies can provide transformative solutions for athletes, coaches, and supporting service providers. The COVID-19 pandemic accelerated the integration of digital interventions into mental healthcare systems, setting the stage for new opportunities in athlete mental health support (Taylor et al., 2020). However, this integration also highlighted potential resistance to technology among mental healthcare providers.

This research endeavors to bring this mental wellbeing to the forefront, as a key contributor to performance, and foster the adoption on a more holistic perspective on athlete development. It explores technologies for mental wellbeing tracking and assessment, development, and treatment applications to support athletes in enhancing performance and achieving their goals.

This project primarily focuses on professional and commercial high-performance sports, where the dual components of an athlete's physical and psychological health are foundational to their success and, by extension, the long-term financial opportunities for them and their teams. Investments in performance technologies, sports psychologists, sports psychiatrists, and specialized wellbeing coaches are increasingly common in these organizations, thanks to increased need and funding.

In today's ultra-competitive environment, the distinction between good and great athletes is narrowing, emphasizing the need for holistic athlete development that centralizes mental health and wellbeing to contribute to improved performance. This report explores two key components of mental wellbeing in high-performance sports: mental health and mental training, examining the role of technology applications in athlete wellbeing and sports psychology. It underscores the importance of viewing athlete health holistically, recognizing that physical and mental wellbeing are interconnected facets of elite sports performance.

# Project Structure: Overview of Three Horizons

## Model

This project will follow the Three Horizons model, a futures analysis tool used to map the current state of a system, the preferred future(s), and paths to close the gap between the two timelines (Curry & Hodgson, 2008). This model was selected to support emerging changes and sense-making trends at the intersection of high-performance sport and wellbeing technologies within the context of shifting ideologies around wellbeing in sport.

The project is structured as follows:

**Horizon 1:** The current state and its existing paradigms and ideologies. This section provides an analysis of the current state of elite athlete wellbeing and the existing paradigms and ideologies around it. The focus is on understanding the current system and what elements are no longer fit for purpose. The section will also explore what is worth keeping from the present and what evidence of the future can be found in the present. Signals of change and emerging technologies that impact elite athlete wellbeing will also be discussed.

**Horizon 3:** The Hoped-For Future. This describes what the long-term future could look like if positive change is implemented. This section explores an ideal future for elite athletes' wellbeing and performance. It is based on emerging trends and signals of change that suggest a positive shift in the long-term future.

**Horizon 2:** How to get from the current state to the Hoped-For Future in the near to medium-term. This section outlines the steps needed to bridge the gap between the current state and the hoped for future. It will provide strategic recommendations on achieving the desired future by exploring emerging technologies, shifting values or ideologies, and use cases that can contribute to the evolution of the current system.



# Methodology

The purpose of this research is to investigate how wellbeing technology can support elite athlete wellbeing and performance, identify the types of technology that can aid in this, explore the challenges to the adoption of wellbeing technologies, and determine who else within elite sports may benefit from integrating wellbeing technologies into their practice. A mixed-methods approach, consisting of both primary and secondary research, was used.

The secondary research involved an in-depth review of existing literature on wellbeing in elite sports, mental wellbeing, and wellbeing-based technologies, and performance technologies. The primary research component consisted of confidential, semi-structured, 60-minute virtual qualitative interviews with athletes, supporting services professionals, subject matter experts, and organizational representatives within the system. Primary research probed around the challenges to overall wellbeing, technology adoption, current technology applications to support athlete wellbeing and performance, benefits, and concerns of technology, and the hopeful future athletes and experts envision for this domain. Please see Appendix A: Example Interviews Questions for more details. Personal identifiers were removed from responses to ensure participant confidentiality.

This primary research specifically reflects the perspectives of those who work in or with professional sports teams. Interview participants compete and work with athletes across professional leagues like the National Football League (NFL), English Premier League (EPL), Professional Women's Hockey Player Association (PWHPA), National Hockey League (NHL), and United Soccer League (USL).

The collected data was analyzed through a stakeholder matrix, environment scan, and three horizons future analysis. The stakeholder matrix aids in uncovering the relationships and influences between stakeholders and their needs. The environmental scan collected findings to better understand the system in which elite athletes operate, signals of influence or change, emerging technologies, and areas of tension or concern. The data was then synthesized into key themes and insights and structured based on the three timeframes outlined in the Three Horizons future analysis: the present state (Horizon 1), the hoped-for long-term future (Horizon 3), and the

near to mid-term future (Horizon 2). This future analysis provides the foundation for strategic recommendations that align with the hoped-for future for elite athlete wellbeing and performance technologies.

### **Limitations**

This research primarily reflects a Western perspective, potentially overlooking regional variations and cultural nuances. Additionally, it does not encompass the firsthand experiences of elite athletes with disabilities, transgender athletes, or non-binary athletes, all of whom may encounter distinct challenges to their mental wellbeing. For instance, paralympic athletes confront unique stressors and obstacles, including inadequate healthcare and insufficient organizational consideration of their specific needs (Bundon et al., 2022). This work also does not explore minority or intersectional cultural perspectives within sports and their implications for mental wellbeing. Nevertheless, further research targeting at-risk populations and demographic-specific requirements will enhance our understanding of cultural contexts and aid in the development of equitable, individualized technology solutions. It is important to note that the data collected for this study primarily originates from English-language sources or English-translated content within the university database.

# Overview of Stakeholders

To understand the current state of athlete mental wellbeing and technology, it is imperative to adopt a perspective that encompasses all relevant stakeholders. High-performance athletes, coaches, and governing sports bodies operate within a complex ecosystem, each with distinct objectives, roles, and responsibilities. As emphasized by Purcell et al. (2022), a thorough examination must consider the individual, contextual, and systemic needs inherent to this ecosystem. This approach acknowledges that the challenges and stressors faced by high-performance athletes are multifaceted and influenced by various factors.

By considering viewpoints and concerns across stakeholders, including athletes, coaches, and governing bodies, a more nuanced understanding of the issues surrounding athlete mental wellbeing and technology emerges. This perspective enables these key stakeholders to identify and address the specific stressors and demands faced by athletes within their unique contexts. Furthermore, this view facilitates a strategic assessment of available technological tools, allowing stakeholders to determine how technology can be effectively integrated to optimize athlete mental wellbeing and overall performance. In understanding the collective needs and perspectives of stakeholders, a tailored and effective approach to enhancing athlete mental wellbeing through technology can be explored, aligning the interests and objectives of all parties involved (Chee, 2010; Jensen et al., 2020).

## **Athletes**

Athletes are the heart of sports. Their involvement and performance are paramount to the entire sports ecosystem. Competing at elite levels demands immense dedication from athletes, encompassing significant investments of time, energy, and financial resources. Most elite athletes begin their sporting journey from a young age, shaping their lives around their chosen sport.

High-performance athletes thrive on routine, finding comfort and confidence in structured daily schedules that best support their peak performance. At the elite level, athletes typically allocate a substantial portion of their daily routines, ranging from 45-minutes during

intense playoff seasons to up to four hours per day, for activities such as specialized treatments, mental visualization exercises, or game footage analysis. Athletes want to feel confident in their preparation for competition, and many are open to exploring new techniques or technologies that will give them a performance edge.

However, it's crucial to acknowledge the significant disparities that exist within the realm of elite athletics, particularly in terms of compensation. Athlete earnings vary widely, influenced by factors such as the sport they compete in, the league they participate in, the team they represent, and their individual status within the sport. While some athletes may secure lucrative multi-million-dollar contracts, others must juggle multiple jobs, even at the professional level, to sustain themselves financially. This diversity in income levels significantly affects an athlete's access to essential resources and support systems regarding mental wellbeing.

Furthermore, an athlete's performance outcomes often dictate their job stability with the industry, contributing to considerable financial pressures (Gonzalez, 2023). Many athletes grapple with the constant need to prove themselves, and performance cycles are part of their reality, with not every day being perfect. These challenges highlight the multifaceted nature of elite athletes' lives and underscore the importance of understanding their unique needs and circumstances.

## **Coaches**

Coaches play a critical role in devising strategies and training routines that enable athletes and teams to excel in sports. Head coaches wield significant influence in shaping the training environment and overall team culture. However, the nature of their position often means that job security hinges on specific performance metrics, such as the number of wins and the consistent performance of their athletes. Coaches face unique stressors related to their occupation, including the immense pressure to achieve success, heavy workloads, uncertainties about job security, frequent travel demands, and a sense of isolation. These stressors can contribute to the development of symptoms of depression, which coaches may experience at rates similar to those observed in the general population (Purcell et al., 2022).

Balancing the imperative to win with the responsibility of fostering the holistic wellbeing of athletes poses a significant challenge for coaches, particularly at elite levels where the stakes are exceptionally high. While athletes are expected to deliver peak performances, winning in competitive sports is never guaranteed, and the intense pursuit of victory can overshadow the prioritizing of athlete wellbeing. Coaches frequently find themselves in precarious positions, viewed as expendable assets whose job security is closely linked to the performance outcomes of their athletes or teams.

### **Supporting Service Providers**

Supporting services, including trainers, physiotherapists, psychologists, nutritionists, mental skills coaches, and managers, offer specialized expertise to help an athlete's performance and career trajectory. Although each role is distinct, collectively, they contribute to an athlete's holistic wellbeing and goals. Trainers, nutritionists, and physiotherapists focus on optimizing physical performance and guiding athletes through rehabilitation or recovery processes. Psychologists and mental skills coaches equip athletes with the knowledge and tools to maintain peak mental form amid changes and challenges. Meanwhile, managers play a pivotal role in advancing athletes' professional journeys. The efficacy of their services frequently determines the job security of supporting service providers. Elite athletes, especially at the professional level, often have teams of up to seven supporting service providers behind them, depending on the available resources. These supporting service providers are funded and employed either by the larger organization the athlete competes under (e.g., professional sports team, National Collegiate Athletics Association A Division 1 team administration) or directly contracted by the athlete.

### **Administrators**

This group encompasses management (e.g., general managers, athletic directors) and other key figures who, while not directly involved in athletic performance training, are essential in shaping the strategy for a team or program's success. Administrators also allocate financial and human resources, provide consistency within, and work towards the growth of an organization, as athletes and coaches change. For many administrations, the success of their organization is largely tied to the success of its programs, teams, and athletes. Much like

coaches, administrators play a crucial role in establishing a sports organization's wellbeing culture.

### **Governing Sport Bodies (e.g., Federations, Professional Leagues, and Players Associations)**

This category includes government-funded and independent organizations, national and international sports governing bodies, and professional leagues and players associations. Although all are separate entities, they have similar needs, influences, and responsibilities. Governing sports bodies are responsible for sports programming and competition organization, athlete wellbeing and safety oversight, certification of coaches and other sports officials, establishment of the rules of play governing the sport, and growing the game for fans. Additionally, both governing sports organizations and professional leagues and teams share a common objective: financial sustainability or profitability.

The link between financial sustainability and athlete wellbeing is evident. Governing sports bodies and organizations have a vested interest in minimizing the risk of athlete injuries and fostering the mental wellbeing and skills of athletes. These efforts are aimed at enabling athletes to perform at their optimal level, which, in turn, contributes to the overall success and financial viability of the sport.

### **Personal Support System**

Athletes' personal support systems, primarily comprised of family, friends, and mentors, play a crucial role in their overall wellbeing. Interviews with athletes underscore the significant impact these relationships can have, either by exacerbating stressors or helping individuals cope with the pressures of elite sports. Research has indicated that negative relationships with family members are predictive of higher levels of depression and mental health distress among athletes. Additionally, general pressure from family members is associated with elevated anxiety and mental health distress (Hussey et al., 2019). In fact, reports of strained family relationships can serve as indicators for identifying athletes at risk of mental conditions such as depression and anxiety (Hussey et al., 2019).

Support systems serve a dual purpose by not only mitigating the negative effects of stress but also by grounding athletes in the joys, comforts, and successes beyond the sports arena.

Moreover, an athlete's support system plays a pivotal role in their development during their youth sports journey. These support systems facilitate an athlete's engagement with the sport by providing essential resources such as transportation to training and competitions and financial support. Additionally, they help shape the cultural and contextual aspects that influence an athlete's early experiences with mental health and wellbeing.

In elite and professional sports, athletes often find themselves distanced from the social support systems they grew up with. They must adapt these relationships to accommodate the demands of busy travel schedules and the unique challenges associated with their professional careers.

### **Wellness & Performance Technology Companies**

Wellness technology companies are dedicated to developing products and services that cater to the mental wellbeing and overall performance of a broad user base. Their primary goal is to achieve profitability while extending their market share. To achieve these objectives, many of these companies are actively engaged in innovating their offerings, focusing on enhancing the accuracy of measurements and providing concrete evidence of efficacy.

While these wellness technology companies serve a diverse range of users, including elite athletes, the majority of technologies in this domain primarily concentrate on supporting physical performance and conditioning. Mental wellbeing, a crucial aspect of an athlete's overall performance, has historically received comparatively less attention in terms of dedicated technologies. In the subsequent sections of this study, we will delve into some of the technologies that are either specifically designed for or adapted to address the unique mental wellbeing needs of athletes.

### **Media**

The media aims to create content and engagement with fans and the broader public. Through normal media channels and social media, content around sports and athletes makes a profit and raises awareness of news coverage stations, athletes, and coaches.

## **Spectators**

Integral to the growth and engagement of all sports, spectators and fans fuel interest and funding in elite and professional sports. Spectators seek entertainment, experience, or inspiration and bring money into these sports. In today's social media age, spectators can generate and share content on social platforms to rapidly shift perceptions or viewership of sports and athletes.



# Horizon 1: Describing the Current State

## Context

### Wellbeing, Health, and Mental Wellbeing in the World

Since the COVID-19 pandemic, a global focus has been on improving wellbeing. The World Health Organization (2021) defines *wellbeing* as,

"A positive state experienced by individuals and societies. Similar to health, it is a resource for daily life and is determined by social, economic, and environmental conditions. It encompasses quality of life and the ability of people and societies to contribute to the world with a sense of meaning and purpose" (p. 10).

The World Health Organization (2021) defines *health* as "a state of complete physical, social and mental wellbeing, and not merely the absence of disease or infirmity" (p.3). These distinctions are important as they highlight the relationship between wellbeing as feeling capable of operating with purpose in society and mental health as a critical contributor to overall health and, therefore, overall wellbeing. As the world becomes increasingly complex, wellbeing and mental health are valued more than ever, with all industries creating new solutions and intervention models (Fisher & Shaikh, 2020). Mental wellbeing includes overall mental health, mental coaching, personal growth, and specific mental disorders or challenges, which can differ from person to person and change over time (Poucher et al., 2023). Dealing with mental health is a regular part of the human experience for most, and although research and support for the field has grown overtime, only recently has significant attention focused on the impact of mental health on overall health and the dire need for widespread intervention.

As science continues to discover more about the contributors to our overall wellbeing and health, there is a growing adoption and need for a more holistic approach. We now know that our body and mind are interconnected, with relationships between the gut and the brain, and the brain and the autonomic nervous system. For instance, the K. Lisa Yang Brain-Body Center at MIT is exploring these connections (Yang Tan Collective at MIT, n.d.). Growing discoveries on

how physical, mental, and social are interconnected allow us to approach components of health as complementary, providing a stronger look to overall wellbeing.

### **Wellbeing in High-Performance Sports**

In the high-performance sports arena, athlete wellbeing has been a growing topic of discussion. Various factors, including physical, mental, and social health, contribute to an elite athlete's overall wellbeing. This report will use the definition of *athlete performance health* as defined by the Australian Institute of Sport as "a state of optimal physical, mental, and social wellbeing related to an athlete's sporting success, and not merely the absence of illness or injury that limits participation" (Australian Institute of Sport, n.d.). Furthermore, the holistic health of athletes, including physical and mental wellbeing, has been recognized as fundamental to their identity as individuals and performers (Woodford & Bussey, 2021).

### **Mental Health in High-Performance Sports**

The performance lifestyle of elite athletes presents numerous challenges and risk factors for mental wellbeing and health. Elite athletes face unique stressors like significant and consistent pressure to perform at their highest level, frequent travel, position or job instability, and injury management, which can contribute to ill health (Purcell et al., 2022). Research shows that some mental health symptoms are relatively common among elite athletes like anxiety, depression, and drug and alcohol use and that elite athletes are at higher risk of experiencing mental health challenges or disorders than non-athlete populations due to stressors that are specific to the high-performance sporting environment (Chang et al., 2020; Hussey et al., 2019). For instance, a study by Poucher et al. (2021) found that a staggering 41.4% of 186 Canadian Olympic and Paralympic athletes surveyed exhibited symptoms of depression, anxiety, or eating disorders. The same study found that stress and training are significant predictors of anxiety and depression among athletes (Poucher et al., 2021). Anxiety and stress have been found to compromise an athlete's focus, concentration, and decision-making abilities while depression can diminish an athletes' motivation and energy, impeding their ability to perform at their best (Habay et al., 2021; Aftab et al., 2022). Participants mentioned that when athletes underperform due to these mental health challenges, they can feel stuck in a cycle of deteriorating mental

health and subpar performance while, conversely, strong mental health can enable athletes to tackle the demands of competition and training, promoting concentration, drive, and resilience.

In the high-performance sports arena, mental health is still considered taboo within training contexts despite numerous athletes coming forward to discuss sports-related mental health struggles. There is plenty of research within sports psychology on athlete mental health and an increasing demand for sports psychologists (Weir, 2018; Birrer & Morgan, 2010). Researchers and governing sports bodies have created a growing host of frameworks to offer mental health assessment and intervention to create a nurturing atmosphere for everyone involved in elite sports, from athletes to administrators (Purcell et al., 2022; Purcell et al., 2019; Giles et al., 2020; International Olympic Committee, 2023). These tools are slowly being adopted yet still face challenges as they may need to be adapted or tailored to fit elite sporting organizations' unique cultural, contextual, and resourcing circumstances. Furthermore, few high-performance mental health frameworks embrace a holistic view, and this research did not encounter any that project future developments in the field.

### **Growing Interest in Mental Skills Training**

In recent years, there has been a notable surge in attention towards mental skills training within the realm of sports, attracting athletes, researchers, sports psychologists, and technology innovators. The area of mental, cognitive, or psychological skills training is a domain that holds immense promise. Athletes are increasingly recognizing the value of mental skills training as a means to bolster their overall wellbeing and enhance their performance even in the face of adversity. These mental skills encompass practices like mental imagery training, mindfulness, positive self-talk, and goal setting which have been shown to foster confidence, nurture resilience, and prepare athletes for the rigors of competition (Chee, 2010; Jensen et al., 2020; Delfin et al., 2022).

Some of the most renowned athletes, including Cristiano Ronaldo, Kobe Bryant, Rafael Nadal, and Serena Williams, have attributed a portion of their success to mental skills training. However, it is noteworthy that while elite athletes endorse the benefits of psychological training, physical and technical training remains the predominant focus for most athletes and coaches (Taylor, 2014; Svoboda, 2021).

The growing interest in mental skills training is accompanied by ongoing research that seeks to unveil the intricate relationship between mental wellbeing, performance, and the management of athletic and psychological burdens (Perrey, 2022; Mellalieu et al., 2021; Vanrenterghem et al., 2017). Despite the acknowledgment of a psychological load's impact on performance by athletes and coaches, it is seldom incorporated into training management (Perrey, 2022). Mental fatigue, characterized by feelings of tiredness, exhaustion, or energy depletion following extended cognitive exertion, has recently received scientific attention in high-performance sports. However, the field still lacks standardized practices for its assessment and management (Boksem & Tops, 2008; Proost et al., 2022). A study by Russell et al. (2023) underscores the significant adverse effects of mental fatigue and the challenges associated with mental recovery among high-performance athletes. Astonishingly, only a small percentage of participants in the study felt knowledgeable about mental fatigue (11.5%) and mental recovery (5.1%) (Russell et al., 2023). Research has also established that mental fatigue can detrimentally impact physical performance, particularly in endurance-based activities (Brown et al., 2020; Giboin & Wolff, 2019; Van Cutsem et al., 2017). Moreover, it can compromise decision-making, reaction time, and accuracy outcomes (Habay et al., 2021; Smith et al., 2018).

Fortunately, there is hope for athletes seeking to combat mental fatigue. Studies have demonstrated that engaging in cognitively demanding tasks during exercise, known as brain endurance training, can enhance resilience to mental fatigue and improve physical performance. Studies have shown that there is greater improvement in performance following brain endurance training (Dallaway et al., 2021).

Mindfulness practices have also gained recognition for their potential to enhance performance and prevent burnout among athletes, as evidenced by a study involving university student-athletes (Amemiya & Sakairi, 2019). Furthermore, high-performance athletes have increasingly embraced yoga and yogic breathing exercises for reasons extending beyond physical benefits. These practices have proven effective in mitigating stress, anxiety, and post-traumatic stress disorder (PTSD) resulting from the demands of intense training and competition, fostering mental toughness and emotional detachment (Bucea-Manea-Tonis et al., 2023). As these trends continue to shape the landscape of high-performance sports, there is a growing understanding of

the intricate interplay between mental skills training, mental fatigue management, and overall athlete mental wellbeing.

### **Technology in High-Performance Sport**

High-performance sports, athletes, coaches, support personnel, and managers have become increasingly savvy at harnessing the power of data analytics to propel their careers and improve athletic performance. The realm of high-performance sports is currently experiencing a great transformation, driven by the pervasive influence of information and communication technology. This transformation is underpinned by the utilization of technology across various facets of the sports domain (Reyaz et al., 2023). Currently, technology primarily supports advancements in physical assessment, tactical training, and performance monitoring. High-performance athletes and teams are leveraging an array of cutting-edge technologies, including wearable sensors, motion and image capture systems, and artificial intelligence (AI), to gain a competitive edge. This adoption of technology holds immense promise, not only in elevating the state of athletes' physical health but also in fostering greater connectivity among coaching and support teams (Reyaz et al., 2023).

One prominent manifestation of this technology and data analytics revolution is the widespread use of mainstream wearables like the Apple Watch and the Whoop Fitness Tracker by athletes. These wearables enable athletes to easily track biometric data such as heart rate variability and an array of metrics related to their overall wellbeing, including sleep patterns. Moreover, athletes are now more interconnected than ever before, utilizing their smartphones to access a plethora of support systems and health resources. This newfound connectivity offers athletes convenience and simplicity in managing their wellbeing (Reyaz et al., 2023).

The ongoing advancements in technology adoption within the realm of athlete performance and management are laying the groundwork for a future where athletes wield tools that not only optimize their physical prowess but also provide invaluable support for their mental health.

## **Where Do Pain Points Exist in the Current State?**

Although there has been an increase in research, advocacy, and initiatives focused on athlete mental wellbeing, health, and skills training, the changing cultural and technological landscape of high-performance sports presents challenges that warrant further understanding and action. These challenges exist across all levels of sport, however they are most prominent in collegiate sports, and the professional arena.

### **Balancing Performance Expectations with Wellbeing**

Performance results drive high-performance sports, strengthen competition, and raise the level of play. This objective to win permeates across stakeholders and is a central focus within the elite sports ecosystem. Consequently, tension arises between the pursuit of optimal wellbeing and the drive for strong performance outcomes. Athletes inherently desire to perform at their peak potential. As mentioned, high-performance athletes face unique stressors (i.e., frequent travel, injury management) yet are expected to deliver stellar and consistent results. This demand places athletes under immense and sustained pressure throughout their sporting careers, with position and job security often hinging on performance results. The tension between wellbeing and performance results strongly resonated across stakeholder interviews in this study. Athletes never felt like the work was done; they had to prove themselves daily.

Furthermore, in today's digital age, social media has emerged as a potent force alongside traditional media, exerting a more significant and impactful influence. Social media has shaped an era of athlete celebrities and renewed fan engagement, where athletes' performances and personal lives can be hyper-analyzed (Andrew, 2021). This digital landscape shapes public expectations where elite athletes can be subject to exceptionally high standards (Andrew, 2021) (e.g., athlete as a role model). These heightened expectations for all-around performance, in and out of the sports arena, often expected by their teams, fans, and the public, can add significant mental and emotional strain to their already demanding careers. As athletes become increasingly public figures, it is necessary to understand and address these internal and external pressures and their impact on wellbeing, given that elite athletes frequently find themselves at the crossroads of society, culture, and politics (Carp, 2021).

For student-athletes, there is even more considerable pressure to perform. Student-athletes can face additional stressors like achieving good academic standing to continue playing their sport or maintain scholarships, all while balancing training (Radford, 2023). It is alarming to note that the suicide rate among college student-athletes is at a record high, underscoring the urgent need to address the mental wellbeing challenges they face (Harris, 2023). Over the past few years, major shifts across the US college athletics landscape have occurred. Many of these changes have stem from accelerating revenue growth in college sports. Since 2021, athletes have been allowed to profit from their name, image, and likeness (NIL), and some have secured deals over USD 1 million while still in school (Claybourn, 2023). These financial incentives create additional stressors for student-athletes, compounding the pressures they already face, pressures that are not typically encountered by professional athletes.

### **Weakening But Prevailing Stigma Around Mental Health**

There is still a stigma associated with mental health in the high-performance sports community. For some time, elite sports culture and leadership saw mental health challenges as weaknesses incompatible with the demands of high-performance sports (Lundqvist & Andersson, 2021). This stigma exists due to a combination of factors such as prevailing beliefs around mental toughness, poor mental health literacy, a perceived lack of psychological safety, and negative past experiences seeking help, which can make athletes hesitant to seek the support they need or disclose mental health difficulties (Purcell et al., 2022; Gulliver et al., 2012; Castadelli-Maia et al., 2019; Souter et al., 2018).

### **Cultural Confusion Around the Meaning of Mental Toughness**

Although understanding of and perceptions around mental health are slowly changing in high-performance sports, there is a more significant cultural belief around *mental toughness* that challenges the normalization of mental health conversations, awareness, and interventions. In sports psychology, mental toughness is the ability to consistently perform at the highest level under pressure, cope effectively with the demands of competition, and remain determined, focused, confident, and in control in challenging situations (Gucciardi & Hanton, 2016). Mental toughness is associated with optimal functioning and strengths and is considered, by many, essential for success in sports (Ruparel, 2020). It has been linked to psychological advantage, enabling athletes to perform at their best, and research suggests that mental toughness attributes

can be learned (Singh et al., 2022; Gerber et al., 2012). Furthermore, mental toughness may be positively related to self-reported psychological skill use, such as self-talk, emotional control, goal setting, and relaxation activations (Manley et al., 2019). With these relationships considered, we can consider mental toughness as attributes athletes can *develop and leverage* to perform at the highest standards consistently, despite adversity. This notion of mental toughness is often at odds with sporting culture's variation, which is to remain silent and power through, regardless of the consequences.

### **Mental Wellbeing Culture is Determined by Leadership**

Coaches and organizational leadership are fundamental in setting the cultural precedent that athletes and team members adopt. Coaches are often the first line of support for athletes, setting the tone for what is acceptable. Research shows that the adopted coaching style and attitudes toward mental health play pivotal roles in an athlete's wellbeing among other factors, such as language choice and teammate support (Kaplan, 2023; Poucher et al., 2023). For instance, the concept of mental toughness in sports psychology is often at odds with coaches and training staff who teach athletes, starting in youth sports, to “suck it up” which can deter athletes from seeking help in the present and long term (Participant 4; Beasley & Hoffman, 2023). Psychological safety in elite sports settings has garnered attention as a critical factor associated with mental health and wellbeing (Rice et al., 2022). Cultures where athletes must stay silent perpetuate the taboo nature of mental health, making athletes fear negative consequences, such as being viewed as weak or losing their position or job, for seeking help (Gonzalez, 2023).

### **Low Mental Wellbeing and Health Literacy**

Athletes' lack of knowledge about mental health is a significant obstacle to improving mental wellbeing. Especially in cultures where mental wellbeing or health is stigmatized, athletes may be unable to recognize the signs of mental health issues or unsure whether their condition qualifies as a mental health challenge (Gonzalez, 2023). Without mental wellbeing education, athletes may be unable to recognize concerning symptoms and are likely unaware of the available resources. In stakeholder interviews, athletes well-informed about mental health often mentioned gaining knowledge through collegiate programs, coaches who prioritize the mental aspect of training, or peers and friends who share their insights. A pressing concern highlighted



by study participants is that young athletes (under 18 years old) are seldom educated on these critical topics or provided with appropriate resources despite their engagement in high levels of competitive sport. This lack of early education represents a significant gap in equipping young competitors for success.

### **Limited and Fragmented Access to Wellbeing Resources**

Athletes face significant challenges in accessing mental health resources and professionals, often exacerbated by the high-pressure environment and demanding schedules of elite sports. Time constraints, due to rigorous training and competition routines, leave athletes with limited opportunities to focus on their mental health. This situation is further complicated by the difficulty in recognizing and addressing mental health issues within the competitive sports setting, as noted by Gonzalez (2023). Additionally, the availability of mental health resources varies greatly; while some teams provide access to sports psychologists or mental conditioning coaches, others lack these essential services or struggle to maintain consistent care during transitions between teams or locations.

The support for mental health and wellbeing that athletes receive from their sports teams or organizations is often the primary source of assistance. However, athletes seeking to delve deeper into mental health care are frequently confronted with a choice between limited team-provided services and seeking self-funded external support. The landscape of available services and platforms is fragmented and unclear, posing challenges for athletes in constructing a comprehensive understanding of their health and wellbeing. This issue becomes more acute for athletes with larger support teams, where the sharing of plans, treatments, and insights among care providers is crucial for optimal care.

Building relationships with sports psychologists, whether in-person or virtual, is a time-intensive process. Professional athletes, who often face frequent relocations and demanding schedules, may find themselves disconnected from these established support systems. This discontinuity is further complicated by the tendency of technology companies to operate in data silos, resisting the sharing of information. Such practices hinder the seamless uptake and distribution of data among relevant stakeholders, posing additional barriers to effective mental health care and support for athletes.

## **Gender, Sport Culture, and Mental Health Perceptions**

Perceptions of mental health within the realm of sports are profoundly influenced by the interplay of sport-specific cultures and gender norms, resulting in a complex tapestry of attitudes and responses. This intersection of factors gives rise to a landscape where mental wellbeing is perceived differently based on one's gender and the sport engaged in.

In sports traditionally dominated by men, such as football and hockey, a prevailing emphasis on physical toughness often overshadows the recognition of mental resilience. Within these hypermasculine environments, male athletes may hesitate to engage in mental wellbeing practices, fearing that such activities could be construed as a sign of weakness (Castaldelli-Maia, 2019). Studies have also underscored the importance of creating spaces where male elite athletes feel comfortable discussing their emotions, concerns, and anxieties as they face unique hesitations to engage in mental health-related conversations in sports environments (Souter et al., 2018). Conversely, female athletes, while potentially more receptive to mental wellbeing practices, encounter their own set of challenges. The stigma attached to care practices being labeled as 'feminine' can deter female athletes from openly embracing these practices, despite their potential benefits (Castaldelli-Maia, 2019).

The high-performance sports landscape, often demarcated by gender, introduces further complexities in the realm of mental health. Sport-specific cultures, societal perceptions of women in high-performance sports, and deeply ingrained gender norms all contribute to shaping unique challenges and approaches. Female athletes frequently grapple with issues like wage disparities in professional sports and find themselves navigating environments originally tailored for and by men (Strout, 2022; Castaldelli-Maia et al., 2019). These disparities exert a notable impact on their mental health and underscore the need for gender-equitable solutions. For instance, Marshall et al. (2022) have highlighted how the COVID-19 pandemic exacerbated gender inequality in sports, intensifying stressors among elite female athletes.

Furthermore, research has shed light on the specific challenges faced by female athletes, resulting in higher rates of mental health disorders and negative psychological emotions (NCAA, 2023; Marshall et al., 2022; Mohebi et al., 2021). The influence of the menstrual cycle on training, competition, and performance is a noteworthy example, with studies like that of Taim et

al. (2023) illuminating this often-overlooked aspect. Forms of mental anxiety have been closely associated with menstrual irregularity in elite athletes (Miyamoto et al., 2021). Additionally, the intricate connections between mental wellbeing and physical performance in female students have been explored, highlighting the profound impact of mental health on athletic ability (Eganov et al., 2021).

Recognizing these multifaceted experiences and challenges is of paramount importance. It necessitates the creation of supportive sporting environments that empower all athletes, with a particular focus on addressing the unique needs of men and women in high-performance sports and championing mental wellbeing as a central pillar of athletic success.

### **Confusion Around Wellbeing Technologies and Limited Access to Learning Resources**

The rapid emergence of new technologies in the realm of athlete wellbeing presents both opportunities and challenges. Athletes today often find themselves in a complex landscape where adopting these technologies can be overwhelming due to their novelty and the sheer number of options available. This complexity is compounded by a general lack of awareness about the available technologies and a shortage of skilled professionals who can assist athletes in effectively integrating these tools into their routines.

While current wellbeing technologies have been employed in areas like load management, physical development, readiness analysis, and injury prevention, their application in broader aspects of athlete wellbeing is still in its infancy. Athlete participants expressed interest in technologies that support various facets of wellbeing but often feel that these tools are either underdeveloped or they are uncertain about how to seamlessly incorporate them into their demanding training schedules. The current challenge of selecting the right tool or technology highlights the need for specialized knowledge, which many teams and organizations lack.

Furthermore, mental health and skills professionals in sports have not yet widely embraced mental wellbeing technologies as this field is still emerging and due to uncertainties about the evaluation and integration of technologies. However, this study will later explore some emerging frameworks that are beginning to address these gaps. These resources aim to provide athletes, coaches, and sports organizations with the necessary guidance to understand and

effectively navigate the complexities of wellbeing technologies. As these resources expand and become more accessible, they hold the potential to significantly enhance the understanding and utilization of wellbeing technologies in sports, thereby supporting athletes in achieving both their physical and mental health goals.

### **Concerns Around Data-Centricity**

In the realm of elite and professional sports, the intersection of athlete wellbeing and performance has become increasingly complex, particularly with the growing reliance on performance technologies (Williams & Manley, 2016). These technologies, predominantly data-centric, have introduced new challenges in how athletes are perceived and valued. Participants noted how the heavy emphasis on data collection and analytics in high-performance sports can lead to a situation where athletes feel reduced to mere numbers and statistics, potentially making them feel undervalued. Data undoubtedly offers significant benefits, providing crucial insights and predictions that can enhance performance. However, it is crucial to acknowledge that human behavior and performance do not always conform to data-driven patterns. Misuse or over-reliance on data can be detrimental, failing to capture the nuances and complexities of human capabilities. A key example highlighting this concern is the legendary performance of basketball player Michael Jordan, who, despite being sick, led the Chicago Bulls to victory in the 1997 NBA finals. This instance underscores the importance of considering human factors that defy data predictions (Glassbrook, 2023). Moreover, it raises critical questions about how to safeguard players' interests when integrating new technologies, especially in scenarios where human inconsistencies diverge from data and forecasts.

As mentioned, there is an ongoing debate about the interpretation of data and its responsible, ethical usage in sports. Ensuring data is employed in a manner that respects the unique, immeasurable human qualities of athletes is essential. The challenge lies in finding a balance that leverages data for informed decision-making while also acknowledging and valuing the individual characteristics and unpredictability inherent in human athletes.

### **Concerns Around Data Security and Ownership**

Data security and ownership is a growing concern in high-performance sports. The question of who can access and monetize or leverage athlete data has sparked debates and raised

concerns around data privacy and management (Australian Academy of Science, 2022). Currently, the majority of data is kept within platform silos, and technology companies do not facilitate the easy sharing of data outside their products. Athletes and leaders alike want to be clear about the intentions and implications of using technology in the context of their data (Anderson, n.d.). Ensuring that data is secure, accessible only to authorized entities, and owned and managed transparently and accountably is crucial for building trust and confidence in the sports industry.

# Horizon 3: The Hoped-For Future

## What is the Hoped-For Future?

In the examination of the intersection between wellbeing and technology in high-performance sports, notable themes have surfaced among key stakeholders envisioning their ideal future. These themes serve as an initial exploration into the shared aspirations and expectations of individuals deeply immersed in elite sports. A deeper dive into these foundational insights can aid in constructing a detailed view to the envisioned future, where mental wellbeing technology seamlessly and comprehensively propels athletes toward their wellbeing and performance goals.

## The Hoped-For Future: Key Insights and Projections

- **Mental Wellbeing as Standard to Health:** Holistic wellness approaches make mental wellbeing and development key components to overall athlete health and performance. As Ed Chavez, clinical psychologist for the Rockies Major League Baseball (MLB) Team says, “wouldn’t it be amazing if we could have honest conversations about mental health just the same way we would about physical health” (Gonzalez, 2023)? Mental wellbeing topics are normalized within sports culture, with environments and leadership that foster confidence. Athletes are recognized as humans first, and success in sports considers growth and value, aside from only competition results, to lessen the pressure of outcome expectations.
- **Athlete-Centric Culture and Synergetic Team Dynamics:** Athletes are at the core of organizational cultures that prioritize both their individual wellbeing and the collective wellness of the broader team, including coaches and administration, which fosters a collaborative and supportive environment. Within this framework, there is a pronounced emphasis on athletes as integral members of a cohesive team, collectively striving toward shared goals. Athlete-centric cultures go beyond mere acknowledgment; they actively shape organizational structures, particularly in larger organizations, to align seamlessly with the unique needs of athletes, thereby enabling them to achieve peak performance.

- **Comprehensive Spectrum of Care and Development Options:** Athletes and coaches benefit from an array of accessible mental wellbeing support encompassing education, assessment, development, and treatment. This spectrum includes hybrid models harmonizing clinical expertise with both established and emerging technology. Additionally, self-directed options are tailored to athletes' preferences and convenience, seamlessly integrating with common devices like phones or videogames. This approach ensures athletes have rapid access to mental wellbeing resources, thereby promoting their overall health. Crucially, a spectrum of care and development options allow for varying levels of privacy, empowering individuals who would otherwise avoid seeking support options to discreetly manage their mental wellbeing.
- **Personalized Wellbeing Strategies:** Athletes are empowered with a comprehensive and nuanced understanding of their overall health, with actionable steps towards their healthiest self. Insights are extracted from various tracked facets including physical condition, mental wellness, nutrition, and sleep to create personalized strategies aimed at mitigating injury risks and optimizing conditions and development for peak performance.
- **Guidance From Trusted Sources:** There is a wealth of knowledge from reliable sources guiding the safe and effective integration of mental wellbeing practices and technologies into training regimes. A growing number of sports psychologists and mental skills coaches are well-versed in wellbeing technologies, seamlessly incorporating them into hybrid models of care. Additionally, athletes and support service providers have access to tools that assist in selecting the most effective and suitable technologies to meet athletes' unique needs and goals.
- **Mental Game is Elevated:** The training of mental skills is elevated due to its complementary relationship with performance, and this connection is thoroughly explored and leveraged. Athletes are progressively embracing mental skills training with the integration of technology, often in collaboration with specialized clinicians, to enhance overall wellbeing and performance. Techniques such as mindfulness, resilience, mental

toughness, and imagery training become more consistent, engaging, and immersive, thus significantly amplifying their impact, thanks to advancements in technology.

- **Integrated Data-Sharing:** The technologies employed prioritize seamless data integration across key platforms and systems, maximizing the inputs from various sources to enable triangulated insights. These platforms ensure the safe and real-time sharing of data and insights with a broader training team selected by the athlete, including doctors, support service providers, and coaches. This approach enhances visibility into an athlete's overall health, fostering effective communication and collaboration across their training team for integrated, holistic care.
- **Transparency in Data Ownership and Privacy Protection:** Athletes possess a comprehensive understanding of how their personal data is managed, shared, and utilized, with ownership of their own data. Prioritizing data security, athletes seek assurance that their information is safeguarded. Additionally, athletes aspire to leverage their data beyond health-related realms, envisioning its application in determining the best team fit and during contract negotiations, highlighting the multifaceted utility of their personal data.
- **Early Integration of Mental Health and Mental Skills Development in Youth Sports:** The journey toward mental health and mental skills development commences early in youth sports, laying a robust foundation for athletes as they advance into high-performance sports and life beyond. Coaches, administrators, and governing sports bodies embrace leadership styles and programs that normalize mental wellbeing, making it an integral and prioritized aspect of sports development across all levels. This multi-level approach extends to the specific exploration and targeted interventions for at-risk populations within the sporting community, such as women, youth elite athletes, elite student-athletes, and those with disabilities, ensuring a comprehensive and supportive development trajectory for all.



# Horizon 2: How May We Reach the Hoped-For Future?

As we envision the journey towards the Hoped-For Future in wellbeing technology for high-performance sports, distinct themes highlight the necessary changes that must unfold to manifest the desired future.

## **Dissolve the Cultural Stigma Around Mental Health**

Despite the evident connection between mental health and overall well-being, the significance of mental well-being in dedicated training programs for high-performance sports remains undervalued. This undervaluation is primarily rooted in the persisting cultural stigma surrounding mental health. In order to make meaningful progress in the realms of mental health and mental skills development in sports, it is imperative that this stigma be eradicated, paving the way for transformative advancements. Mack et al., (2023) propose reframing mental health care in sports as a “legal performance enhancement” to improve and maintain athletic performance in order to instigate a paradigm shift.

To dissolve this stigma and usher in new paradigms related to athlete health, a broad cultural shift is necessary. This shift must prioritize and advocate for mental wellbeing across stakeholders involved in high-performance sports. As mentioned, the culture within sports is largely influenced by leadership and coaches. Therefore, instigating a top-down transformation is necessary. It requires leaders and stakeholders in positions of authority to adopt fresh and holistic perspectives on mental wellbeing, thus fostering environments where open discussions about mental health are encouraged, and athletes are free from any feelings of shame, guilt, or fear when seeking support.

There is also a shift taking place where high-performance athletes recognize a personal responsibility for managing their wellbeing, indicating greater autonomy having conversation around mental health and in seeking out mental health resources and support. Although the COVID-19 pandemic created ambiguity about the future of training and competition, for many athletes it triggered a renewed sense of personal responsibility for their wellbeing and studies

found that self-awareness and self-value increased among athletes during this time (Tingaz, 2020).

In a bottom-up approach to drive progress towards the destigmatization of mental health, athletes are taking a stand, becoming vocal advocates for mental wellbeing and health in the sports community. They are leveraging their public platforms to catalyze change, sharing personal experiences to raise awareness and push for improvements in support systems. This proactive role has contributed to the destigmatization of mental health conversations, particularly among younger generations who have grown up in a culture increasingly open to discussing wellbeing. For example, legendary gymnast, Simone Biles who holds seven Olympic and thirty World Championship medals, recently won the Global Wellness Summit's Debra Simon Award for Furthering Mental Wellness for her leadership and transparency about mental health challenges, and continued advocacy for mental health support and abuse awareness and prevention (Global Wellness Summit, 2023; Gunston, 2023). At the 2020 Tokyo Olympics, which took place in 2021 amid the COVID-19 pandemic, Biles withdrew from the team competition citing significant mental health concerns that placed her at risk of injury (Global Wellness Summit, 2023). Reminding the public that she is still human, Biles captured her sentiments on Instagram, "it wasn't an easy day or my best but I got through it. I truly do feel like I have the weight of the world on my shoulders at times. I know I brush it off and make it seem like pressure doesn't affect me but damn sometimes it's hard!" (Biles, 2021). Although her competition withdrawal was met with mixed reactions, many athletes and organizations applauded Biles' decision and courage in prioritizing her wellbeing, further cementing her status as a role model for many.

In response to the growing recognition of athletes' need for a more comprehensive and empathetic sporting culture, leagues and organizations are actively forging partnerships aimed at reshaping public and sport-specific attitudes toward mental health, and they are driving organizational transformations. For example, the LA Rams football organization has been proactively addressing mental wellbeing through adopting an athlete-centric mindset, initiatives like their partnership with guided meditation and sleep mobile app Calm and exploring career pathways for retired athletes. Collaborative campaigns such as the May 2023 Mental Health Awareness Month, where six sports unions (The National Football League Players Association,

National Basketball Players Association, National Hockey League Players Association, Major League Baseball Players Association, Major League Soccer Players Association, and Women's National Basketball Players Association) teamed up to invest resources and raise awareness underscore a collective commitment to creating supportive environments across sports and challenging mental health stigmas (NFLPA, 2023). Similarly, ahead of the 2023 FIFA Women's World Cup, the US Women's National Soccer Team partnered with soccer-based nonprofit Common Goal and FOX Sports to offer a mental wellbeing education series and public announcements throughout the tournament with FOX Sports also pledging 1% of World Cup airtime to discussing the importance of mental health across its platforms (Common Goal, 2023). Leading this advocacy project, defender Naomi Girma had the goal to humanize people and athletes, "hoping to demonstrate that vulnerability is a sign of strength", as many athletes are still suffering in silence (Common Goal, 2023). These types of initiatives at the highest levels of professional sport are setting the foundation for cultural change across the sports industry to reframe athlete mental wellbeing.

### **Increase Access to Effective Mental Wellbeing Interventions and Development**

To enhance the mental wellbeing of high-performance athletes, it is crucial to prioritize mental wellness across all levels and stages of the sporting journey. This comprehensive approach should encompass assessment, education, and access to effective resources and support. Mental health literacy among elite athletes needs improvement, making it essential to initiate interventions and normalize mental wellbeing in youth sports settings. The leadership of governing sports bodies, administrators, and coaches, guided by clinicians, should take the lead in this effort and also consider how a multi-level approach spur cultural change. For example, Hägglund et al. (2022) observed high support, perceived value, and lasting behaviour change among high-performance coaches in a study on mindful self-reflection's impact on sustainable high-performance coaching.

Despite the implementation of numerous large-scale mental wellbeing interventions in sports leagues and associations in recent years, as well as the increasing presence of sports psychologists and mental skills trainers, high-performance athletes continue to grapple with mental health challenges at rates higher than the general population. Promotion and prevention

interventions should be tailored to each athlete's unique needs and objectives, considering the broader context of their sport and environment. Research conducted during the COVID-19 pandemic underscores the importance of context-based interventions to support athlete wellbeing (Urbański et al., 2022). Additionally, it is essential to gain a better understanding of sports-specific contexts, identify at-risk populations within high-performance sports (such as women, youth elite athletes, athletes with disabilities, and ethnic minorities), and recognize the intersectional experiences within sports, each with its unique stressors. The NCAA found that women, BIPOC and LGBTQ+ student-athletes reported the highest rates of mental health struggles (NCAA, 2023). This understanding is vital for personalizing interventions.

For instance, there is a significant need for increased mental health education in elite youth sports. A study by Gerber et al. revealed that approximately one in ten elite youth athletes reported burnout or depressive symptoms with potential clinical significance (Gerber et al., 2018). Given that elite youth athletes are susceptible to both physical and psychological challenges, it becomes imperative to introduce mental health education and interventions early in elite youth sports (Sabato et al., 2016).

In addition to the necessity for mental wellbeing interventions at all levels of sports, it is equally important to demonstrate the effectiveness of these interventions. Preliminary studies on the effectiveness of mental skills training courses have shown promise, with athletes reporting improvements in mental toughness and coping scores, along with positive feedback regarding the content and overall experience (Griffith et al., 2022).

The current state of access to wellbeing support for elite athletes is characterized by fragmentation and dependency on available resources and the prevailing team culture. Addressing this issue is of paramount importance, and there is an urgent need to establish a comprehensive ecosystem of resources, particularly at the team or league level. This need arises because athletes often experience transitions between teams or locations that can disrupt their access to crucial wellbeing resources. Furthermore, despite the presence of in-house clinicians within many professional and high-performance teams, athletes frequently harbor uncertainties regarding the benefits of these resources. Additionally, they may fear potential repercussions or judgment if they were to seek help. To address these concerns and create a supportive

environment, it is essential to provide resources with varying degrees of privacy. This way, athletes who may not feel psychologically safe sharing their experiences with in-house clinicians, coaches, or trainers can access the support they need discreetly.

To ensure the safety and effectiveness of mental health interventions, active involvement of athletes in the co-creation of programs, interventions, and technologies designed to support their mental wellbeing is imperative. This collaborative approach will not only promote the development of tailored and effective solutions but also empower athletes to take an active role in their mental health journey.

### **Redefining Success in Sports**

The meaning of success is being challenged in high-performance sports. Athletes and coaches are moving from self-critical to more self-compassionate approaches (Frenz et al., 2020; Ceccarelli et al., 2019). Historically success was centered around victory, however many are now embracing new narratives of success that value personal growth and potential. This shift is embodied in the attitudes of athletes like basketball player Giannis Antetokounmpo, who emphasized that success is a journey with varying outcomes beyond the binary of winning or losing when asked about his thoughts after the Milwaukee Bucks loss in the 2023 Eastern Conference Finals:

"Every year you work, you work towards something, towards a goal, right? Which is to get a promotion, be able to take care of your family, to be able to provide the house for them or take care of your parents. You work towards a goal. It's not a failure; it's steps to success. Michael Jordan played 15 years, won six championships; the other nine years was a failure? That's what you're telling me? There's no failure in sports. You know, there's good days, bad days. Some days you are able to be successful, some days you're not. Some days it's your turn, some days it's not your turn. And that's what sports is about. You don't always win; some other team's gonna win. And this year, somebody else is gonna win. Simple as that" (Washington, 2023).

Such a stance promotes a culture where athletes strive for personal bests and are recognized for their progress, regardless of the competition outcome. This evolving understanding of success is

fostering more supportive and less pressure-driven sports environments, where athletes can pursue excellence without the burden of unrealistic expectations.

Coaches and organization leadership must adopt leadership styles that value and treat athletes as human. There is a need for cultural change to remove the “win at all costs” mentality by seeing athletes as human, rather than only sports performers. Only then can constructive conversations take place to establish new terms of success in sports.

### **Advancing Gender Equity in High-Performance Sports and Technology**

Efforts to address gender disparities in high-performance sports and technology are essential to elevate women's participation and understand the resulting impact on female athlete mental wellbeing. Pioneers in this field are actively devising strategies to provide comprehensive support tailored to the unique needs of female elite athletes. One notable initiative is the transdisciplinary working group Healthy Women in Sport: A Performance Advantage. This collaborative endeavor assembles experts in sports medicine, psychology, physiology, nutrition, and endocrinology to conduct research aimed at enhancing the health of female athletes (Thorpe et al., 2023).

In challenging the once-prevailing gender disparities in sports, significant strides are being made toward fostering a more equitable and inclusive sporting culture (Federico & Hamalian, 2023). Progress toward gender equity is evident in high-performance sports, particularly in areas such as media representation, officiating, and pay parity. For instance, the inaugural game of the Professional Women’s Hockey League (PWHL) attracted 3 million viewers (Ahmed, 2024). Historically, women’s hockey was often perceived as inferior to the men’s game, particularly due to international competition rules that prohibited body checking. However, the PWHL adopted many of the NHL's rules, allowing for increased physicality, a change strongly supported by players. This shift brings the women's game closer to the men's and enhances viewership (Donkin, 2024). Another example is the record-breaking viewership of the 2023 Women’s NCAA Basketball Final, with 9.9 million viewers tuning in, making it the most-watched college basketball game (men's or women's) on ESPN platforms (Elchlepp, 2023).

In 2022, the US National Women's Soccer Team successfully secured equal pay for its members after 28 team members filed a discrimination lawsuit against the US Soccer Federation (USSF) (BBC Sport, 2022). This landmark achievement represents a significant shift toward fairness and recognition for female athletes, setting a precedent for other teams. The lawsuit alleged gender discrimination by the USSF, highlighting the persistent gender pay gap despite the women's team's superior achievements, which the USSF attributed to "market realities" (BBC Sport, 2019). Such challenges can leave female athletes feeling undervalued and disrespected, even as they perform the same roles and responsibilities as their male counterparts.

In addition to addressing gender disparities in sports, technology must also be designed and researched to meet the specific needs of women, offering tailored solutions. Within wellbeing technologies, it is crucial to comprehend gender-based differences in biomarkers and consider the ethical implications of technology and artificial intelligence (AI). As observed by Reading Turchioe et al. (2023) in a study involving non-athlete women and their attitudes toward AI-based technologies in mental health, concerns were raised regarding the ethics of using data sets primarily reflective of men. This is particularly significant as women's mental health is intricately linked to reproductive health, underscoring the importance of a holistic approach to athlete health.

### **Advancing Wellbeing Technology Adoption in High-Performance Sports**

In the realm of high-performance sports, the integration of technology to support athlete mental wellbeing necessitates critical advancements and adherence to specific guidelines. This exploration delves into key themes to facilitate the effective and secure utilization of wellbeing technology among elite athletes. There is an urgent need for technology to be designed with a focus on the unique mental wellbeing requirements of high-performance athletes. Athletes are vocal about their desire for streamlined access to mental wellbeing resources, which includes flexible, secure, and privacy-focused technology-based solutions. To transition towards a future where mental wellbeing resources can comprehensively track, assess, develop, and treat mental health and skills, scientific research must demonstrate the benefits and efficacy of technological applications in enhancing overall wellbeing and performance. Furthermore, these technologies should be co-designed by both psychologists and athletes to ensure their effectiveness (Drake,

2020). In response to the growing need for athletes to have a holistic view of their overall health, wearable health technology Oura has partnered with esteemed sports organizations, such as the NBA, WNBA, NASCAR, UFC, MLB's Seattle Mariners, and La Liga's Real Madrid (Oura, 2022; Schlosser, 2020).

The proliferation of mental health technology tools can lead to confusion. Thus, there is a pressing need for mental health technology specialists who can identify solutions aligned with individual goals and needs, guiding users in effectively leveraging these tools (Drake, 2020). While it is advisable for the adoption of mental wellbeing technologies to be overseen by clinicians, challenges exist in finding competent, accessible mental health professionals, particularly those well-versed in emerging technologies or mainstream technology integration within their practice (Balcombe & De Leo, 2020). Additionally, streamlining the process of connecting with the right support is essential, especially for individuals seeking to integrate mental wellbeing technologies with other platforms to gain a comprehensive view of their overall health.

With technology's continuous evolution in athlete performance development, frameworks like the Quality Framework for Sports Technologies are emerging to navigate the plethora of available tools. These frameworks emphasize the customization of technology use to individual needs (Sports Tech Research Network, n.d.). While research and framework applications in the context of wellbeing technologies in sports are still developing, evaluation in crucial areas such as quality assurance, measurement, demonstrated benefits, ethics, security, user experience, and data management can guide users and clinicians in identifying the most suitable technological solutions (Sports Tech Research Network, n.d; Balcombe & De Leo, 2023.). By addressing these imperatives, the sports and technology sectors can pave the way for a future where wellbeing technology is seamlessly integrated into high-performance sports, catering to the unique needs of elite athletes while promoting their mental health and overall wellbeing.

Furthermore, addressing concerns about the ownership, privacy, and usage of players' data has led players' leagues to partner with specialists. For example, the NFLPA has partnered with BreakawayData and acquired an equity stake in the start-up, a move that will enable all



players to own their data and control the process by which teams may collect and access it, along with having centralized access to their data via its mobile app (BreakawayData, 2022).

### **Advancing Mental Skills Training and Technology Integration for Enhanced Athlete Mental Health**

In the context of fostering the adoption of wellbeing technology in high-performance sports, several pivotal changes must occur to propel the role of mental skills training in supporting athlete mental health and performance. Despite being recognized by athletes, coaches, experts, and researchers, the full potential of mental skills training remains untapped in high-performance sports. Its profound impact on overall mental health and athletic performance necessitates a shift in perception within the sporting community. The existing stigma surrounding mental health issues in high-performance sports must be dismantled to unlock the true potential of mental skills training. By eradicating this taboo, the sports community can create an environment where mental skills are harnessed to holistically support athletes.

Many athletes are already engaging in mental skills training practices, signifying a substantial opportunity for technology to play a pivotal role in enhancing psychological training. Technology can transform mental skills training into an engaging and interactive experience for athletes, thereby augmenting their performance (Rist & Pearce, 2016).

# Strategic Recommendations

To work towards a Hoped-For Future, a set of strategic recommendations has been formulated to guide stakeholders across the sports ecosystem. These recommendations encompass advocacy, cultural transformation, technological innovation, and collaboration, all aimed at elevating mental wellbeing support for athletes.

## Topline Strategic Recommendations:

- **Promote Mental Wellbeing Awareness:** Advocate for mental wellbeing as a fundamental component of overall health across all sports levels and stakeholders to eliminate stigma and enhance literacy.
- **Cultural Change:** Facilitate cultural change within sports organizations by providing education and interventions for athletes, coaches, and administrators to reshape perceptions about athlete mental wellbeing.
- **Invest in Mental Wellbeing Resource:** Sports governing bodies and administrators should invest in mental wellbeing resources for athletes and coaches. Consider partnerships with technology companies and onboard in-house mental health specialists.
- **Co-create Athlete-Centric Technologies:** Collaborate with athletes and licensed mental health professionals to design wellbeing technologies tailored to elite athletes' specific needs. Understand generational differences in technology usage and expectations for user-friendly and effective tools.
- **Educate Mental Health Professionals:** Train mental health professionals in high-performance sports about mental wellbeing technologies and encourage their integration into their practice.
- **Integration with Other Platforms:** Technology companies should prioritize integration with other platforms, including Big Tech, to offer a comprehensive view of overall athlete health.
- **Ensure Effectiveness and Security:** Technology companies must demonstrate the effectiveness, equity, and security of their technology. Conduct thorough testing and validation.

- **Data Security Partnerships:** Athletes and sports governing bodies should consider partnerships with data security specialists and stay informed about evolving regulations.
- **Sports-Specific Wellbeing Frameworks:** Create comprehensive and effective sports-specific frameworks for assessing and improving mental wellbeing across sports. Explore the adoption of mental wellbeing technologies within these frameworks.
- **Align with Performance Goals:** Athletes should evaluate how wellbeing technologies can support their performance goals and incorporate them strategically.
- **Framework for Evaluating Wellbeing Technologies:** Develop frameworks for assessing the impact and integration of mental wellbeing interventions in high-performance sports, especially those leveraging technology.

These recommendations provide a **starting** roadmap for enhancing mental wellbeing support in high-performance sports through technology integration and cultural change.

# Environment Scan of Wellbeing Technologies

## Applications of Wellbeing Technologies

In conducting this research, three themes emerged in which technologies can be adopted to support athlete wellbeing.

### 1. Tracking and Assessment Applications

The use of technology for tracking, management, and assessment purposes related to mental health has witnessed a significant surge in recent years in healthcare. These tools have the potential to play a pivotal role in supporting mental wellbeing by monitoring various inputs and offering valuable insights into overall health and behavioral patterns. Importantly, technology holds substantial promise in broadening the horizons of mental health support, particularly in its capacity to interpret symptoms and detect disorders (Balcombe et al., 2020; Purcell et al., 2020).

The potential of mental wellness tracking and assessment applications is especially promising for professional sports leagues teams, where injuries bear not only personal consequences for athletes but also substantial financial costs for organizations (Marston, 2023). Through comprehensive tracking, the proactive identification of potential issues and the implementation of early intervention strategies become feasible, offering a valuable resource for safeguarding athlete wellbeing and broader team success.

### 2. Development Applications

Various technologies, including mobile apps, biofeedback, and virtual reality offer unique avenues for athletes to strengthen mental skills and emotional regulation, drawing from the principles of sports psychology and mindfulness. Some of these tools can provide athletes with tailored exercises and simulations designed to sharpen cognitive abilities or improve mental state (Lv et al., 2022). The repeated exposure to these tasks and scenarios can build mindfulness skills and mental resilience ultimately enhancing athlete performance.

### **3. Treatment Applications**

When thoughtfully integrated into the treatment process of individuals diagnosed with mental health disorders and guided by licensed health professionals, mental wellbeing technologies become invaluable tools for improving mental health among high-performance athletes. Treatment applications of wellbeing technologies are important in offering athletes accessible, effective, and comprehensive mental health. These applications can be especially beneficial for individuals who frequently travel or have limited access to in-person care, offering a valuable complement to traditional interventions.

# Overview of Wellbeing Technologies

It is important to recognize that many of these technologies are not mutually exclusive and can be effectively used in combination. The order in which they are presented here reflects their adoption and utilization hierarchy, as revealed through the research conducted in this study.

## 1. Mobile Apps

**Use: Tracking and Assessment, and Development**

**Cost: \$**

Smartphone applications have revolutionized the management of mental wellbeing, offering both athletes and the general public a convenient, self-directed approach to tracking their psychological state. These apps have become accessible to a wide audience due to the widespread ownership of smartphones. They provide individuals with a valuable tool to monitor and categorize their mood and stress levels, enabling them to identify triggers and patterns over time (Qu et al., 2020). Athletes, in particular, benefit from the convenience of these apps, as they can engage with wellbeing technologies anytime and anywhere, allowing them to stay connected to their mental health needs within the constraints of their demanding schedules. Additionally, these applications contribute to enhancing motivation, and emotional control and in assisting users in setting and achieving their wellbeing goals (Crookston et al., 2017). For athletes seeking to enhance cognitive skills, platforms like Molliteum offer valuable coaching, focusing on building resilience (Molliteum, n.d.)

Some more advanced applications sync with wearable sensors, creating a central hub for wellness data and offering a comprehensive overview of an athlete's health. However, a gap remains in the market for apps specifically tailored to athletes' mental wellbeing, which would include features for confidential data sharing with support teams and a holistic health perspective. Such tools are vital, especially for those lacking the resources to access professional mental health services, underlining the importance of technology in democratizing mental wellbeing support. This study's participants noted the need for more athlete-centric wellbeing apps, signaling a significant opportunity for developers to impact the sports industry positively.

## **2. Athlete Optimization Platforms**

**Use: Tracking and Assessment, and Development**

**Cost: \$-\$\$**

Human performance optimization software plays a pivotal role in providing athletes with valuable insights into their health, training routines, and overall well-being. These insights serve as the basis for crafting highly personalized strategies aimed at reducing the risk of injuries, optimizing energy levels, and enhancing overall performance. However, despite the advanced capabilities of these systems, a significant challenge lies in effectively integrating mental wellbeing components into the equation.

For instance, Inspiretek stands out as an athlete wellbeing management system that places a primary focus on mental health and wellbeing (Inspiretek, n.d.). Notably, it is among the few programs that offer specific features for tracking and assessing youth athletes. To truly enhance an athlete's performance, it becomes imperative for these systems to evolve further. They should not only collect but also interpret mental wellbeing data and seamlessly integrate with other platforms. Embracing this holistic approach promises more comprehensive insights, ensuring that an athlete's physical training, mental health, and recovery efforts are all seamlessly aligned with their performance objectives. Therefore, the next generation of human performance optimization software must transcend the compartmentalization of different aspects of performance and treat athletes as holistic entities.

## **3. Wearable Sensors**

**Use for: Tracking and Assessment, and Development**

**Cost: \$-\$\$\$**

Wearable sensors have become increasingly popular in elite sports, allowing athletes to track and analyze their physical performance metrics in real time. These increasingly miniaturized devices provide valuable insights into an athlete's physical state, such as their movement, sleep patterns, and recovery times, by leveraging biomarkers like heart rate variability, body temperature, fluid loss, respiratory rate, and electroencephalogram (EEG).

Although these biomarkers are typically interpreted for physical health status, they can also indicate mental health risks, and, when triangulated with other information on wellbeing factors, create a clearer picture of an athlete's health. For example, researchers at Caltech have developed wearable sensors that detect estradiol (low levels of which can lead to depression in women) and cortisol in sweat (commonly known as the stress hormone) (Velasco, 2023; Velasco, 2020).

While specialized tracking devices may be difficult or expensive to acquire, mass-market health and fitness tracking devices such as the Apple Watch, Whoop, and Oura Ring are common among athletes due to their accessibility and improving accuracy. Apple's next generation of AirPods will feature in-ear body temperature sensors, which will collect more accurate data than wrist temperature sensors (Gurman, 2023). With this wealth of information, athletes, coaches, and support service providers can make data-driven decisions to optimize an athlete's performance.

#### **4. Sound Technologies**

##### **Use: Development and Treatment**

**Cost: \$-\$\$**

The integration of sound technologies into wellbeing development and treatment represents an emerging theme at the intersection of health and technology. While not entirely new, this field has yet to be widely explored and leveraged, especially within the realm of high-performance sports.

Research is increasingly revealing the beneficial impact of audio and music on mental wellbeing, with a particular focus on their ability to reduce stressors that affect the human brain (Dekker et al., 2014). For individuals dealing with conditions like depression or anxiety disorders, these auditory interventions may offer a promising supplement to clinical treatments (Greenberg et al., 2021). The accessibility and variable cost of these technologies make them a viable option for a wide range of users, including athletes seeking non-pharmacological methods to enhance their mental health.



Furthermore, practices such as mindfulness, known for their stress-coping and cognitive performance benefits, are being enhanced by sound technologies. Research by Axelsen et al. (2020) indicates that binaural beats, for instance, can improve sustained attention, thereby supporting the cognitive demands placed on high-performance individuals. Companies like Myndstream are translating this research into practical applications by creating music specifically designed to foster health and wellbeing (Myndstream, n.d.). These innovations are carving out a space where technology and therapeutic practices intersect, offering novel avenues for mental health support that are both innovative and grounded in emerging scientific evidence.

Sound technologies, with their dual focus on wellbeing development and treatment, are poised to become an integral part of comprehensive health strategies, especially considering that many athletes already view music as a crucial component of their training and competition routines.

## **5. Telehealth**

### **Use: Tracking and Assessment, Development and Treatment**

**Cost: \$-\$\$**

Telehealth, while not a novel concept, has established itself as an enduring and transformative development in the realm of mental wellbeing care. Its widespread adoption is a testament to its enduring impact. This technology has empowered athletes to effortlessly connect with clinicians, counselors, and mental health professionals, regardless of their physical location. This remote accessibility ensures that crucial support is readily available, offering a level of flexibility that aligns seamlessly with the demanding schedules of athletes. Telehealth's effectiveness in expanding access to mental wellbeing support has been well-documented since its inception (Hilty et al., 2013).

As telehealth technology continues to advance, it has opened doors to innovative alternatives, such as virtual clinics. These fully digitized environments, created by healthcare practitioners, have emerged as a promising frontier in mental health care. Virtual clinics are poised to revolutionize the delivery of digital therapeutic care, offering athletes a range of tailored interventions to address their specific needs. The evolution of telehealth into more

comprehensive virtual clinic services, as observed by Torous and Hsin (2018), underscores the ongoing commitment to enhancing athletes' mental wellbeing by leveraging the capabilities of technology.

## **6. Virtual Reality**

**Use: Development and Treatment**

**Cost: \$\$-\$\$\$**

Imagery training is a well-established practice in the world of sports, and emerging technologies, such as virtual simulation environments, are rapidly gaining traction not only in sports but also in fields like medicine due to their effective immersive qualities. Most elite athletes routinely engage in some form of visualization exercises, whether unaided or assisted by tools like video footage. Interestingly, athletes often use game footage on competition days primarily for mental imagery exercise, underlining the role of preparatory visualization in boosting confidence and composure.

While many athletes already practice unaided visualization or imagery training, researchers are actively exploring how technologies like virtual reality can enhance these experiences, making them more lifelike and effective (Wu et al., 2023; Clarey, 2014; Svoboda, 2021). Moreover, virtual reality serves as a versatile tool for cognitive behavioral therapy, with numerous potential applications in mental wellbeing development and treatment (Yunchao et al., 2023; Le Noury et al., 2022; Montana et al., 2020; Pagé et al., 2019). One notable example is Tripp, a research-backed system for virtual reality meditation practices in the metaverse (Tripp, n.d.). Virtual reality also offers a potential alternative to traditional telehealth options. A study involving non-athletes found that virtual reality outperformed Skype videoconferencing in remote therapy due to its perceived sense of presence (Pedram et al., 2020).

## **7. Artificial Intelligence and Machine Learning**

**Use: Tracking and Assessment, and Development**

**Cost: \$-\$\$\$**

Artificial intelligence and machine learning have proven to be valuable tools in the realm of mental wellbeing tracking and screening, offering athletes personalized recommendations to optimize their health. These technologies can be integrated into various platforms, including mobile apps and performance optimization programs, making them versatile assets for athletes. One unique example, specifically tailored to address cultural aspects in sports organizations, is Innerlogic. This AI-powered conversational survey tool is designed for cultural measurement and analysis, supporting cultural change within sports organizations (Innerlogic; n.d.).

Chatbots, another promising digital coping intervention, have also demonstrated their effectiveness. A study involving non-athlete university students during the COVID-19 pandemic found that chatbot interventions led to a decrease in anxiety symptoms for some users and a decrease in stress symptoms for all users (Gabrielli et al., 2021). These findings highlight the potential of chatbots in providing mental health support to athletes.

However, as these technologies rely on data analysis and prediction, there is a pressing need to ensure their safety and accuracy. Peer-reviewed algorithms are essential to guarantee equity and reliability in their recommendations (Balcombe & De Leo, 2020; Carr, 2020). This emphasizes the importance of maintaining high standards in the development and implementation of AI and machine learning solutions for mental wellbeing in sports.

## **8. Biofeedback and Neurofeedback**

**Use: Tracking and Assessment, Development, and Treatment**

**Cost: \$\$-\$\$\$**

Biofeedback involves the use of bio-monitoring systems equipped with sensors to provide real-time measurements of psychological and neurological states. These systems are integrated with sensory stimuli, such as haptic or audio feedback, offering athletes real-time sensory cues as part of their mental wellbeing coaching. One such example is OxaLife, a wearable device designed to function as a breathing coach. OxaLife employs haptic feedback to deliver instant biofeedback, measuring various physiological parameters including breathing, electrocardiogram (EKG), and body temperature. It serves as a valuable tool for relaxation, stress management, and sleep support (OxaLife, n.d.).

Another area of biofeedback, known as neurofeedback, harnesses sensors like electroencephalogram (EEG) devices to continuously monitor brain activity. The primary aim is to regulate and optimize brain functioning. This therapeutic approach has demonstrated promise in addressing a range of conditions, including ADHD, anxiety, depression, and epilepsy (Flanagan & Jyoti Saikia, 2023). For instance, the Muse EEG wearable device is coupled with a smartphone app tailored for guided meditation sessions. This innovative app employs sound cues to provide real-time insights into brain activity, assisting users in recognizing and entering a meditative state (Flanagan & Jyoti Saikia, 2023). These advancements underscore the integration of sensory feedback technologies as a means to enhance mental wellbeing and optimize performance for athletes.

## **9. Brain-Computer Interfaces & Brain Stimulation**

### **Use: Development and Treatment**

**Cost: \$\$-\$\$\$**

While still in its nascent stages within the realm of sports, brain-computer interfaces represent a cutting-edge technology that translates brain activity into specific outputs through the utilization of brain-processing algorithms (Jeunet et al., 2020). Although brain-computer interfaces are predominantly employed to assist individuals with physical disabilities, preliminary research hints at their potential to enhance cognitive skills relevant to athlete performance (Jeunet et al., 2020).

However, it is essential to highlight the need for further research to comprehensively understand how this technology can be specifically harnessed to bolster athlete mental wellbeing. Another tool in this regard is brain stimulation techniques, like transcranial direct current stimulation (tDCS), which use electrical currents to influence cognitive states and behaviors (Thair et al., 2017; Jeunet et al., 2020). This convergence of brain-computer interfaces and brain stimulation techniques holds potential, offering an exciting avenue for exploration that could change the landscape of mental wellbeing support for athletes.

# Conclusion

This report delves into the transformation occurring in high-performance sports in the present, near future, and distant future, driven by the convergence of culture, science, medicine, and technology. Within this evolving landscape, there is a growing recognition of the need for a holistic approach to optimize athletes' performance and wellbeing. This shift is further underscored by the contemporary societal emphasis on overall wellbeing.

Technology plays a pivotal role in this transformation, facilitating the development of innovative solutions to support athletes' mental and physical health. The research explored the intersection of culture, high-performance sports, and wellbeing, focusing on how mental wellbeing technologies can best serve elite athletes. It operates on the premise that athletes are multifaceted individuals whose mental and emotional states significantly impact their performance.

A central theme of this research is the interconnectedness of mental and physical health. While physical attributes have traditionally dominated athlete development, this study highlights the equally critical role of mental wellbeing. Mental health is recognized as a strategic asset that can enhance an athlete's performance and overall health. The research underscores the importance of adopting a holistic perspective on athlete wellbeing, where mental health holds a central position.

In conclusion, this research project explores the intersection of culture, high-performance sports, and wellbeing, with technology as a driving force. It emphasizes the need to perceive athletes as multifaceted individuals whose mental and physical health are intricately intertwined and offers strategic recommendations to develop a Hoped-For Future with regards to athlete wellbeing and technology integration. By investigating the potential of technology to support athlete wellbeing, this research strives to pave the way for a future where elite athletes can thrive not only physically but also mentally, ultimately leading to more successful and fulfilling athletic careers.

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# Appendix A: Example Interview Questions

## **Athletes & Coaches:**

Describe how you want to feel when training or playing [SPORT]?

How long have you been playing [SPORT]?

Can you please walk me through what a typical training day looks like for you?

Can you please walk me through what does a typical game/competition day looks like for you?

Do you use any technology when training or competing? For what purposes?

Are there any wellbeing technologies you have heard of that you are interested in trying? Why?

For you, what role does mental or psychological wellbeing play in [SPORT], if any?

Are there any techniques you use to develop your mental wellbeing skills?

How much time do your coaches spend on developing your mental skills?

How comfortable do you feel speaking about mental wellbeing with your coaches or teammates?

When you are with your coaches or teammates, how often do you speak about mental wellbeing?

Do you feel as though your coaches prioritize your mental wellbeing as an athlete?

For yourself as an athlete, how much time would you like to spend dedicated to your mental wellbeing – in what ways?

Is mental wellbeing development something you are interested in further exploring? If so, why?

Please describe the current state of wellbeing in elite sports.

- How has/is this changing? Why do you think that is?

What, if any, are some of the largest pressures elite athletes face?

Is a sports psychologist or psychiatrist available to you? If so, are you encouraged to see them?

- Are they using any technology to further their work?

Have you tried activities like mindfulness or meditation?

- How much time do you allocate to these activities and how often are you doing them?

**Experts (dependent on expert):**

What kind of technologies have you seen adapted for sports?

What technologies currently exist that can measure or track psychological responses?

What types of immersive technologies are currently available?