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Cyber Stress among Athletes: An Analytical Study on the Impact of Digital Anxiety and Resistance to Technological Innovation in Modern Training Environments.

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Abstract :

This study analyzes how cyber stress impacts athletes' psychological states and performance in modern training environments through a comprehensive review and descriptive-analytical approach.

The findings reveal that digital anxiety elevates stress levels and impairs cognitive functions like concentration and decision-making. Physiologically, it causes elevated cortisol, sleep disturbances, and compromised physical recovery. Additionally, resistance to technological innovation emerges as a significant barrier preventing effective adoption of modern training technologies.

Results demonstrate that integrating psychological support, relaxation techniques, digital time management, and technological training enhances athletes' adaptation and sustainable performance in contemporary settings. The study addresses a critical knowledge gap in sports science regarding digital challenges and provides practical recommendations for developing training models that merge psychological, social, and technological dimensions.

Keywords: Cyber stress ; Digital anxiety ; Resistance to innovation.

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1. INTRODUCTION

In recent years, the landscape of sports training has undergone a profound digital transformation, driven by rapid advances in wearable technologies, artificial intelligence (AI), and real-time data analytics. These technological developments have fundamentally reshaped how athletes train, monitor progress, and achieve peak performance. According to Romagnoli, Bonaiuto, and Padua (2025), digital tools have become indispensable in the assessment and monitoring of human movement, offering unprecedented precision in biomechanical and physiological analysis. Similarly, highlights that smart wearable devices and instant feedback systems enable athletes and coaches to optimize performance through continuous data-driven insights. Emerging AI-driven platforms further enhance this ecosystem by providing adaptive and predictive coaching support (Luo et al., 2025; Yi, 2024). The integration of Internet of Things (IoT) sensors, machine learning models, and virtual-reality simulations has allowed for dynamic, individualized training programs that align physiological data with tactical performance goals (Dev et al., 2025; Bernardes et al., 2025). Consequently, the digitalization of sports training represents a paradigm shift from intuition-based methods to evidence-based performance optimization, enhancing both athletic outcomes and injury prevention strategies.

While the rapid transition toward digital culture has provided enormous opportunities for enhancing athletic performance, it has also introduced new psychological and physiological challenges previously unrecognized in sports contexts. One of the most notable phenomena is *cyber stress*, defined as the psychological and physical strain resulting from intensive use of digital technologies and continuous interaction with electronic training and work environments. Athletes, due to the highly demanding nature of their physical and mental workload, are among the most vulnerable groups to cyber stress. They face persistent pressures related to monitoring their performance data, adapting to constant technological updates, and maintaining engagement with digital platforms within dynamic training ecosystems (Kashyckina, 2025).

These ongoing digital demands require a balanced approach to ensure that athletes benefit from technology without compromising their mental health or behavioral well-being (Anderson & Rainie, 2018). Moreover, both coaches and

athletes often encounter *technological resistance*, a psychological and social barrier characterized by reluctance to adopt innovation due to uncertainty, fear of the unknown, or attachment to traditional training practices (Trempe, Rodrigue, Smith, & Koutrias, 2025). This resistance can create a gap between the potential of digital innovation and its actual implementation in sports environments. Therefore, the central issue that emerges concerns how *cyber stress* and *digital anxiety* influence athletes' mental health and performance, and what role *innovation resistance* plays in moderating these effects. Developing balanced strategies that enable optimal technological engagement while mitigating psychological strain is essential for sustainable athlete well-being and performance (Geiger, Aufderlandwehr, & Esser, 2024).

2. Objectives of the Study : The main objectives of this study are to:

- Analyze the impact of cyber stress and digital anxiety on athletes' psychological and physical health by examining levels of stress, anxiety, and sleep disturbances associated with intensive use of digital technologies in training environments.
- Explore the nature and underlying causes of athletes' and coaches' resistance to technological innovation in sports training, identifying the psychological and social determinants that shape acceptance or rejection of digital transformation.
- Assess the relationship between psychological factors (cyber stress and digital anxiety) and innovation resistance, and determine how these dimensions influence the quality of athletic performance and persistence within digitally mediated training contexts.
- Propose practical, evidence-based strategies that integrate psychological support and technological adaptation, enabling athletes to fully benefit from digital advancements without compromising mental well-being or physical performance.
- Enhance specialized scientific understanding through an extensive critical review of Arabic and international literature, thereby enabling researchers and practitioners to develop adaptive approaches for addressing the challenges of the digital era in sports training.



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3. Definition of Study Variables :

3.1 Cyber stress :

also referred to as digital stress, is a complex psychological and physiological response that results from continuous and repetitive exposure to stressors within digital environments, including social media, electronic communication tools, mobile computing, and digital performance-tracking devices.

Unlike traditional psychological fatigue, cyber stress involves intricate interactions among technological, personal, and social dimensions that collectively influence individual well-being.

From a psychological perspective, athletes experiencing cyber stress often exhibit symptoms such as chronic tension, persistent anxiety, reduced concentration, sleep disturbances, and impaired decision-making during training and competition.

Behaviorally, these manifestations may lead to social withdrawal, diminished motivation, and defensive or avoidant reactions toward digital technologies used in the training process.

From a physiological standpoint, prolonged exposure to digital stimuli can elevate stress-related hormones such as cortisol, negatively affect immune functioning, and increase vulnerability to chronic conditions and muscle fatigue (Afifi, R., Zambrano-Varaon, J. A., & Turel, O., 2018).

Associated symptoms may include headaches, muscular tension, and neurocognitive fatigue that further compromise recovery and performance capacity.

Cyber stress arises from an intricate interplay of factors, including the intensity and pattern of technology use, the quality of social support, individual coping capacities, and the nature and volume of digital information that is continuously received.

Accordingly, understanding cyber stress requires situating it within both social and technological ecosystems rather than viewing it as a purely individual phenomenon.

In the sporting context, it represents a growing challenge, given the high cognitive, emotional, and physical demands placed on athletes across training and competition schedules.

Effectively addressing cyber stress therefore necessitates a multidisciplinary approach that integrates sports psychology, cognitive science, and digital technology in order to design preventive and therapeutic interventions tailored to athletes' needs.

3.2 Digital Anxiety :

Digital anxiety refers to a psychological state of tension, unease, and apprehension that arises from direct or sustained exposure to digital technologies and their environments, manifesting as a cognitive and emotional response to technological stimuli perceived as threatening or overwhelming (Osiceanu, 2015).

This form of anxiety is characterized by fear of technological errors, difficulty using new systems, and concerns about data privacy or loss of control. Unlike digital addiction, digital anxiety may affect even individuals with limited technological exposure, particularly those undergoing transitions into digitally mediated professional or educational settings.

Psychologically, digital anxiety manifests through symptoms such as:

- Fear of losing control over digital systems and devices.
- Reduced self-confidence when performing technology-based tasks.
- Cognitive fatigue due to continuous adaptation to rapidly changing digital environments.
- Physiological symptoms such as increased heart rate and muscle tension during digital interaction.

Moreover, digital anxiety extends beyond the individual to shape the social dimensions of digital participation. Individuals who experience this form of anxiety often avoid digital technologies, leading to digital isolation and reduced engagement in professional or academic digital communities (Saleem, F., Chikhaoui, E., & Malik, M. I., 2024).

Such avoidance is frequently driven by perceived incompetence, fear of criticism, or fear of failure when handling technology, which in turn reduces social connectedness and limits learning opportunities.



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In the Algerian context, digital anxiety is further reinforced by limited access to digital social support networks, which are crucial for adaptive coping and digital inclusion. Older adults and individuals with low levels of digital literacy are particularly vulnerable to this form of anxiety, contributing to digital inequality and constraining opportunities for professional growth (Barreda Gutiérrez, M., Cantarero-Prieto, D., & Pascual Sáez, M., 2024).

3.3 Resistance to Innovation :

Resistance to innovation is a psychological and social phenomenon that reflects individuals' or organizations' reluctance or refusal to adopt new technologies or innovations, often driven by fear of the unknown, perceived loss of control, or deeply entrenched habits (Deger, 2025). In the sports domain, innovation resistance manifests as hesitation or refusal among athletes, coaches, or sports administrators to integrate modern technologies—such as artificial intelligence, virtual reality, or wearable devices—into training programs and performance analytics. Despite clear scientific evidence of their benefits, such resistance constrains modernization, slows the adoption of injury-prevention and recovery-enhancing solutions, and ultimately diminishes the efficiency of training processes.

This resistance frequently stems from psychological barriers (e.g., techno-anxiety, fear of obsolescence) and organizational inertia (e.g., limited digital literacy, rigid traditional hierarchies). Understanding this phenomenon is essential for fostering a culture of technological adaptability within sports institutions, thereby ensuring that innovation is harnessed in ways that support both performance enhancement and athlete well-being.

4. The impact of cyber stress and resistance to innovation on athletic performance:

4.1 Psychological Dimension :

Cyber stress imposes a significant psychological burden on athletes, as constant interaction with digital technologies elevates anxiety and mental tension. Many athletes experience digital performance anxiety—a state of apprehension arising from the pressure to keep pace with advanced technologies such as real-time analytics tools, wearable trackers, and performance-monitoring devices. This anxiety can develop into depressive symptoms, diminished self-confidence, and avoidance of training sessions, all of which undermine motivation and constrain high-level performance.

Such psychological disturbances disrupt athletes' capacity to focus, process information efficiently, and make rapid decisions during training and competition, thereby reducing overall performance quality (Anderson & Rainie, 2023). The digital environment also amplifies self-comparison anxiety, as athletes continuously monitor and compare performance metrics, which further exacerbates psychological strain (Hayes, M., Filo, K., Geurin, A., & Riot, C., 2020).

4.2 Physiological Dimension :

Digital anxiety and cyber stress trigger a cascade of physiological responses, including elevated cortisol secretion, a core biomarker of stress that disrupts muscle-recovery processes, weakens immune function, and increases susceptibility to chronic fatigue and injury (Mei, Z., Zhang, Y., Fan, Q., Luo, S., & Luo, S., 2024).

Sleep disturbances caused by prolonged digital exposure impair energy restoration and endurance capacity, with evidence from sleep research indicating that reduced sleep duration or poor sleep quality leads to decreased athletic performance, diminished coordination, and slower post-exercise recovery (Souissi et al., 2021).

Moreover, chronic anxiety and sustained physiological arousal are associated with increased muscular tension—particularly in the shoulders, neck, and lower back—resulting in persistent pain that compromises biomechanical efficiency and fine movement control (Fullagar et al., 2015).



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4.3 Behavioral Dimension

Cyber stress and digital anxiety significantly shape athletes' behavioral responses toward technology, with fear of technology (technophobia) often giving rise to avoidance and resistance behaviors in which athletes reject advanced devices and instead persist with traditional training methods despite global shifts toward data-driven performance enhancement (Wu et al., 2024).

This resistance to innovation may stem from fear of change, perceived digital incompetence, or reliance on long-standing routines that hinder technological adaptation, thereby reducing opportunities to leverage performance analytics, injury-prevention monitoring, and feedback-based optimization tools.

In more severe cases, athletes may exhibit overt hostility toward digital training modalities, which undermines collaboration with coaches and peers and limits the effective integration of technology within the training environment.

4.4 Social Dimension

Digital isolation is one of the most prominent consequences of cyber stress and innovation resistance, as sustained digital anxiety can gradually erode athletes' willingness to participate in technology-mediated interactions. Athletes experiencing high levels of digital anxiety often disengage from online or collaborative training communities, depriving themselves of the social and emotional support that is critical for maintaining motivation and self-efficacy, as highlighted by Jackson and Drummond (2023).

Reduced digital social engagement leads to fewer opportunities for constructive feedback, weaker team cohesion, and poorer collective decision-making processes, all of which are central to successful performance in modern, digitally integrated training environments. Over time, such isolation widens the gap between athletes who embrace technological innovation and those who resist it, thereby diminishing competitiveness at elite and international levels.

This pattern of social withdrawal not only undermines group morale but also limits athletes' exposure to technological learning and innovation, ultimately constraining their ability to compete effectively within increasingly digitalized sports systems (Welch & Norman, 2025).

5. Strategies for Coping and Mitigating Cyber Stress:

5.1 For psychological kit:

- **Mental mindset training: (mindfulness)**

Mental mindset training (mindfulness) represents one of the most effective psychological approaches for reducing stress and anxiety associated with cyber stress in athletes. Mindfulness practice cultivates non-judgmental awareness of the present moment, enabling athletes to observe their thoughts, emotions, and bodily sensations in a conscious and balanced manner without becoming overwhelmed by worry or tension.

This heightened awareness strengthens self-regulation of emotional responses to technological pressures, thereby enhancing attentional focus and perceived control during both training and competition. Empirical evidence indicates that athletes who regularly engage in mindfulness-based programs, such as Mindfulness-Based Stress Reduction (MBSR), demonstrate greater resilience to stress and more effective management of performance-related pressure (Kabat-Zinn, 2013)

- **Breathing and Relaxation Techniques:**

Deep breathing exercises and guided meditation activate the parasympathetic nervous system, which is responsible for relaxation and physiological calm. This shift toward parasympathetic dominance reduces the secretion of cortisol, the primary stress hormone, and helps alleviate tension associated with digital anxiety and cyber stress.

These simple yet effective techniques provide relatively rapid relief from digital anxiety and promote a stable physiological state that supports both psychological equilibrium and bodily homeostasis (Jerath et al., 2006)

- **Digital Time Management (Digital Detox):**

Constant exposure to digital stimuli from screens and connected devices is a major contributor to cyber stress, as it sustains high cognitive load and mental fatigue.

Managing and limiting technology usage—for example, scheduling screen-free periods and disabling non-essential notifications at set times—helps reduce cognitive overload, supports mental recovery, and allows for more effective cognitive renewal. These behavioral strategies are associated with improved concentration, better sleep quality, and enhanced overall performance in digitally demanding contexts.

Specific ergonomic guidelines such as the 20-20-20 rule, which recommends looking away from screens every 20 minutes at an object



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approximately 20 feet (about 6 meters) away for at least 20 seconds, help reduce visual strain and support sustained comfort during prolonged screen use.

5.2 Physical and Health Interventions

- **Comprehensive Medical Monitoring:**

Regular health assessments of athletes, including measurements of stress hormones, sleep-quality indices, blood pressure, and markers of sustained stress effects on the nervous system, are essential for protecting long-term health and performance. Such multidimensional monitoring provides objective data for evaluating the effectiveness of coping strategies and enables early intervention when signs of chronic stress or overreaching begin to appear (Tarnai, 2024)

- **Fitness training programs:**

Regular physical exercise—including relaxation practices, yoga, and strength training—serves as an effective outlet for muscular tension and enhances overall physiological functioning. Programs that systematically target both endurance and strength also increase athletes' capacity to tolerate diverse stressors, including digital stress associated with constant technology use (Woodyard, 2011).

- **Nutritional balance and sleep hygiene:**

Proper nutrition, combined with a consistent and well-regulated sleep–wake schedule, is critical for building resilience and promoting recovery from stress and modern technological pressures. Reducing evening exposure to blue light from digital screens and incorporating evidence-based sleep-enhancing strategies or technologies are important supportive measures for improving sleep quality and sustaining optimal performance (Walker, 2017).

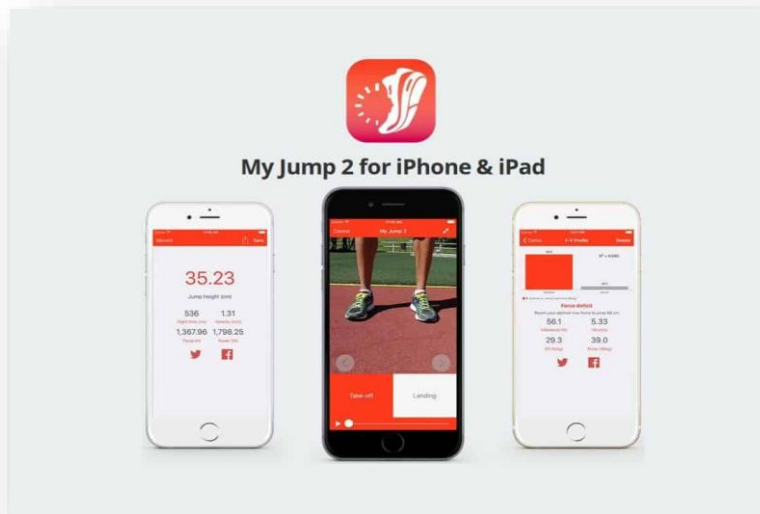
6. Using Smart Applications to Analyze Physical Abilities:

6.1 A Field Study on Football Team Players:

This field study utilized the My Jump 2 application to analyze the physical preparation level, running strength, and speed of football players. The results indicated that smart applications provide precise data that assist coaches in tailoring specialized training programs suited to each player's needs. This personalized approach improved players' power and speed attributes, thereby enhancing training efficiency and achieving the desired performance outcomes. The reliability and validity of My Jump 2 in assessing athletic performance

variables make it an effective tool in sports training and monitoring (Balsalobre-Fernández et al., 2018; López-Fernández et al., 2024).

Fig.1: the My Jump 2 application



Source:App store

6.2 Wearable Technology:

such as heart rate monitors and GPS systems have become essential tools that provide real-time, comprehensive data on athletes' performance, including distance covered, heart rate frequency, and movement patterns. This data helps coaches design personalized training programs and reduces injury risks by monitoring signs of fatigue and exhaustion moment by moment (Tsilimigkras et al, 2024).

In wearable technology is commonly used to monitor player movements, heart rates, and overall workload during training sessions and matches. These devices provide information on player speed, distance covered, and intensity levels. Such insights enable coaches to tailor training regimens according to individual needs and manage player fatigue effectively.

Fig.2: Wearable tracking devices



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6.3 Performance Analysis Software and Big Data :

The use of artificial intelligence techniques and data analysis software has helped sports teams improve strategies and playing techniques. For example, AI has been utilized for early detection and prediction of injuries by analyzing player data. This approach has been applied in recent studies with football clubs, resulting in a 20% improvement in the quality of player recruitment and enhanced collaboration between medical teams and coaches Gowda, V. R. (2025).

Fig.3: the use of modern technologies in sports training



6.4 Digital Training and Education Platforms:

are integrated electronic systems that allow athletes, coaches, and technical teams to organize, monitor, and analyze training programs online. These platforms provide interactive educational content, performance analysis tools, and direct communication among different parties through videos, schedules, posts, and performance reports (Timmerman et al., 2024).

Many prestigious clubs such as Real Madrid and Chelsea, as well as national organizations like the French Football Federation, use systems like Catapult Sports to analyze performance and track players' training loads. These platforms offer advanced football-specific analytics with **detailed** metrics capturing every aspect of player performance on the field—from individual movement tracking to team dynamics analysis—helping to improve both individual and collective team performance.

Fig.4: the Catapult Sports system for performance analysis and tracking players' training load





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7. General Results of the Study

After analyzing numerous specialized studies on cyber stress in athletes and the impact of digital anxiety and technological innovation resistance in modern training environments, the overall findings can be summarized as follows:

- ✓ Digital anxiety is prevalent among athletes in contemporary training settings due to increasing reliance on digital devices and systems, leading to psychological stress responses that impair concentration and the ability to make quick decisions.
- ✓ Cyber stress results in various physiological effects such as elevated cortisol levels, sleep disturbances, and persistent muscle tension, negatively impacting physical recovery and increasing injury risk.
- ✓ Resistance to technological innovation constitutes a major barrier to adopting modern training technologies, driven by psychological fears of failure, lack of technical expertise, and attachment to traditional methods, thereby limiting the effectiveness of training and performance enhancement mechanisms.
- ✓ The social dimensions of digital anxiety contribute to digital isolation and weakened social support, which undermine coordination among training team members and adversely affect athlete motivation.
- ✓ Modern technologies, including wearable devices, digital training platforms, artificial intelligence, and virtual reality, have proven effective in improving training quality, real-time performance monitoring, and injury reduction, provided innovation resistance is overcome and adequate support is available.
- ✓ Multidimensional adaptation and mitigation strategies—psychological, technical, social, and health-related—are essential to address cyber stress effects and achieve a sustainable, high-quality training model.

These results highlight the importance of disciplined technology integration supported by awareness programs and psychological and technical training to ensure successful adaptation and enhanced athletic performance.

8. Recommendations and Proposals for Managing Cyber Stress Among Athletes and Its Impact on Performance

- ✓ Develop Comprehensive Psychological and Technical Awareness Programs: Implement inclusive awareness programs for athletes and coaches

about the nature and symptoms of cyber stress, emphasizing building skills to manage digital anxiety and effective digital time management.

- ✓ Enhance Training on Technology Usage: Organize specialized training courses to improve athletes' and coaches' proficiency with modern technological devices and tools, thereby reducing resistance to innovation and increasing technical confidence.
- ✓ Incorporate Mindfulness and Relaxation Techniques: Encourage the integration of mindfulness practices and deep breathing exercises into athletes' daily training routines to mitigate the effects of stress and negative fatigue.
- ✓ Adopt Structured Digital Detox Periods: Establish schedules that include dedicated periods free from any digital devices to alleviate mental and physical load and foster self-repair of mind and body.
- ✓ Strengthen Social and Institutional Support: Create supportive psychological environments within teams and sports clubs through group events and activities, and provide specialized psychological counseling services for athlete follow-up.

9. Practical Proposals:

- ✓ Adopt User-Friendly Technological Devices: Choose technology with easy-to-use interfaces tailored to different athlete proficiency levels to minimize digital anxiety and resistance to technology adoption.
- ✓ Design Individualized Training Programs Based on Digital Performance Data: Utilize data drawn from wearable devices and analysis platforms to customize training programs that meet individual athlete needs.
- ✓ Activate Virtual Reality for Mental and Tactical Training: Deploy virtual reality technologies to simulate game scenarios, enhancing decision-making efficiency and reducing injury costs related to field training.
- ✓ Regularly Monitor Health and Physiological Indicators: Conduct periodic assessments of stress hormone levels, sleep quality, and vital signs to adjust preventive training programs.
- ✓ Foster a Positive Sports Culture Toward Innovation: Conduct continuous workshops and share success stories of players and coaches who overcame innovation resistance, cultivating an environment that encourages balanced digital adaptation.
- ✓ These recommendations and proposals form a practical foundation for the healthy integration of modern technology into training environments while



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providing necessary psychological and physical support to athletes to effectively confront challenges posed by cyber stress

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