



## Analysis of Athlete Behaviors in the Light of Forensic Sciences: Doping, Violence and Crime

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### Abstract

Although sport is a phenomenon that symbolizes high performance and global integration in modern society, it has become a focal point for unethical behaviors such as doping, violence, and crime, especially in environments with intensified professional pressures. This situation poses a serious public health and forensic medicine problem that threatens the integrity of sport and the health of athletes. The purpose of this study is to present a holistic forensic framework by systematically analyzing athlete misconduct (doping, violence, and crime) in terms of current analytical methods and legal consequences within the discipline of Forensic Science. The study was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Data were retrieved from the Google Scholar and PubMed databases, and 12 articles published between 2020 and 2024 that met the determined criteria were included in the final analysis. The findings indicate that doping should be treated not only as a medical problem but also as a legal offense (criminalization), and that new technologies such as electrochemical sensors are needed for its detection. The phenomenon of violence is defined as an institutional problem through the concept of "Sports Family Violence," while match-fixing and crime are found to stem from sport's inherent "activity-focused" vulnerabilities. This research offers valuable insights for developing holistic forensic examination protocols for the prevention of athlete misconduct, including independent whistleblowing mechanisms and psychological screenings.

**Keywords:** Doping, Violence, Crime, Sport, Forensic Sciences.

### Introduction

Sport, while symbolizing high performance, ethical competition, and global integration in modern society, has increasingly become a focal point for unethical and illegal behaviors particularly in environments characterized by intense professional and commercial pressures (La Gerche and Brosnan, 2018). This "dark side" of athletic behavior, manifested through doping, violence, and crime, threatens not only the integrity of sport and athlete health but also broader societal norms. However, despite the visibility of these issues, current scholarship largely treats these domains as separate problems, resulting in a fragmented understanding of their shared forensic relevance. Although these issues are widely acknowledged, the existing literature often treats them as isolated phenomena: doping is predominantly examined as a biochemical or medical problem, while violence and other misconduct are framed within sociological or psychosocial perspectives. This disciplinary separation creates a conceptual and methodological gap that limits the development of comprehensive forensic analyses. Given that these behaviors carry biological, behavioral, and legal consequences, their comprehensive examination lies squarely within

**Citation:** Arslan, S. (2026). Analysis of athlete behaviors in the light of forensic sciences: Doping, violence and crime. *Journal of Sports Science Academy*, 2(1), 1–13.  
<https://doi.org/10.5281/zenodo.18011609>

Received: 05.03.2025

Revised: 09.05.2025

Accepted: 18.05.2025

Published: 11.03.2026

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the domain of Forensic Science. Thus, a forensic-centered perspective is essential to capture their interconnected nature and to inform both investigative and regulatory responses.

Doping has expanded beyond elite sports into mainstream fitness culture, creating substantial public health and forensic concerns (Garcia-Arnes and Garcia-Casares, 2022; Andreasson and Henning, 2019). Substances such as Anabolic-Androgenic Steroids (AAS) and Performance- and Image-Enhancing Drugs (PIEDs) produce long-term toxic effects—sometimes fatal on cardiovascular, neuropsychiatric, and endocrine systems (Dunn et al., 2023). Beyond their physiological risks, these substances also influence emotional regulation and aggression, thereby linking doping toxicology to forensic behavioral science. Simultaneously, criticism of current anti-doping policies suggests that traditional approaches may unintentionally push athletes toward more dangerous and harder-to-detect “designer drugs,” driving substance use underground and disabling medical oversight (Waddington, 2016; Henning et al., 2021). In response, forensic sciences increasingly employ advanced analytical technologies such as AI- and ML-based blood doping detection (Rahman et al., 2022), multivariate Bayesian steroid profiling methods (Eleftheriou et al., 2025), and activity-based bioanalytical screening for designer drugs (Janssens et al., 2025). These advancements reveal that doping is no longer merely a biomedical concern but a technologically evolving forensic challenge requiring innovative detection paradigms.

Another critical dimension of athlete behavior is the emergence of violence and anti-social tendencies in competitive environments. The neuropsychiatric effects of doping, particularly AAS-induced aggression, form a central focus for forensic behavioral analysis (García-Arnés and García-Casares, 2022). Violence also manifests beyond physical alterations to include verbal and physical abuse toward referees (Mojtahedi et al., 2024), cyberbullying, and toxic communication across digital platforms (Kwak and Blackburn, 2015). These varied manifestations of violence demonstrate that athlete misconduct extends beyond the physical arena and encompasses digital and psychological domains, which likewise demand forensic evaluation. Furthermore, the impact of violent environments on the psychosocial development of young athletes underscores the importance of integrating sport psychology and criminology into forensic assessments (Gonzalez-Hernandez et al., 2025).

Within the realm of crime, forensic sciences pay particular attention to the motor skills, biomechanical capacities, and training histories of offenders. In cases involving unarmed homicides or serious assaults, the presence of combat sport or martial arts training can significantly influence forensic interpretations. Biomechanical and trauma analysis of injury patterns resulting from specific fighting techniques plays a critical role in distinguishing such cases from conventional blunt force trauma, thereby shaping investigative and legal processes (Bourantanis et al., 2024). This indicates that athletic training itself functions as a forensic variable one capable of altering injury morphology, force dynamics, and legal attribution. Taken together, these domains highlight the need for a unified forensic framework capable of integrating biochemical, behavioral, and biomechanical evidence. Therefore, the purpose of this systematic review is to address the multidisciplinary knowledge gap by synthesizing current analytical methods (e.g., toxicological testing, trauma analysis) and their legal ramifications concerning athlete misconduct specifically doping, violence, and crime. By establishing this holistic forensic perspective, the review aims to support the development of more accurate detection methods, informed regulatory mechanisms, and effective preventive strategies within contemporary sport.

## Material and Methods

The method section should describe the research process in detail. It must specify the participants and the criteria for their selection, along with a clear identification of the research design (e.g., experimental, correlational). The tools used for data collection, such as tests or scales, should be stated explicitly, along with the data analysis methods and statistical software employed. Furthermore, adherence to ethical standards must be emphasized, including information on ethical approval obtained from relevant institutions.

### *Research Design and Search Strategy*

This study is a systematic review designed to evaluate the current academic literature addressing athlete behaviors from a forensic sciences perspective. The research design was structured in accordance with the PRISMA guidelines to ensure transparency and reproducibility in the systematic review process. The literature search was conducted in the PubMed and Google Scholar databases in order to access the most up-to-date and comprehensive scientific studies relevant to the topic. To focus on contemporary literature, the search was limited to studies published between January 1, 2020, and December 31, 2024. The search strategy was developed by combining the English equivalents of key concepts relevant to the research question using logical operators (AND, OR). The following keyword combination was used: (“Doping in Sport” OR “Doping in Sports”) AND (“Violence in Sport” OR “Violence in Sports”) AND (“Crime in Sport” OR “Crime in Sports”). The retrieved publications were initially screened based on their titles and abstracts, after which studies that directly contributed to the research objective were subjected to full-text review. Within the scope of the systematic review, the selected studies were evaluated and synthesized according to the extent to which they addressed the forensic and legal consequences of athlete behaviors.

### *Article Selection Criteria*

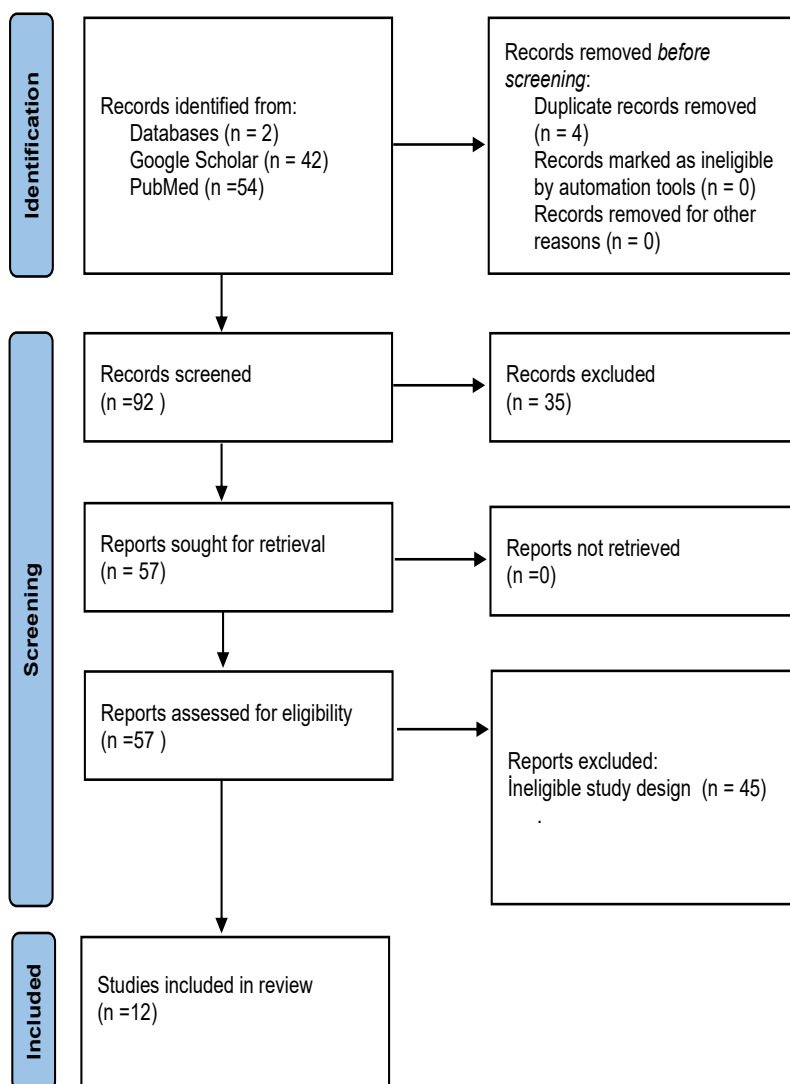
To determine the eligibility of studies retrieved from the search results for inclusion in the systematic review, predefined eligibility criteria were established. These criteria were developed to ensure that the review consisted of studies that were directly relevant to the research question, methodologically consistent, and comparable. Accordingly, scientific articles published between 2020 and 2024, searchable in the PubMed or Google Scholar databases, and available in full text were considered for inclusion. As a primary inclusion criterion, studies were required to address at least one forensic, legal, ethical, psychosocial, or criminal dimension of athlete behavior in the context of doping, sports violence, or sports-related crimes such as match-fixing and illegal betting.

Publications excluded from the review were determined based on specific qualitative and content-related limitations. Theses, conference papers and abstracts, editorial materials, technical reports, and journalistic texts were not considered. In addition, studies focusing exclusively on the medical or physiological aspects of the topic without addressing the forensic, legal, or social consequences of athlete behavior, as well as publications without accessible full texts or those falling outside the specified time frame, were excluded from the systematic review. This approach aimed to ensure that the literature synthesis was conducted within a coherent and comprehensive framework aligned with the objectives of the study.

### *Data Screening and Selection Process*

Following the application of the search strategy and the removal of duplicate records, a total of 96 articles were initially identified for inclusion in the systematic review.

These studies were subjected to a two-stage screening process. In the first stage, the titles and abstracts of the 96 identified articles were independently reviewed in accordance with the predefined inclusion and exclusion criteria. In the second stage, the full texts of studies deemed to meet the criteria were retrieved and assessed, and those most relevant to the main topic and objectives of the review were selected. After a rigorous evaluation process, a total of 12 articles that supported the main theme of the study and provided a basis for analyzing doping, violence, and crime from a forensic science perspective were included in the final analysis. The process of study identification, screening, exclusion, and final inclusion is illustrated in the PRISMA flow diagram presented in Figure 1.



**Figure 1.** The PRISMA flow diagram.

#### *Data Extraction and Synthesis*

Key information from each of the 12 final articles was systematically extracted and entered into a data extraction table (Table 1). These extracted data are presented in tabular form under Journal Name, Author(s), Publication Year, Subject, Objective, and Conclusion to summarize the scope and findings of the review. This methodological approach facilitated a transparent summary and synthesis of the available evidence from the selected literature.

## Results

The results of this study are presented in Table 1.

**Table 1.** Presentation of research that passed the selection criteria.

First Author and Year	Title	Subject	Objective	Results
Toni L. Williams, et al. (2024)	Barriers and enablers in doping, anti-doping, and clean sport: A qualitative meta-synthesis informed by the theoretical domains framework and COM-B model	Qualitative meta-synthesis on barriers and facilitators of doping, anti-doping and clean sport behavior.	To identify barriers/facilitators in doping, anti-doping and clean sport by examining qualitative research and to propose interventions according to behavior change models.	It has been suggested that anti-doping programmes should target the athlete's opportunity and motivation components rather than just his or her ability.
Minhyeok Tak, et al. (2023)	Traces of (dis)organised crime in sports gambling: a case study of the 2011 K-League match-fixing scandal	The role of organized crime in sports betting, match-fixing and the 2011 K-League scandal.	To examine the extent to which organised crime (actor-driven) and illegal activities (activity-driven) are involved in betting match-fixing and the internal/external factors.	Match-fixing has been found to be fuelled not only by external criminal organisations but also by vulnerabilities within sport itself, such as low wages, normalised betting habits and a lack of ethics ('activity-centred' crime)
Amitava Ghosal (2021)	Doping in The Field of Sports – An Overview	The global situation of doping, its causes and statistical analysis of WADA test reports (2009-2018).	To monitor the global situation of doping and to review the causes of doping.	It was emphasized that doping prevention is not the result of a single organization but rather the development of moral values through education.
Muneera Ahmed Alkhelaifi, et al.. (2022)	Doping in sports and current regulations	Doping in sport and current regulations: A critical review of doping criminalization and legal gaps.	Reiterate the importance of criminalising doping and highlight gaps that need to be addressed, focusing on the role of the legal framework.	To combat this, it is recommended that local and international laws implement penalties such as imprisonment and fines.
Erin Willson, et al.. (2023)	Gender-Based Violence in Girls' Sports	Gender-based violence in girls' sports, especially psychological violence and its effects.	To address gender-based violence in sports among adolescents, particularly focusing on psychological violence; to present its causes, effects and prevention recommendations.	It has been found that girls are exposed to more psychological violence (body shaming, exclusion) in sports than boys, and this leads to serious developmental and psychological

				consequences such as eating disorders, PTSD and dropping out of sports.
Yunyan Sun. (2022)	Research on Detection of Sterol Doping in Sports by Electrochemical Sensors: A Review	Electrochemical sensors used for the detection of sterol doping in sports	To summarize and compare different electrochemical sensing strategies for sterol doping detection	It was concluded that electrochemical sensors have the potential for rapid on-site detection.
Mohamed Belkhaoud, Amine Rkhaïla, et al. (2023)	Doping in Sports, from Chemical to Genetic: A Technological Evolution or a Threat to Sport's Future?	Technological evolution of doping from chemical doping to genetic doping, mechanisms of action and usage statistics	To highlight the latest developments and methods of action in the field of doping in sports.	It has been suggested that chemical doping (40%) is the most common method and that the only solution is preventive education
Forsdike, K., et al. (2024)	Women's Experiences of Gender-Based Interpersonal Violence in Sport: A Qualitative Meta-Synthesis	Women's experiences of gender-based violence in sports and its socio-ecological analysis.	Examining women's experiences of violence through a qualitative meta-synthesis and developing a feminist socio-ecological model.	A 5-theme model has been presented in which violence manifests as "Sports Family Violence", women do "safety work" and organizations remain impotent.
Saulius Sukys, et al.. (2021)	Moral Identity and Attitudes towards Doping in Sport: Whether Perception of Fair Play Matters	The role of moral identity and fair play perception on doping attitudes in athletes.	To examine the relationship between moral identity and doping attitudes and whether perception of fair play mediates this relationship	The effect of moral identity on doping attitudes is partially mediated by perceptions of fair play.
Andrea Chirico, et al. (2021)	The Motivational Underpinnings of Intentions to Use Doping in Sport: A Sample of Young Non-Professional Athletes	Motivational bases underlying intention to use doping in young non-professional athletes.	To test whether athletes experiencing a loss of personal significance would be more likely to intend to use doping through obsessive passion and moral dissociation strategies.	It has been suggested that a motivational dynamic based on the need to regain personal significance underlies illegal behaviors such as doping.
Filomena Mazzeo, et al. (2021)	Data investigation on the performance-enhancing drugs spread in Italy among young athletes: Prevention through education and the fight against doping in sport	Data survey on the prevalence of performance-enhancing drugs among young athletes (<19) in Italy and prevention through education.	To analyse data on doping prevalence among young athletes in Italy and to investigate the importance of education in doping prevention.	A result demonstrating the importance of educational programs and social prevention was obtained.
Attila Szabo (2023)	Placebo doping in sport: Overview and ethical considerations	An overview and ethical implications of placebo doping in sport.	To examine the ethical issues of using placebo doping in sport and exercise settings.	It has been stated that placebo doping is an undetectable form of doping.

WADA: World Anti-Doping Agency; COM-B: Capability, Opportunity, Motivation–Behavior; TDF: Theoretical Domains Framework; PTSD: Post-Traumatic Stress Disorder; PE: Performance-Enhancing Drug.

The 12 articles included in the analysis were categorized under three main themes: Doping (9 articles), Sports Violence (2 articles), and Crime/Match-fixing in Sports (1 article).

*Psychosocial, Ethical, and Technological Dimensions of Doping*

The majority of the selected articles examine the psychological motivations, ethical debates, and technological detection methods underlying doping behavior.

**Motivation and Ethics:** Moral identity and fair play perception in athletes have been found to be negatively related to doping attitudes, and the effect of moral identity is mediated by fair play perception (Sukys et al., 2021). It has been suggested that the intention to use doping in young non-professional athletes is based on a motivational dynamic stemming from concerns about experiencing a "loss of personal significance" (Chirico et al., 2021). Furthermore, a meta-synthesis on doping, anti-doping, and clean sport behaviors indicated that current education is inadequate and that social/cultural norms are powerful factors hindering clean sport (Williams et al., 2024). It has been emphasized that preventing doping is not possible through the efforts of a single organization, but rather through the development of moral values through education (Ghosal, 2021).

**Legal and Ethical Framework:** It has been emphasized that doping should be recognized not only as an ethical violation but also as a legal crime (criminalization), supported by prison sentences and fines (Alkhelaifi and Martinez, 2022). Furthermore, it has been noted that the use of "placebo doping," an undetectable method, in sports and exercise environments challenges ethical boundaries (Szabo, 2023). Research on young athletes has shown that educational programs and social prevention play a critical role in preventing the use of prohibited substances (Mazzeo et al., 2021).

**Technological Developments:** The technological evolution of doping, from chemical doping to genetic doping, has been examined, and it has been determined that the literature is insufficient for the development of analytical methods for the detection of genetic doping (Belkhaoud et al., 2023). On the other hand, it has been concluded that electrochemical sensors used for the detection of sterol doping have the potential for rapid on-site detection (Sun, 2022).

*Violence and Abuse in Sports*

Analyzed studies reveal that violence in sports is not merely momentary physical acts; it is a systematic cycle of violence with gendered, institutional, and "domestic" dynamics.

**Psychological Violence and Body-Shaming in Adolescents:** Willson and Kerr (2023) found that female adolescent athletes are more likely to be subjected to gender-based violence than male athletes, with "psychological violence" being the most common form of this violence (Willson & Kerr, 2023). These forms of violence, particularly body shaming and exclusion, have been found to lead to severe developmental and psychological consequences, such as eating disorders, post-traumatic stress disorder (PTSD), depression, and withdrawal from sports (Willson & Kerr, 2023).

**Sport Family" Violence and Security Work among Women:** Synthesizing the experiences of adult female athletes, Forsdike and Giles (2024) demonstrated that violence in sports operates through the dynamics of "Sport Family Violence" (Forsdike & Giles, 2024). According to this model, in structures where the coach is positioned as an authoritarian "father figure," violence (yelling, control, humiliation) is normalized as necessary for the success of the "family" (the team) (Forsdike & Giles, 2024). The study also found that female athletes are forced to perform constant "safety work" to protect themselves from harassment, such as changing their uniforms, adjusting training times, or not using certain

routes, while sport organizations exhibit either an "ineffectiveness" or a "hostility" attitude toward complaints (Forsdike & Giles, 2024).

#### *Crime and Match-Fixing in Sports*

The role of organized crime groups and the inherent weaknesses of sports are examined under the heading of sports-related crimes.

**Organized Crime and Internal Vulnerability:** A case study of the 2011 K-League match-fixing scandal revealed that match-fixing is not solely orchestrated by external "mafia-type" criminal organizations (actor-centered) (Tak et al., 2023). The study demonstrated that "activity-centered" vulnerabilities within sports, such as low salaries, normalized betting habits among athletes, and a lack of ethics, are key factors fueling and facilitating crime (Tak et al., 2023).

### **Discussion**

This systematic review has revealed that athlete behavior (doping, violence, and crime) are not just isolated rule violations; when examined through a forensic science lens, they constitute multilayered and interconnected "forensic cases" embedded within the structural and cultural dynamics of sport. These cases involve forensic toxicology, forensic medicine, forensic psychology, and criminology, highlighting the need for an integrated and interdisciplinary analytical framework rather than fragmented regulatory responses. The findings are synthesized across a wide spectrum, from the legal criminalization of doping to the "intra-family" dynamics of violence and the internal "opportunity structures" of match-fixing, demonstrating that ethical breakdowns in sport are systemic rather than incidental.

#### *Doping: The Dilemma of Biological Detection and Legal Criminalization*

Within the scope of this study, doping is conceptualized not merely as a biochemical violation but as a complex forensic phenomenon involving technological, legal, and psychological dimensions. From a forensic science perspective, doping represents a dynamic crime scene in which perpetrators (athletes) often move faster than detection technologies, particularly within the domain of forensic toxicology. Literature indicates that doping has evolved from chemical substances to genetic manipulation, thereby exposing a critical gap between emerging enhancement methods and existing analytical detection capacities. Analytical methods remain particularly inadequate for detecting genetic doping. This limitation underscores the need for a shift from reactive laboratory-based testing toward proactive, real-time detection strategies. The technological gap necessitates the development of instantaneous field detection technologies, such as the electrochemical sensors proposed by Sun (2022), as traditional laboratory processes increase the risk of evidence tampering and delayed intervention. However, doping is not merely a technological challenge; it also represents an ethical and legal crisis. Alkhelaifi and Martinez (2022) argue that sports disciplinary penalties are insufficient to deter doping and that the act should be legally defined as a criminal offense. This reclassification fundamentally relocates anti-doping efforts from the limited domain of sports governance to the broader and more deterrent framework of criminal law. From a psychological perspective, Chirico et al. (2021) argue that doping intent has deep motivational roots, such as a "loss of personal significance." This finding suggests that forensic psychological profiling should extend beyond competitive ambition and incorporate athletes' existential insecurities, identity crises, and perceived threats to self-worth. Such an approach broadens the evidentiary and preventive potential of forensic psychology in anti-doping investigations.



*The Normalization of Violence Within the “Sports Family”*

Violence in sport emerges in this review as a largely normalized and institutionally obscured form of abuse rather than an exceptional deviation from acceptable practice. The mechanisms of violence in sports bear a striking resemblance to the dynamics of domestic violence. The concept of “Sports Family Violence,” defined by Forsdike and Giles (2024), explains how power imbalances within coach–athlete relationships normalize violence as a disciplinary tool framed as necessary for success. From a forensic science perspective, this represents a complex form of abuse in which the victim’s consent is systematically manipulated. Such manipulation complicates forensic evaluations, as athletes may internalize coercion as legitimate training practice. Willson and Kerr (2023) demonstrated that violence, particularly among adolescent girls, is frequently perpetrated through psychological mechanisms such as body shaming rather than overt physical abuse. This finding raises the risk that forensic investigations focused solely on visible physical trauma may overlook critical psychological evidence, including eating disorders and post-traumatic stress disorder (PTSD). Moreover, differentiating between accidental sports trauma and non-accidental injury constitutes a critical forensic challenge. In cases of physical abuse disguised as training accidents, forensic physicians must meticulously analyze injury biomechanics to identify inconsistent patterns or defensive wounds that do not align with standard athletic movements. Such biomechanical inconsistencies provide crucial indicators of intentional harm within ostensibly legitimate sporting contexts. Furthermore, the “safety work” strategies developed by female athletes to protect themselves document the ineffectiveness of sports organizations in providing a safe environment. This institutional failure strengthens the legal and ethical argument that responsibility for violence should extend beyond individual perpetrators to include organizations that neglect their oversight and safeguarding obligations.

*Match-Fixing and the Internalization of Crime: The “Activity-Centric” Crime Model*

Match-fixing and illegal betting are increasingly understood not as external infiltrations of sport but as crimes that emerge from internal structural vulnerabilities. In their analysis of the 2011 K-League scandal, Tak et al. (2023) demonstrated that match-fixing is organized not only by external mafia groups (actor-centric crime) but also by actors embedded within the sport itself (activity-centric crime). Low salaries, normalized betting habits among athletes, and the erosion of ethical values create internal “opportunity structures” that push athletes toward criminal behavior even in the absence of external coercion. This insight significantly reframes criminological investigation priorities, shifting attention from external criminal networks to financial imbalances, cultural norms, and subcultures operating within teams and clubs. In this context, digital forensics emerges as an indispensable investigative tool. Since contemporary match-fixing and illegal betting networks operate primarily through encrypted messaging applications and cryptocurrency transactions, reliance on traditional testimony alone is insufficient. Integrating financial profiling and digital trace evidence analysis into forensic protocols is essential for establishing evidentiary links in activity-centric crimes. Match-fixing, therefore, should not be interpreted solely as an external threat to sport. Rather, it represents a systemic vulnerability rooted in weakened ethical governance and fragile economic structures—an internal pathology thriving due to the compromised “immune system” of sport. Consequently, effective countermeasures must move beyond individual punishment and prioritize structural, ethical, and institutional reform.

*Limitations of the Study*

This review has several limitations. First, the search was restricted to PubMed and Google Scholar and to publications between 2020 and 2024, which may have excluded relevant studies indexed in other databases or published outside the selected timeframe. Second, the keyword strategy prioritized the intersection of doping, violence, and crime, which may have underrepresented research addressing these behaviors separately (e.g., match-fixing, illegal betting, safeguarding, harassment) despite their forensic relevance. Third, the included literature was heterogeneous in design and scope, and a formal quality appraisal tool was not applied; therefore, findings should be interpreted as a thematic synthesis rather than a quantitative estimate of effect. Finally, limiting inclusion to full-text accessible articles may introduce selection bias.

### **Conclusions**

In conclusion, the twelve examined articles demonstrate that doping, violence, and crime in sport are not isolated phenomena but interdependent and mutually reinforcing forms of violation that operate within the same structural ecosystem. The common denominator across these behaviors is a sports environment characterized by intense win-driven pressure combined with persistent deficiencies in ethical, legal, and institutional oversight. Williams et al. (2024) argue that education-based interventions alone are insufficient to prevent such violations, while Forsdike and Giles (2024) emphasize that institutional structures often remain hostile, passive, or ineffective in addressing violence within sport. Taken together, these findings indicate that individual-level interventions fail when they are not supported by robust structural and regulatory mechanisms. Therefore, future research within the emerging field of Sports Forensics should move beyond fragmented prevention strategies and prioritize the development of a holistic forensic defense system. Such a system should integrate advanced biological detection technologies (e.g., real-time sensors), forensic psychological profiling focused on motivation and identity threats, and strong institutional oversight mechanisms, including independent safeguarding and ethics boards. Ultimately, strengthening sport's ethical and regulatory "immune system" requires a coordinated forensic framework capable of early detection, accountability, and structural reform, rather than reactive responses to individual transgressions. This integrative approach positions Sports Forensics not only as an investigative discipline but also as a preventive and policy-oriented field essential for the long-term integrity of sport.

### *Recommendations*

Forensic experts should not focus solely on physical trauma findings when evaluating athletic injuries. Given the prevalence of psychologically mediated abuse in sport, forensic examination protocols must be expanded to systematically include psychological screening tools. As noted by Willson and Kerr (2023), integrating psychological screening tests into forensic examination processes allows for the identification of body shaming, coercive control, and other forms of psychological abuse, thereby strengthening evidentiary accuracy by capturing both visible and invisible forms of harm. To disrupt the cycle of institutional ineffectiveness and "Sports Family Violence" identified by Forsdike and Giles (2024), legally empowered and fully independent Sports Violence and Abuse Reporting Offices should be established. These bodies must operate independently of sports clubs and federations and possess judicial authority to initiate investigations. By eliminating organizational dependency, such mechanisms reduce victim silencing and remove the need for athletes to engage in "security work" through identity concealment, thus fostering safer reporting environments. In parallel, doping should be defined not merely as a sporting rule violation but as a legal crime, as suggested by Alkhelaifi and Martinez

(2022). Criminalization enhances deterrence by extending accountability beyond athletes to include coaches and support personnel involved in the trafficking of prohibited substances. Incorporating deterrent prison sentences into legislation further aligns anti-doping enforcement with broader criminal justice frameworks, reinforcing the seriousness of such violations. From a technological standpoint, electrochemical sensor technologies highlighted by Sun (2022) should be further developed, alongside the deployment of mobile forensic units capable of conducting real-time doping and toxic substance screening during competitions and training sessions. Field-based detection minimizes risks of evidence manipulation and enables early intervention before violations escalate into systemic misconduct. Finally, to reduce the risk of activity-driven crime demonstrated by Tak et al. (2023), athletes' salaries and financial rights should be secured through state guarantees or union-based protection funds. Addressing economic precarity directly weakens the internal opportunity structures that normalize betting manipulation and match-fixing, positioning financial safeguards as preventive criminological tools rather than post hoc sanctions.

**Author Contributions:** Author of this article made the following contributions: conceptualization, S.A.; methodology, S.A.; software, S.A.; validation, S.A.; formal analysis, S.A.; investigation, S.A.; resources, S.A.; data curation, S.A.; writing—original draft preparation, S.A.; writing—review and editing S.A.; visu-alization, S.A.; supervision, S.A.; project administration S.A.

**Funding:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Ethical Approval Statement:** This research did not require ethics committee approval as it did not involve human or animal participants.

**Informed Consent Statement:** This study did not involve human participants requiring informed consent.

**Conflict of Interest:** The author declare no conflicts of interest regarding this study

**Data Availability Statement:** Data supporting this study is available from the authors upon reasonable request.

**Artificial Intelligence (AI) Usage Disclosure:** During the preparation of this manuscript, the author used the AI tool ChatGPT (OpenAI) solely for language editing and proofreading purposes. AI was not used for generating scientific content, data analysis, interpretation, or drawing conclusions. All scientific contributions are the sole work of the author.

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