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Advancing Women's Soccer: Interconnected Challenges in Athlete Health and Equity

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Women's soccer has experienced unprecedented global growth, yet this expansion is shadowed by a high prevalence of anterior cruciate ligament (ACL) injuries and persistent systemic inequities. This exploratory narrative synthesis (2004–2026) aims to bridge the gap between biomechanical risk and social justice by examining the interconnected challenges of injury prevention and equity. The review identifies that female athletes face significant biomechanical vulnerabilities, including increased knee valgus and altered muscle activation patterns, which are exacerbated by "gender-blind" footwear design. Currently, 82% of female players in top leagues report discomfort or pain related to cleats designed for male morphology. Simultaneously, the study explores the underrepresentation of Black women in soccer, highlighting how socioeconomic barriers and chronic underfunding (particularly at Historically Black Colleges and Universities) limit access to elite development. Findings show a staggering resource gap, with average HBCU athletic expenditures ($11M–$12M) dwarfed by those of Power Five institutions ($150M+). The synthesis concludes that addressing these disparities requires an interdisciplinary paradigm shift. Technical innovations, such as the Kofa Agilita women-specific cleat, are presented as essential social interventions. By prioritizing sex-specific biomechanical needs and equitable resource distribution, the sport can foster an environment where athlete health and performance are no longer compromised by systemic neglect.

Keywords: *ACL injury prevention; footwear biomechanics; Black women's sport; HBCU athletics*

Introduction

Women's soccer has experienced exponential growth in participation and professionalization worldwide, yet this expansion is shadowed by significant challenges that threaten the long-term health and equitable development of the sport. This research addresses two critical, interconnected issues: the alarmingly high prevalence of knee injuries, particularly anterior cruciate ligament (ACL) tears, among female players, and the persistent lack of diversity, specifically the underrepresentation of Black women, at all levels of competition. These two problems, one biomechanical and one systemic, are mutually reinforcing and demand a holistic, interdisciplinary approach for resolution.

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Historical Context and Growth of Women's Soccer

The global history of soccer is expansive, tracing its origins to ancient variations like "Tsu Chu" in China (5000–300 B.C.) and "Calcio Fiorentino" in Renaissance Italy, before its standardized codification in 1863 (Wood, 2008). While women's participation was initially slow to develop, the formation of FIFA in 1904 marked a pivotal step toward global organization (Wood, 2008). In the United States, the National Collegiate Athletic Association's (NCAA) sponsorship of women's sports in 1982 significantly propelled the sport's domestic growth (Lewis, 2023). This trajectory accelerated with the establishment of the Women's World Cup in 1991 and the subsequent successes of the USWNT, notably their victory in the 1999 World Cup (FIFA, n.d.; Timm-Garcia, 2019), which catalyzed the growth of professional leagues and increased public interest (Wikimedia Foundation, 2023). Today, women's soccer boasts a global player base of 29 million, including 4.2 million in the United States (FIFA, n.d.; Culpan & Meier, 2016).

Resource Inequity in Soccer Leading to the Gender Divide

The global landscape of professional soccer, while celebrating the immense success and growing popularity of the women's game, is fundamentally marked by a persistent and deep-seated disparity in resources compared to men's soccer (Harman, 2022). This literature review synthesizes academic research exploring the nature and consequences of this inequity, which spans financial investment, player compensation, media coverage, and access to quality training environments. The consensus across scholarly work is that these institutionalized disparities reflect and reinforce broader societal gender biases, despite evidence of the economic viability and athletic excellence of women's soccer (Fuder et al., 2024; Scheadler & Wagstaff, 2018).

Purpose

This exploratory review article aims to synthesize existing research on the interconnected challenges of injury prevention and equity in women's soccer. Specifically, the scope of this review encompasses an examination of the biomechanical factors contributing to knee injuries in female players, a critical analysis of the limitations inherent in current soccer footwear designs, and an exploration of the systemic barriers that hinder the participation and success of Black women in the sport. Ultimately, this work advocates for interdisciplinary research and innovative solutions, identifying critical areas for future investigation across kinesiology, biomechanics, sports medicine, and social sciences to promote the health, performance, and equitable participation of all female soccer players.

Methods

Research Design

This study employs an exploratory narrative synthesis approach to map the intersection of physiological risk and systemic resource inequity within women's professional, collegiate, and amateur soccer. Given the multi-disciplinary nature of this inquiry (which spans biomechanical engineering, sports medicine, sports social work, and critical race theory) this design was selected to facilitate the systematic integration of highly heterogeneous data types. This framework allows for the concurrent synthesis of quantitative kinetic datasets (e.g., joint loading, traction mechanics) and qualitative sociological analyses concerning institutional disparities.

Search Strategy and Information Sources

A systematic comprehensive literature search was executed across five electronic databases to capture both clinical and social science literature: PubMed/ MEDLINE, Scopus, Web of Science, SPORTDiscus, and JSTOR. To ensure inclusion of the most contemporary advancements in athletic footwear technology and the accelerating landscape of women's sports professionalization, the timeline was restricted to peer-reviewed articles, dissertations, and official technical reports published between 2004 and 2026. The search strategy utilized combinations of Boolean operators (AND, OR) alongside targeted MeSH terms and keywords. The precise search string architecture was structured as follows: "ACL" OR "knee kinematics" OR "valgus stress" OR "neuromuscular control" OR "traction" OR "stud configuration" OR "footwear design" OR "soccer cleats"; "gender-blind design" OR "Black women in sport" OR "systemic barriers" OR "intersectionality" OR "racial disparity" OR "socioeconomic access" OR "Historically Black Colleges and Universities" OR "HBCUs".

Screening Flow and Selection Outcomes

A total of 842 records were initially identified through the electronic database searches. After removing duplicates (194 records), the titles and abstracts of 648 studies were independently screened for general relevance. Of these, 512 studies were excluded during the abstract phase for failing to meet core thematic boundaries (e.g., investigating non-soccer cohorts, examining purely cardiovascular metrics, or focusing exclusively on male biomechanics). The remaining 136 articles underwent rigorous full-text evaluation against strict inclusion and exclusion criteria. To be retained for final synthesis, studies were required to meet specific selection criteria outcomes:

1. Focus explicitly on female soccer populations (youth, collegiate, or professional/elite),

2. Provide primary quantitative empirical data or formal meta-analyses regarding lower-extremity injury mechanisms, anthropometric foot morphology, or shoe-surface traction interfaces, or
3. Directly examine the structural, institutional, or socioeconomic factors affecting sport access, funding, or psychological well-being among marginalized populations, specifically Black female athletes and sports programs at historically underfunded academic institutions.

Following full-text assessment, 74 articles were excluded for failing to provide cross-disciplinary data or for utilizing non-peer-reviewed blog posts (except where explicitly bounded as primary source material for cultural discourse analysis). Ultimately, 62 primary sources met all criteria and were included in the final qualitative and quantitative synthesis.

Data Extraction and Systematic Derivation of Conclusions

Data from the final pool of 62 studies were extracted using a standardized digital template to capture authorship, sample demographics, specific athletic competitive levels, independent variables (e.g., cleat stud geometry, institutional funding brackets), and dependent outcomes (e.g., rotational torque, ligamentous failure rates, self-efficacy scores). Conclusions were systematically derived utilizing a three-stage iterative synthesis matrix to guard against biased aggregation:

1. Categorical and thematic grouping wherein extracted data were isolated into distinct analytical domains. Biomechanical data were organized into structural categories (e.g., hormonal influences on ligament laxity vs. foot-fixation under high-velocity cutting maneuvers). Concurrently, sociological and financial data were categorized by systemic factors (e.g., capital allocation disparities in Predominantly White Institutions [PWIs] versus Historically Black Colleges and Universities [HBCUs]).
2. Cross-disciplinary intersection mapping wherein thematic matrices were systematically cross-referenced to locate precise relational overlaps. Specifically, the technical and physical limitations of athletic footwear (such as the historical industry reliance on scaled-down men's lasts) were mapped directly against institutional purchasing frameworks and financial constraints. This stage traced how an athlete's physical vulnerability is compounded when executing maneuvers in substandard equipment due to institutional underfunding.
3. Critical inductive synthesis wherein final conclusions were systematically generated by synthesizing the mapped data through an intersectional lens. By evaluating the combined weight of physical risk factors and socioeconomic neglect, the synthesis determined how the historical underrepresentation of diverse cohorts in sports science research leads to generalized, potentially counterproductive injury prevention paradigms. The final synthesis establishes a unified, auditable logical pathway proving that ergonomic footwear equity functions as an active mechanism of social and clinical intervention.

Results: The Dual Challenges of Health and Equity

Biomechanical Risk Factors and Injury

Despite the sport's prominence, the alarmingly high incidence of knee injuries, particularly non-contact ACL tears, is a growing concern for the longevity of female athletes' careers (Brockway, 2023; Lewis, 2024; Warren & Pennington, 2025). Existing research consistently demonstrates that female soccer players exhibit significant biomechanical differences compared to their male counterparts that contribute to this risk (Thomson et al., 2022; ACSM, 2023). These differences include an altered lower extremity alignment and kinematics, often manifesting as increased knee valgus, an inward collapse of the knee, that is more pronounced during dynamic tasks such as landing, cutting, and pivoting, consequently placing greater stress on the ACL (Fortune Journals, n.d.; Grassi et al., 2023). Furthermore, females tend to exhibit greater hip internal rotation and adduction, which can exacerbate knee valgus and ACL loading (Fortune Journals, n.d.). Differences are also observed in landing mechanics, with female athletes often landing with less knee flexion and greater quadriceps activation, increasing anterior shear forces on the tibia and subsequently increasing ACL strain (Fortune Journals, n.d.; PMC, n.d.). Finally, altered muscle activation patterns, specifically a potentially less dominant hamstring activation relative to the quadriceps, may contribute to the increased ACL risk in females (Weingart et al., 2022).

Footwear Limitations and Biomechanical Exacerbation

These inherent biomechanical vulnerabilities are exacerbated by the widespread use of sports equipment, particularly soccer cleats, that is often ill-fitting and inadequately designed to meet female-specific needs (Lewis, 2024). Current soccer cleats are frequently designed primarily for male athletes and simply scaled down in size for women (Wrack, 2023; Stefanyshyn et al., 2000). This "shrink it and pink it" approach disregards distinct anatomical features of the female foot, such as a narrower heel, wider forefoot, and often a higher arch (Footalk, 2019; Soccer.com, 2014). Ill-fitting footwear can lead to discomfort, pain, blisters, altered movement patterns, and increased risk of injury, as confirmed by a European Club Association study which found that 82% of female soccer players in the top leagues reported issues with their cleats (Wrack, 2023).

Beyond fit, another limitation lies in traction systems. While traction is vital for performance, cleats designed for male force output may provide excessive grip for women, who typically generate less lower body power (News Detail, 2023). This potentially increases rotational forces at the knee joint during directional changes, a known risk factor for ACL injuries, as excessive rotational traction can cause the foot to become fixed while the body continues to move (Thomson et al., 2022; Andriacchi et al., 2009). Research specifically examining the interaction between stud design and ground reaction forces in female soccer players is less prevalent, highlighting a critical gap in optimal footwear development.

Anatomy and the Imperative for Sex-Specific Design

A modern soccer cleat is a complex, highly engineered athletic tool comprising several integrated structural elements, all of which are essential for supporting the athlete's foot and facilitating the complex, dynamic movements of the sport. The structural components begin with the Upper, the part encasing the foot, providing containment, ball feel, and fit through various materials, lacing systems, and specialized "Touch Zones" (Nike, n.d.). The Heel Counter, a rigid insert at the rear, is critical for providing stability to the hindfoot and controlling excessive movement during rapid changes of direction (Nike, n.d.). The Toe Box must allow adequate space for natural toe splay, which is essential for balance, stability, and avoiding discomfort (Roach, 2023).

The Outsole/Sole Plate forms the structural foundation, typically made of high-performance polymers that balance flexibility and rigidity to transfer force to the ground (Nike, n.d.). Attached to the sole plate are the Cleats, or Studs, which are designed in varying shapes and lengths to optimize linear and rotational traction on different surfaces, such as firm ground (FG) or soft ground (SG) (Chanis, 2022; Thomson et al., 2022). Finally, the removable Insole provides comfort, cushioning, and arch support, playing a crucial role in managing moisture and distributing plantar pressure (Roach, 2023).

Despite continuous innovations in materials and traction systems in the broader footwear market, including laceless designs and adaptive fit technologies (Adidas X Speed Portal; Adidas, n.d.; Nike, n.d.), the historical lack of dedicated research and development for women has led to a major shortfall in design (Karolidis & Hahn, 2023; Full article: A mechanical comparison, 2024). A growing body of research underscores the anatomical and biomechanical differences that necessitate a sex-specific approach across three domains (1) *Foot Morphology*: Women generally possess a narrower heel relative to their forefoot width compared to men, meaning standard cleats may fail to provide adequate heel lockdown, resulting in instability (Footalk, 2019). (2) *Plantar Pressure and Arch Height*: Women often exhibit higher arch heights and unique patterns of plantar pressure distribution, requiring tailored insoles for proper arch support and comfort (ACSM, 2023). (3) *Force Production*: Traction patterns must be optimized for the typically lower force output of female athletes to avoid excessive rotational grip that exacerbates ACL risk (Thomson et al., 2022; News Detail, 2023).

These distinctions unequivocally highlight that simply scaling down men's cleats is a notion of disrespect that compromises comfort, performance, and, most critically, increases the risk of lower extremity injuries in female soccer players at every competitive level.

Systemic Barriers to Diversity

In addition to health concerns, the underrepresentation of Black women in soccer, particularly at elite collegiate, professional, and leadership levels, represents a fundamental equity challenge (Gonzalez, 2023). Research indicates a clear disparity in participation rates compared to White counterparts (Harrison & Hardin,

2018; Lapchick et al., 2023). Systemic barriers, most notably socioeconomic disparities, play a significant role, as the financial prerequisites for elite development, such as access to quality coaching, training facilities, and expensive travel teams, disproportionately affect marginalized communities (Harrison & Hardin, 2018; Nargiso et al., 2020). Furthermore, cultural factors and a lack of media visibility for Black female soccer players can limit positive role models and discourage participation among young Black girls (Norman, 2020; Baxter, 2023). The consequences of this lack of diversity extend beyond statistics, impacting team dynamics and failing to fully reflect the diverse communities that the sport aims to serve (Norman, 2020).

Disparity in Financial Investment and Compensation

One of the most examined aspects of resource inequity is the vast difference in financial compensation and investment, which extends beyond simple pay-per-game metrics to overall operating budgets and prize money (Stahler & Pennington, 2025). Studies on the United States Women's National Team (USWNT), a globally dominant force, illustrate a stark contrast in earnings compared to the less-successful men's team, despite the women's higher profits and television ratings in certain periods (Braciska, 2018; Utah Law Digital Commons, 2024).

This pay discrepancy is often justified by organizations using the argument of lower revenue generation in women's sports (Utah Law Digital Commons, 2024). However, scholars argue that this claim is flawed, as it fails to account for the historical lack of investment and media attention that created the current economic gap (Agha & Berri, 2021; Fuder et al., 2024). Furthermore, the disparity in global prize money for major tournaments, such as the FIFA World Cup, remains astronomical, with the men's prize pool significantly outstripping the women's, even as the women's prize money increases (Vanderbilt Law, 2019). The trickle-down effect of this funding gap is evident at the professional club level, where salary caps in women's leagues have been documented to be dramatically lower than those in men's leagues, with many female players globally receiving minimal or no wages for their play (Priddy, 2018; Vanderbilt Law, 2019).

Inequitable Working Conditions and Facilities

The resource gap extends beyond financial figures and impacts the tangible working conditions and development opportunities for female athletes. The lack of investment in infrastructure, including training facilities, pitch quality, and travel accommodations, often leaves women's teams with second-tier resources (Braciska, 2018). The necessity for better-resourced development programs is highlighted in research, especially for elite women's sports in countries with higher overall gender inequality (Hoffmann et al., 2006).

Beyond facilities, the underrepresentation of women in coaching and management positions is another key resource deficiency. Scholarly work suggests that the perpetuation of male-dominated sports organizations, which prioritize hiring men into leadership roles, creates a less supportive environment for female players and sustains the cycle of gender inequality (Priddy, 2018). In addition, research

reveals a significant gap in sports science attention, with a clear underrepresentation of studies focusing on the specialized training, injury prevention (e.g., ACL injuries), and match analysis of professional female soccer players (PMC, 2024). This dearth of specialized knowledge acts as a resource barrier, limiting the ability to maximize female players' performance and safety.

Resource Scarcity and Systemic Disadvantage in HBCU Athletics

Historically Black Colleges and Universities (HBCUs) have long served as vital centers for education, culture, and social mobility, often operating under conditions of systemic capital deprivation compared to Predominantly White Institutions (PWIs) (HBCU Money, 2025; Williams & Davis, 2019). This chronic underfunding of the institutions as a whole cascade directly into their athletic departments, creating profound and persistent resource disparities that hinder competitiveness, impede facility maintenance, and limit the capacity to support student-athletes fully (Elliott & Kellison, 2019; Granger, 2021). Academic literature consistently frames this resource gap using theoretical perspectives, such as Resource Dependency Theory, which posits that an organization's resources determine its overall power and sustainability, demonstrating that HBCUs are the most under-resourced members of the NCAA (Elliott & Kellison, 2019; Quarterman, 1992).

Financial and Budgetary Disparities

A key theme in the literature is the vast difference in annual athletics expenditures and revenue generation between HBCUs and PWIs. Studies comparing athletic budgets confirm that HBCU peer groups spend significantly less than their PWI counterparts across all major categories, including operating expenses, head coach salaries, recruiting, and athletic aid (Elliott & Kellison, 2019; Duby & Chen, 2023). For example, annual athletics expenditures for MEAC and SWAC institutions often average between $11 million and $12 million, figures that are dwarfed by the budgets of Power Five conference schools, which can exceed $150 million (HBCU Money, 2025).

This financial struggle is fundamentally linked to the institutions' smaller endowments and their mission of serving a higher proportion of low-income, first-generation students who rely heavily on financial aid, limiting the schools' internal ability to subsidize athletics (Gasman, 2009; Priddy, 2018). Consequently, HBCU athletic departments do not generate significant revenue through conventional means and often must divert institutional funds, raise student fees, or rely on locally sourced donations to sustain programs (HBCU Money, 2025).

Operational and Infrastructure Deficiencies

The under-resourced nature of HBCU athletics manifests tangibly in substandard facilities and aging infrastructure. Scholars and coaches have noted that the difference in facilities (e.g., fields, weight rooms, training centers) is a visible consequence of systematic underfunding, with HBCU teams often unable to provide the same

resources that are "second nature" at well-funded PWIs (Spokesman-Recorder, 2023; Elliott, Kellison, & Cianfrone, 2019). This lack of funding for long-term initiatives, such as facility renovations and additions, can negatively affect recruitment and the overall student-athlete experience (Southern Regional Education Board, 2023).

Furthermore, administrators and coaches at HBCUs often operate with smaller staff sizes and are forced to take on more responsibilities (e.g., coaching/teaching alongside administrative duties) and are paid significantly less than their PWI peers (Elliott & Kellison, 2019). The lack of dedicated marketing or external relations staff is also cited as a barrier to maximizing revenue generation and engaging potential sponsors (Elliott, Kellison, & Cianfrone, 2019).

Competitive and Policy-Related Disadvantages

Resource limitations directly impact HBCU athletic competitiveness and create unique policy challenges: (a) "Guarantee Games" and Competitive Disparity: HBCU football programs often participate in "guarantee games" against higher-resourced PWIs to generate much-needed revenue, receiving a payment for an almost guaranteed, demoralizing loss (Journey Magazine, 2019). While this provides financial intake, research suggests the contracts may not be as lucrative as they should be, and the talent disparity remains a key issue, primarily driven by the ability of PWIs to offer better resources and exposure to recruits (Journey Magazine, 2019; Lillig, 2009, as cited in Elliott & Kellison, 2019); (b) NCAA Policies: NCAA policies, such as the Academic Performance Program (APP) and its metrics (Academic Progress Rate and Graduation Success Rate), have been criticized for unfairly penalizing under-resourced HBCUs (SLR, 2022). By holding institutions to standards without accounting for the inherent disparities in institutional resources available to support student success, the policy can inadvertently perpetuate systemic inequalities and threaten postseason eligibility, further limiting revenue opportunities (SLR, 2022); and (c) Name, Image, and Likeness (NIL): Recent policy changes surrounding NIL and scholar-athlete compensation pose a new challenge for HBCUs, which must find ways to compete for top talent in a landscape where PWIs can leverage their massive resources and alumni networks to establish lucrative deals (Southern Regional Education Board, 2023).

In conclusion, the resource challenges faced by HBCU athletic departments are inseparable from the historical and systemic underfunding of the institutions themselves (NEA, 2025). While these programs hold immense cultural pride and serve as vital engagement tools for alumni and the community, their financial sustainability is constantly threatened by inadequate operational budgets, aging facilities, and policies that fail to account for the deep-seated financial inequalities in American higher education (HBCU Money, 2025; Southern Regional Education Board, 2023).

The Role of Media and Stereotypes

Unequal media coverage is a crucial factor contributing to and justifying resource inequity. Women's soccer often receives significantly less broadcast space and is frequently subjected to a sexualized or patronizing portrayal in the public eye,

in contrast to the focus on athletic performance for men's soccer (Braciska, 2018; Fuder et al., 2024). This disparity in representation is not benign; it directly influences public perception and the commercial valuation of the sport.

Experimental research challenges the notion that the lower demand for women's soccer is solely due to lower perceived skill. Studies have shown that when the gender of players is obscured, the perceived quality ratings of men's and women's performance do not significantly differ, suggesting that existing gender stereotypes, which portray women as less capable or inferior athletes, artificially depress the demand and, consequently, the investment in women's soccer (Taylor & Francis Online, 2023). This cycle of lower investment, poor media coverage, and resulting lower economic returns creates a self-fulfilling prophecy that reinforces the initial gender bias (Fuder et al., 2024).

The academic literature consistently demonstrates that the resource inequity in women's soccer is not simply a market-driven outcome but a complex issue rooted in historical, institutional, and cultural biases. Disparities in pay, facilities, coaching representation, and scientific research attention perpetuate an environment that undervalues female athletes. Moving toward true equity requires not only equal pay but also a systemic reevaluation of resource allocation, significantly increased institutional investment, and an end to discriminatory media representations (Fuder et al., 2024; Utah Law Digital Commons, 2024).

Discussion

This review highlights the complex interplay between biomechanical factors, suboptimal footwear design, and systemic inequities in women's soccer. The disproportionately high rate of ACL tears is fundamentally linked to biomechanical predispositions, which are exacerbated by the widespread use of equipment that fails to accommodate the female athlete's unique anatomical and functional requirements. Simultaneously, the underrepresentation of Black female athletes underscores the systemic challenges related to access, resources, and culturally appropriate support. These experiences align with existing research demonstrating that inequitable resource distribution functions as a social determinant of athlete health, shaping not only physical injury risk but also self-esteem, identity, and motivation (Sabo & Veliz, 2020; López & McDonough, 2021). Taken together, the results highlight not only biomechanical concerns but also the psychosocial cost of inequitable equipment access, which disproportionately affects women and athletes at HBCUs. These systemic barriers directly undermine confidence, belonging, and sport performance (Bennett & Gioia, 2020; Carson & Polk, 2022), core determinants of athlete well-being.

At the systems level, providing women with equipment designed specifically for their needs represents more than an ergonomic improvement, it is a corrective action against long-standing inequities in funding, access, and gender responsiveness within sport. Research in sport psychology and sport social work consistently demonstrates that when athletes feel adequately resourced and supported, they exhibit higher levels of self-efficacy, confidence, motivation, and perceived control, all of

which are predictors of improved performance (Henriksen & Stambulova, 2017; Myer et al., 2016).

Conversely, inequitable distribution of equipment functions as a social determinant of athlete health, reinforcing systemic disparities that begin in youth sport and intensify through college. Women, especially those at underfunded and historically marginalized institutions, internalize these inequities as indicators of their value or worth within their programs (López & McDonough, 2021). This marginalization affects not only physical safety but also psychological readiness, identity development, and long-term sport participation.

The existing literature compellingly argues that a paradigm shift is needed in the design and development of soccer cleats for women. The historical reliance on scaled-down men's models disregards fundamental sex-based differences and has led to far too many ACL tears. Future research must prioritize a user-centered approach, integrating detailed biomechanical analyses of female-specific movements with advanced material science and innovative design principles. This includes creating women-specific lasts, optimizing stud patterns to efficiently execute pivoting and cutting with optimal rotational traction, and incorporating durable insoles that sustain their cushioning and proper arch/heel support beyond a single season of play, addressing a key complaint from players (Wrack, 2023).

Furthermore, addressing the systemic barriers that limit the participation of Black women requires a multi-faceted approach, encompassing initiatives to increase access to quality training, promote equitable talent evaluation, and foster inclusive and supportive environments. Research specifically examining the footwear needs and experiences of Black female soccer players is notably scarce, highlighting an important area for extension to an often unheard and unseen, yet vital, athlete population (Harrison & Hardin, 2018; Prempeh & Pennington, 2025a,b).

In summary, the continued success of women's soccer hinges on innovative, evidence-based solutions that prioritize the health, performance, and equitable participation of all female athletes. Kinesiology scholars and footwear developers play a vital role in this endeavor, providing the scientific foundation for informed decision-making in equipment design and policy development. By acknowledging and accommodating the unique needs of this growing demographic, the industry can contribute significantly to a future where women's soccer is both thriving and equitable, allowing female collegiate athletes to perform at the highest level without it being in exchange for their health.

Alternative Perspective & Dialectical Balance

While the imperative for sex-specific footwear design is clear, a comprehensive epidemiological perspective requires acknowledging that ACL injury etiology is inherently multifactorial, and equipment modification constitutes only a single variable within a broader preventative framework. Biomechanical counterarguments suggest that focusing primarily on footwear structural design may overshadow the critical roles of neuromuscular control, hormonal fluctuations across the menstrual cycle, and fatigue-induced kinematic changes, which independently influence ligamentous strain regardless of cleat geometry (Renstrom et al., 2008; Hertel & Denegar, 2012).

Furthermore, caution must be exercised to avoid bio-essentialist generalizations; morphological metrics and force-production profiles vary significantly across a heterogeneous female athletic population, meaning a universal "women's last" may not inherently accommodate every individual foot structure or running gait. Sociologically, critics of material interventions might also argue that providing advanced footwear risks offering a superficial, techno-centric solution to deeply entrenched structural inequities. Improved equipment access, while vital, cannot serve as a proxy for the comprehensive systemic overhauls required to rectify broader disparities (such as unequal access to certified athletic trainers, dedicated strength and conditioning specialists, and high-quality pitch maintenance) which remain the primary drivers of health and performance disparities at marginalized institutions.

Conclusion: Footwear as a Biomechanical and Social Intervention

The synthesis of biomechanical data and sociological inquiry presented in this review reveals a stark reality: the high rate of ACL injuries in women's soccer is not an architectural flaw of the female body, but rather a consequence of an unlevel playing field. The historical reliance on "gender-blind" equipment is a tangible manifestation of resource inequity that compromises the health of female athletes (Pennington et al., 2026 a, b; Prempeh & Pennington, 2025a, b).

Proper accommodation can prevent eventual short- and long-term injuries. The solution developed from the culmination of this research is the *Kofa Agilita* (KA), a novel women's specific cleat attempting to close the gender gap in sports equipment with the goal of enhanced comfort and mitigating injury risk (Prempeh & Pennington, 2025a, b). The introduction of the *Kofa Agilita* represents a paradigm shift from passive adaptation to active accommodation. By integrating specific technical features, the KA cleat directly addresses the "gender-blind" design failures identified in this review A women-specific last featuring a narrower heel cup and a contoured arch support eliminates the mediolateral instability and "heel slip" typical of scaled-down men's cleats. This design feature minimizes the compensatory kinematic patterns that routinely increase strain on the anterior cruciate ligament (ACL). The stud configuration is calibrated to align with the distinct force-production profiles and biomechanical loading patterns characteristic of many female athletes. By optimizing rotational traction, the KA prevents excessive "foot-fixation" during high-velocity pivots. High-performance polymers within the sole plate ensure that structural integrity does not degrade mid-season. This durability is an essential variable for athletes at historically underfunded institutions, where frequent equipment replacement is financially prohibitive.

Empirical evaluations of the Kofa Agilita indicate profound psychological and behavioral shifts among participants: (a) Athletes utilizing the KA report heightened feelings of institutional visibility and equity, noting that equipment tailored to their physiology makes them feel "seen," "prioritized," and "equal." (b) Self-efficacy increases as athletes are liberated from preventable pain, chronic discomfort, and outdated, ill-fitting gear. (c) Perceptions of authentic inclusion and structural support actively enhance student-athlete motivation, institutional commitment, and sport

adherence. (d) Eradicating the psychological distractions of physical discomfort and the ambient "fear of injury" yields measurable improvements in athletic execution.

However, a robust analysis must acknowledge that "female physiology" is not monolithic; variations in anthroposcopic metrics, baseline conditioning, and playing surfaces introduce nuanced contextual variables. While the KA addresses aggregate morphological trends, individual biomechanical variances mean that footwear modification remains a singular, albeit vital, component of a multi-faceted injury prevention paradigm. By systemic rectification of these physical disparities, the provision of women-specific footwear evolves into a mechanism of psychosocial empowerment.

For athletes at HBCUs and other marginalized programs, the *Kofa Agilita* cleat serves as a mechanism of dignity and equity. In environments where chronic underfunding often forces athletes to utilize second-tier resources, providing equipment designed specifically for their physiology is a powerful social intervention.

When an athlete is provided with a tool that acknowledges her unique biology and racial identity, the benefits transcend the physical paradigm. Athletes benefit from psychological readiness, wherein the "fear of injury" is reduced through evidence-based design enhances self-efficacy and on-field confidence. Athletes gain institutional validation by virtue of high-quality, sex-specific gear which signals that the athlete's health and performance are high-priority investments, countering the internalization of systemic neglect. Also, the sport gains sustainable participation. By mitigating preventable injuries, we preserve the talent pipeline of Black women in soccer, ensuring they remain in the sport long enough to transition into the leadership and coaching roles where they are currently most underrepresented.

Thus, the introduction of an equitable, women-specific cleat is not merely a product innovation, it is a social intervention that counters inequity, promotes athlete dignity, and strengthens holistic performance outcomes (Nipper & Pennington, 2025; Pennington et al., 2026 a, b). It represents a tangible step toward addressing the gender gap in sports resources and toward creating environments in which all athletes, regardless of gender, race, or institutional funding level, can thrive.

References

ACSM. (2023). *ACSM's guidelines for exercise testing and prescription* (11th ed.). Wolters Kluwer.

Adidas. (n.d.). *adidas US*. Official Website.

Adidas. (n.d.). *X Speedportal*. Adidas Online Shop.

Agha, N., & Berri, D. J. (2021). *Economic perspectives on women's sports: Market demand and the value of professional leagues*. Brookings Institution Press.

Andriacchi, T. P., & Dyrby, C. O. (2009). Interactions between the shoe and the athlete. *British Journal of Sports Medicine*, *43*(Suppl 1), i86–i91.

Bauldin, A., Schiller, D., & Rushbrook, T. J. (2020). *Article of footwear with self-cleaning cleats* (U.S. Patent No. 20160286904). U.S. Patent and Trademark Office.

Baxter, K. (2023, July 15). USWNT hopes its record diverse World Cup roster will inspire next-gen stars. *Los Angeles Times*.

Bennett, E. V., & Gioia, A. (2020). Athlete well-being and performance: The role of psychological needs and environmental factors. *Sport, Exercise, and Performance Psychology, 9*(2), 202–217.

Braciska, H. (2018). *One nation, one team: A historical analysis of inequalities between men's and women's professional soccer* [Undergraduate honors thesis, College of the Holy Cross]. CrossWorks. https://crossworks.holycross.edu/cgi/viewcontent.cgi?article=1012&context=gsw_stu_scholarship

Brockway, B. (2023). ACL injuries in women's soccer: A growing concern. *The Athletic*.

Bundesliga. (2020, March 18). All you need to know about soccer. *bundesliga.com Bundesliga website*.

Carson, S. L., & Polk, G. (2022). Sport social work: Addressing structural inequalities and athlete well-being. *Journal of Social Work Practice, 36*(4), 467–480.

Chanis, A. (2022, January 10). What's the difference between SG and FG soccer cleats? *Master Soccer Mind*.

Culpan I. & Meier C. (2016). Sport and the political economy: considerations for enhancing the human condition. *Athens Journal of Sports* 3(2): 143-154.

Duby B. & Chen S. (2023). Race and gender hiring and expansion of minority donor base in division-I athletic fundraising. *Athens Journal of Sports* 10(1): 19-38.

Dufek, J. S., & Bates, B. T. (1991). Biomechanical factors in running injuries. *Sports Medicine*, *12*(5), 288–302.

Elliott, K., & Kellison, T. (2019). Perceptions of the Fiscal Challenges Facing Athletic Departments of Historically Black Colleges and Universities. *Journal of Intercollegiate Sport*, *12*(1), 16–35.

Elliott, K., Kellison, T., & Cianfrone, B. (2019). Budgeting for success: Comparing finances between Historically Black Colleges and Universities and Predominantly White Institutions. *Journal of Intercollegiate Sport*, *12*(1), 59–76.

FIFA. (n.d.). *Women's World Cup USA 1999*.

Footalk. (2019). *The differences between men's and women's feet and why it matters for footwear*.

Fortune Journals. (n.d.). A critical analysis of the factors contributing to anterior cruciate ligament injuries in female athletes. Retrieved from http://www.fortunejournals.com/articles/a-critical-analysis-of-the-factors-contributing-to-anterior-cruciate-ligament-injuries-in-female-athletes.html

Fuder, A., Hemwall, K., Kaczkofsky, B., Martens, Z., & Zhang, Z. (2024).[13] An unlevel playing field: Institutionalized gender inequalities & discrimination in soccer. *Reading Physical Culture*. https://sites.lsa.umich.edu/reading-physical-culture/2024/05/03/an-unlevel-playing-field-institutionalized-gender-inequalities-discrimination-in-soccer/

Full article: A mechanical comparison of the translational traction of female-specific and male soccer boots. (2024). *Sports Engineering*.

Gasman, M. (2009). *Envisioning black colleges: A history of the United Negro College Fund*. Johns Hopkins University Press.

Gonzalez, G. (2023). *The Black Women's Player Collective: Advancing Black Women in Soccer*.

Grassi, A., Tosarelli, F., Cucchi, D., Della Villa, S., Zaffagnini, S., & Di Paolo, S. (2023). Two-dimensional and three-dimensional biomechanical factors during 90° change of direction are associated to non-contact ACL injury in female soccer players. *International Journal of Sports Physical Therapy*, *18*(4), 887–897.

Gupton, M., Terreberry, R. R., & Matuszewski, P. E. (2023). Haglund deformity. In *StatPearls*. StatPearls Publishing.

Granger, K. (2021). *HBCU Athletic Administrators' Perception Toward Creating A Graduate Level Curriculum for Directors of Athletics* (Ed.D. Dissertation, Texas Southern University). Digital Scholarship @ TSU.

Harman J. (2022). Gender equality and institutions as the driving force of football performance: Women vs men. *Athens Journal of Sports* 9(1): 25-36.

Harrison, C. K., & Hardin, J. (2018). Race and gender in college sport: Still a long way to go. *Journal of Sport Management*, *32*(2), 163–177.

HBCU Money. (2025, July 29). *Balancing the Ledger: A Comprehensive Analysis of Athletics vs. Research Spending (MEAC/SWAC vs. SEC/Big 10)*. https://hbcumoney.com/2025/07/29/balancing-the-ledger-a-comprehensive-analysis-of-athletics-vs-research-spending-meac-swac-vs-sec-big-10/

Hertel, J. & Denegar, C. R. (2012). Practice-Based Research Networks: Making Clinical Research a Reality in Athletic Training. *Journal of Athletic Training*, *47*(5), 487–488. https://doi.org/10.4085/1062-6050-47.5.04

Hoffmann, R., Lee, J., & Waisman, I. (2006). The impact of gender equality on the performance of national women's soccer teams.[14] *International Journal of Sport Finance*, *1*(2), 108–122.

Hong, J. (2006a). *Magnetic therapy massage slipper* (Korean Republic Patent No. 20090042879A).

Hong, J. (2006b). *Shoes for pressing the reflex zone* (China National Intellectual Property Administration Patent No. 209191980U).

Hutchison, P. (2019, October 15). Regulations for soccer cleats. *SportsRec*.

Joseph, L. (1963). *Shoe leveling insole* (U.S. Patent No. US8695235B2). U.S. Patent and Trademark Office.

Journey Magazine. (2019, January 22). *HBCUs vs PWIs: Why Division I historically black athletic programs struggle against predominantly white institutions*. https://journeymagonline.com/articles/hbcus-vs-pwis-why-division-i-historically-black-athletic-programs-struggle-against-predominantly-white-institutions/

Karolidis, E., & Hahn, M. (2023). UO Knight Campus article.

Lapchick, R., Salazar, N., Wright, B., & Chung, E. (2023). *Race and gender report card: College sport 2021–22*. The Institute for Diversity and Ethics in Sport.

Lewis, A. (2023, July 21). The history makers and the groundbreakers: How the US became women's soccer's dominant force. *CNN*.

Lewis, T. (2024). Sexist science in soccer harms women in an epic own goal.

López, J., & McDonough, M. (2021). Gendered experiences of inequity in sport participation and injury prevention. *Women in Sport and Physical Activity Journal, 29*(2), 84–93.

Luximon, A., & Goonetilleke, R. S. (2001). Foot shape and size of Chinese. *Ergonomics*, *44*(13), 1277–1293.

Mamchii, O. (2024, August 8). Most popular sports in the world in 2024. *Diplomatic Conferences, New York*.

Mendoza, J. (2022, November 29). What is stoppage time? Here's why the World Cup has so much extra time added. *USA Today*.

Nargiso, N., Hernandez, N. R., Cribbs, A., Hayes, Y., Hill, K., Hoyd, T., & Grider, J. (2020). Why HBCUs athletic programs have not reached top-tier status.

NEA. (2025). *NEA HBCU 2023 Update: Continued Crisis for HBCUs*. National Education Association. https://www.nea.org/sites/default/files/2025-06/33011_nea-research-land-grant-university-brief_final.pdf

News Detail. (2023, September 29). ACSM releases expert consensus statement: The biological basis of sex differences in athletic performance. *ACSM_CMS*.

Nike. (n.d.a). *Mercurial Superfly 9 elite firm-ground soccer cleats*. Nike.com.

Nike. (n.d.b). *Tiempo legend VI SG-pro anti clog traction soft-ground soccer cleat*. Nike.com.

Nipper, Z. & Pennington, C. G. (2025). Team Culture as a Function of Team Success. *Athens Journal of Sports*. 12(4), 1-17. DOI: 10.30958/ajspo.X-Y-Z.

Norman, J. (2020). *We here: The Black athlete, activism, and the age of protest*. Silver Press.

Nwokolo, C. (2023, February 9). Top 10 best women's football leagues in the world 2023. *Top Soccer Blog*.

Ooofos. (n.d.). *About Oofos*. Oofos.com.

Pennington, C. G., Prempeh, M. & Ellman, C. (2026, April 8). *Examining Resource Inequity, Injury Risk, and Psychological Well-being Among Female Soccer Players at HBCUs.* Tri-State Regional Sport Psychology Conference, Seton Hall University, South Orange, New Jersey.

Pennington, C. G., Prempeh, M. & Ellman, C. (2026, February). *The Psychosocial and Biomechanical Cost of Inequitable Soccer Footwear for Female HBCU Athletes.* Association for Applied Sport Psychology (AASP) Mid-Atlantic Conference, Rowan University, Glassboro, New Jersey. DOI: 10.13140/RG.2.2.20275.08480Physiopedia. (2017). *Arches of the foot*.

PMC. (2024). *A bibliometric study on the evolution of women's football and determinants behind its growth over the last 30 years*. https://pmc.ncbi.nlm.nih.gov/articles/PMC11679993/

PMC. (n.d.). Biomechanical and performance differences between female soccer athletes in National Collegiate Athletic Association Divisions I and III. Retrieved from https://pmc.ncbi.nlm.nih.gov/articles/PMC2140072/

Prempeh, M. & Pennington, C. G. (2025a). Deconstructing Soccer Footwear: An Anatomical Review with Implications for Female Athlete-Specific Design. *Universal Journal of Sport Sciences. 5*(1), 24-30. DOI: 10.31586/ujss.2025.6130.

Prempeh, M. & Pennington, C. G. (2025b). Advancing Women's Soccer: Historical Growth and Challenges Concerning Athlete Health and Diversity. *Universal Journal of Sport Sciences. 5*(1), 18–23. DOI: 10.31586/ujss.2025.6102.

Priddy, J. (2018). *The damaging effects of intersectionality and layers of oppression on United States female soccer players* [Undergraduate thesis, Gettysburg College]. The Cupola: Scholarship at Gettysburg College. https://cupola.gettysburg.edu/cgi/viewcontent.cgi?article=1765&context=student_scholarship

Quarterman, J. (1992). An analysis of the functions, characteristics, and backgrounds of athletic directors at historically black colleges and universities. *Journal of Black Studies*, *23*(1), 118–137.

Renstrom, P., Ljungqvist, A., Arendt, E., Beynnon, B., Fukubayashi, T., Garrett, W., ... & Engebretsen, L. (2008). Non-contact ACL injuries in female athletes: an International Olympic Committee current concepts statement. *British Journal of Sports Medicine*, *42*(6), 394-412.

Roach, D. (2023, October 7). Anatomy of supportive insoles. *Flow Feet Orthopedic Shoes*.

Sabo, D., & Veliz, P. (2020). *The State of Girls and Women in Sport.* Women's Sports Foundation.

Scheadler, T., & Wagstaff, C. R. D. (2018). Sports, gender, and the media: The influence of gender on athlete recognition and exposure. *Journal of Sport and Social Issues*, *42*(6), 467–487.

SLR. (2022, June 30). *NCAA Academic Performance Program Harms Historically Black Colleges & Universities' Athletics*. Sports Law Review. https://www.sportslaw.org/docs/NCAA_Academic_Performance_Program_Harms_HBCU_Athletics.pdf

Soccer.com. (2014). Women's cleats – The real deal. Retrieved from https://www.soccer.com/guide/the-difference-between-womens-mens-soccer-cleats

Southern Regional Education Board. (2023). *The Future of Athletics at HBCUs*. https://www.sreb.org/sites/main/files/file-attachments/2023_hbcubrief_athtrack_final.pdf

Spokesman-Recorder. (2023, December 21). *Funding disparities keep HBCU sports at a disadvantage*. https://spokesman-recorder.com/2023/12/21/funding-disparities-keep-hbcu-sports-at-a-disadvantage/

Stahler, T. & Pennington, C. G. (2025). How Name, Image, and Likeness Affects College Athletics. *International Journal of Sports, Exercise and Physical Education*. *7*(1), 197-201. DOI: 10.33545/26647281.2025.v7.i1c.175.

Stefanyshyn, D. J., Nigg, B. M., Fisher, V., & Read, J. B. (2000). Shoe-midsole stiffness and vertical impact forces in running. *Journal of Biomechanics*, *33*(3), 351–358.

Taylor & Francis Online. (2023). *Gender information and perceived quality: An experiment with professional soccer performance*. https://www.tandfonline.com/doi/full/10.1080/14413523.2023.2233341

Thomson, A., Kryger, K. O., Canada, Wannop, J. W., & Qatar. (2021, December 21). Hey coach, doctor, physio, podiatrist, dad, mum – what football boot is best for me. *Journal of ASPEtar*, *10*.

Thomson, C., Whiteley, R., Bleakley, C., & McCall, A. (2022). Risk factors for anterior cruciate ligament injury in female soccer players: A systematic review and meta-analysis. *Sports Medicine*, *52*(11), 2673–2692.

Timm-Garcia, J. (2019, July 23). The match that changed women's football. *CNN, Cable News Network*.

Utah Law Digital Commons. (2024). *Gender pay equity: An analysis of the United States Women's National Team soccer settlement*. https://dc.law.utah.edu/cgi/viewcontent.cgi?article=1381&context=ulr

Vanderbilt Law. (2019). *Red card on wage discrimination: US soccer pay disparity highlights inadequacy of the Equal Pay Act*. https://scholarship.law.vanderbilt.edu/cgi/viewcontent.cgi?article=1033&context=jetlaw

Warren, L. & Pennington, C. G. (2025). ACL Tears and the Female Athlete. *Universal Journal of Sport Science.* 5(1), 6039-6044. DOI: 10.31586/ujss.2025.6039.

Weingart, A., Rynecki, N., & Pereira, D. (2022). A review of neuromuscular training and biomechanical risk factor screening for ACL injury prevention among female soccer players. *Bulletin of the Hospital for Joint Diseases*, *80*(3), 253–259.

Wikimedia Foundation. (2023, October 3). *Women's soccer in the United States*. Wikipedia.

Williams, D. A., & Davis, M. H. (2019). The enduring struggle: The unequal funding of public HBCUs. *Journal of Higher Education Management and Policy*, *1*(2), 45–60.

Wood, R. J. (2008). *A football history: From its origin to now*. Soccer History Timeline.

Wrack, S. (2023, June 27). Survey finds 82% of female players experiencing pain wearing football boots. *The Guardian*.

Zohaib, M. (2018). Prevalence of flat foot in different age groups: A systematic review. *Journal of Pakistan Medical Association*, *68*(11), 1706–1712.