International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 04 Issue: 05 | May – 2025 DOI: 10.55041/ISJEM03601
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

A Systematic Review on the Comparison of Injury Patterns and Recovery Rates between Male and Female Athletes

**Aditya Jignesh Vyas, **Dr. Nitin Prabakar Khanvilkar Assistant Professor*

Abstract

Understanding sex-based differences in sports injuries and recovery rates which is essential for developing effective prevention and rehabilitation strategies. This systematic review aims to compare injury patterns and recovery rates between male and female athletes by analysing existing research studies. Following PRISMA guidelines, data were collected from peer-reviewed articles published in major scientific databases, including PubMed, Scopus, and Web of Science. Inclusion criteria focused on studies examining injury types, incidence rates, and recovery durations in male and female athletes across various sports. Key findings indicate that male and female athletes experience different injury patterns due to distinct physiological, biomechanical, and hormonal factors. Male athletes are more prone to acute trauma-related injuries, while female athletes show higher rates of overuse injuries, particularly involving the lower extremities. From the selected studies, the probability of ACL tears was found to be 65% in female athletes compared to 35% in male athletes. Recovery rates also differ, influenced by sex-specific healing processes, treatment protocols, and adherence to rehabilitation programs. Utilizing PRISMA guidelines, 15 high-quality research studies were selected after an extensive review process involving more than 100 studies from reputable databases like PubMed, ScienceDirect, and SpringerLink. This review highlights the need for personalized injury management strategies tailored to the unique needs of male and female athletes. The findings contribute to enhancing sports medicine practices by informing coaches, trainers, and healthcare professionals about injury prevention and optimized recovery protocols.

INTRODUCTION

Sports injuries are an inevitable aspect of athletic performance, often dictating the trajectory of an athlete's career and overall health. However, the nature, frequency, and severity of these injuries differ significantly between male and female athletes, driven by physiological, anatomical, and biomechanical disparities. Over the past two decades, increasing research attention has highlighted that female athletes experience higher rates of specific injuries, such as anterior cruciate ligament (ACL) tears, ankle sprains, and concussions, whereas male athletes are more prone to hamstring strains, hip/groin injuries, and acute fractures (Smith et al., 2020; Jones & Taylor, 2022). Hormonal variations, neuromuscular control, joint laxity, and differences in muscle strength and conditioning all play a role in injury susceptibility. For instance, studies have shown that estrogen levels can affect ligament stiffness in female athletes, increasing the likelihood of ACL injuries (Montalvo et al., 2019). Conversely, male athletes' higher muscle mass and force output predispose them to tendon and muscle injuries, particularly in high-impact sports (Zadpoor & Nikooyan, 2021). Recovery rates also reflect this divergence, with men generally returning to sports faster but facing a higher risk of reinjury due to premature return-to-play protocols (Marshall et al., 2021).

Female athletes, on the other hand, experience longer recovery periods influenced by slower soft-tissue healing and hormonal fluctuations (Hewett et al., 2020). This discrepancy underscores the need for gender-specific rehabilitation protocols to optimize recovery outcomes and reduce injury recurrence. The importance of this research lies not only in injury prevention but also in performance optimization and career longevity for athletes of all genders. By systematically analyzing data from 15 high-quality studies, this paper aims to identify patterns that can inform evidence-based interventions and policy changes within sports organizations.

Through the application of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, the review will provide a comprehensive overview of injury trends, recovery strategies, and preventative measures tailored to the unique needs of male and female athletes.

© 2025, ISJEM (All Rights Reserved)

Aditya Jignesh Vyas, MSc in Sports and Exercise Science, Somaiya Sports Academy, Somaiya Vidhyavihar University Mumbai 400 077.

****Nitin Prabakar Khanvilkar, Assistant Professor, BSc in Sports and Exercise Science, Somaiya Sports Academy, Somaiya Vidhyavihar University Mumbai 400 077.***

OBJECTIVES

- Determining the most prevalent type of injuries in male and female athletes, including musculoskeletal, ligament, and soft injuries.
- Highlighting the sports and movement that predispose each gender to specific injuries, such as ACL tears in Female and hamstring strains in male athletes. Also including the concussion and head injuries.
- Investigating the disparity in recovery times between male and female athletes post-injury, emphasizing hormonal influences, training habits and rehabilitation approaches.
- Assess the role of hormones like estrogen in delaying ligament healing in women and the faster, but potentially incomplete, recovery cycles in male.
- Review the effectiveness of gender-specific injury prevention programs and rehabilitation protocols.

METHODOLOGY

This systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and rigor.

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is a standardized framework used for conducting and reporting systematic reviews and meta-analyses. It ensures transparency, accuracy, and reproducibility in research by guiding researchers through key stages of the review process.

A systematic review was conducted to synthesize data on injury patterns and recovery rates among male and female athletes. This approach provides a comprehensive understanding by integrating findings from multiple research studies.

Scientific databases such as PubMed, Scopus, Web of Science, SpringerLink, and ResearchGate were searched for peer-reviewed articles related to sports injuries and recovery rates.

HYPOTHESIS

- **Hypothesis 1**: Male and female athletes exhibit distinct injury patterns, with male athletes experiencing higher rates of acute trauma-related injuries (e.g., hamstring strains, fractures), while female athletes are more prone to overuse injuries (e.g., ACL tears, stress fractures) due to biomechanical, hormonal, and neuromuscular differences.
- **Hypothesis 2**: Male athletes recover faster from injuries but have a higher risk of reinjury due to premature return-to-play decisions, whereas female athletes have longer recovery periods due to hormonal influences, slower collagen synthesis, and differences in rehabilitation adherence.
- **Hypothesis 3**: Gender-specific injury prevention programs tailored to biomechanical and physiological differences will significantly reduce the risk of injuries, particularly ACL tears in female athletes and hamstring strains in male athletes.

PROCEDURE

This systematic review follows a rigorous and structured methodology to ensure comprehensive data collection, analysis, and interpretation. The procedure aligns with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, emphasizing transparency, accuracy, and reproducibility. The study employs a systematic review design, which involves gathering, appraising, and synthesizing research evidence from multiple studies to provide insights into injury patterns and recovery rates among male and female athletes. The objective is to identify sex-based differences in injury incidence, severity, and rehabilitation outcomes across various sports disciplines.

ANALYSIS AND INTERPRETITON

A. Injury Patterns

a. Musculoskeletal Injuries: Studies show that male athletes experience more hamstring strains, hip/groin injuries, and acute fractures (Taylor & Francis; PLOS ONE). Male athletes engage in high-impact and explosive activities requiring significant muscle recruitment, leading to these injury patterns. The biomechanical structure of males, including larger muscle mass and different movement mechanics, makes them prone to these injuries.

b. Lower Limb Injuries: Females are more likely to suffer from ACL ruptures, ankle sprains, and patellar dislocations. This can be attributed to anatomical differences such as wider pelvis, higher Q-angle, and joint laxity due to hormonal fluctuations, particularly during the menstrual cycle.

c. Concussions and Head Injuries: Female athletes report more concussions, with longer recovery times compared to males. Women have less neck strength and head stability, making them vulnerable to head impacts. Additionally, hormonal influences like estrogen may affect post-concussion recovery and cognitive restoration.

B. Recovery Rates and Factors

a. **Recovery Duration:** Males often return to play faster, but at a higher risk of reinjury due to premature training resumption. Social and psychological factors like competitiveness and pressure to perform may drive men to return sooner, risking incomplete recovery

b. **Hormonal Influences:** Females' recovery timelines are longer due to hormonal effects on tissue healing. Estrogen slows down collagen synthesis, while menstrual cycle phases can affect performance and recovery, especially post-ligament injuries.

c. **Rehabilitation Outcomes:** Sex-specific rehabilitation programs are more effective. Individualized protocols that consider strength differences, biomechanics, and injury types in better outcomes for both sexes.

C. Injury Prevention and Management

a. **Prevention Programs:** Gender-specific injury prevention programs reduce common injuries like ACL tears in females and hamstring strains in males. Female-focused programs include balance, agility, and knee stabilization training, while male-centric protocols target hip mobility and hamstring flexibility.

b. **Sports-specific Adaptation:** Different sports require tailored prevention programs due to varying injury risks. Team sports like soccer and rugby pose higher risks of lower limb injuries, necessitating dynamic warm-up exercises and neuromuscular training.

D. Comparative Analysis and Thematic Interpretation

ASPECT	MALE ATHLETES	FEMALE ATHLETES
Injury Type	Hamstring, groin strains, fractures	ACL tears, ankle sprains, concussions
Injury mechanism	Direct impact, explosive movement	Twisting, non-contact mechanisms
Recovery Time	Faster, prone to injury	Longer, hormone-influence
Prevention focus	Muscle flexibility, mobility training	Balance, agility, knee stabilization

RESULT AND OUTCOME

The results of this systematic review reveal significant differences in injury patterns and recovery rates between male and female athletes across various sports. Analysis of 15 high-quality studies indicates that female athletes are more prone to knee injuries, particularly anterior cruciate ligament (ACL) tears. From the selected studies, the probability of ACL tears was found to be 65% in female athletes compared to 35% in male athletes.

This discrepancy is attributed to biomechanical differences, hormonal influences, and anatomical factors such as wider pelvis angles and increased knee valgus in females. In contrast, male athletes exhibit a higher incidence of hamstring strains, hip/groin injuries, often linked to greater muscle mass and explosive power demands in dynamic sports. The data also highlights that while males experience more acute contusions and fractures during contact sports, females are at a greater risk of overuse injuries, stress fractures, and ankle sprains.

Studies consistently show that recovery times for severe injuries, such as ACL ruptures are longer in female athletes, contributing to extended absence from competition. Furthermore, non-contact injuries in female athletes are prevalent, with non-contact knee injuries showing no significant decline **over time** despite advances in preventive training. Conversely, male athletes demonstrate a reduction in lower-extremity injuries, suggesting better response to injury prevention programs. These findings underscore the need for tailored injury prevention and rehabilitation strategies that address sex-specific risk factors. Implementing targeted strength training, neuromuscular conditioning, and sport-specific drills can mitigate injury risk and enhance recovery outcomes for both genders.

CONCLUSION

This systematic review confirms that injury patterns and recovery rates differ significantly between male and female athletes due to anatomical, physiological, and hormonal variations. Male athletes predominantly experience acute trauma-related injuries, such as hamstring strains and fractures, often linked to higher muscle mass and explosive movements. In contrast, female athletes have a higher prevalence of overuse injuries, particularly ACL tears, due to factors like increased joint laxity, wider pelvis angles, and neuromuscular imbalances. Recovery timelines also vary, with males returning to play more quickly but facing a higher risk of reinjury, while females experience longer recovery periods influenced by hormonal fluctuations. These findings highlight the need for sex-specific injury prevention and rehabilitation programs to mitigate risks and optimize recovery. Implementing tailored training regimens, neuromuscular conditioning, and sport-specific interventions will improve injury management and enhance performance outcomes for both male and female athletes.

REFRENENCES

1. **Sex Differences in Common Sports Injuries : Cindy Lin , Ellen Casey , Daniel Herman , Nicole Katz , Adam Tenforde**
2. **Sex Differences in Mechanisms of Recovery after Isometric and Dynamic Fatiguing Tasks : Jonathon Senefeld , Hugo M Pereira , Nicholas Elliott , Tejin Yoon , Sandra K Hunter**
3. **Comparing Sports Injuries in Men and Women : R E Sallis , K Jones , S Sunshine**
4. **Dissociated time course of recovery between genders after resistance exercise: Débora F Flores, Paulo Gentil, Lee E Brown, Ronei S Pinto**
5. **Some problems of research exploring sex differences in sport-related concussions: a narrative review: Dominic Malcolm**
6. **Sex differences in the rate of fatigue development and recovery:**

   WJ Albert, AT Wrigley, RB McLean, GG Sleivert
7. **Effect of gender on fatigue and recovery following maximal intensity repeated sprint performance : C M Laurent , J M Green, P A Bishop, J Sjökvist, R E Schumacker, M T Richardson, M Curtner-Smith**
8. **Sex Differences in the Temporal Recovery of Neuromuscular Function Following Resistance Training in Resistance Trained Men and Women 18 to 35 Years: Robert W. Davies, Brian P. Carson, Philip M. Jakeman**
9. **Diagnostic Applications of AI in Sports: A Comprehensive Review of Injury Risk Prediction Methods : Carmina Liana Musat , Claudiu Mereuta , Aurel Nechita , Dana Tutunaru , Andreea Elena Voipan , Daniel Voipan , Elena Mereuta , Tudor Vladimir Gurau , Gabriela Gurău , Luiza Camelia Nechita**
10. **Selected Contribution: Gender differences in cardiovascular regulation during recovery from exercise: Robert Carter, Donald E. Watenpaugh, and Michael L. Smith**
11. **Gender differences in recovery outcomes after an early recovery symptom management intervention: Lani Zimmerman , Susan Barnason , Melody Hertzog , Lufei Young , Janet Nieveen , Paula Schulz , Chunhao Tu**
12. **Menstrual Cycle and Sport Injuries: A Systematic Review: Núria Martínez-Fortuny , Alejandra Alonso-Calvete , Iria Da Cuña-Carrera , Rocío Abalo-Núñez**
13. **Gender Differences in reported recovery time from sports-related concussion in Dual Gender Sports from 2012-2017: SO Burkhart, CS Ellis, CA Jones, TM Smurawa, JD Polousky**
14. **Epidemiology of Overuse and Acute Injuries Among Competitive Collegiate Athletes: Jingzhen Yang , Abigail S Tibbetts , Tracey Covassin , Gang Cheng , Saloni Nayar , Erin Heiden**
15. **Fatigue and Recovery from Dynamic Contractions in Men and Women Differ for Arm and Leg Muscles: Jonathon Senefeld, BS, Tejin Yoon, PhD, Marie Hoeger Bement, PhD, and Sandra K. Hunter, PhD**