



Performance Research Reviews

December 2025

Baseball

A prospective analysis of scapular positioning patterns and shoulder and elbow injury susceptibility in professional baseball pitchers. Journal of Clinical Medicine, 14: 6267, 2025.

Background/Objectives: Baseball pitchers accumulate extreme upper extremity forces during the repetitive, high-velocity motion of throwing, which can lead to shoulder dysfunction and overuse injuries. Although scapular dyskinesis has been linked to various shoulder pathologies, there is a lack of evidence on the specific scapular patterns predisposing pitchers to injury.

Methods: A total of 85 professional pitchers from a single professional baseball organization participated in the entirety of this study. All subjects had their scapular positions and motion patterns measured via a digital goniometer prior to the beginning of a competitive season. Scapular upward/downward rotation, anterior/posterior tilt, and internal/external rotation were assessed with the shoulder at rest and during elevation to 120° in the scapular plane. Overuse injuries of the shoulder/elbow sustained during the subsequent competitive season were documented by the team's medical staff, with statistical comparisons between the injured ($n = 34$) and non-injured ($n = 51$) group for each scapular measure.

Results: Pitchers who sustained shoulder/elbow injuries demonstrated significantly more scapular anterior tilt during humeral elevation compared to those without an injury ($p = 0.04$). The difference in anterior tilt between the two groups was 3.8° and had a medium effect size, suggesting clinical relevance. No significant between-group differences were found in any other scapular positions or motions ($p > 0.22$).

Conclusions: Pitchers with increased scapular anterior tilt were more likely to sustain a shoulder/elbow injury, highlighting this kinematic feature as a potential risk factor. This finding suggests that anterior tilt might contribute to soft tissue strain, increasing injury susceptibility in pitchers.



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Case Report: Effect of a graded task-oriented throwing training on throwing accuracy and kinematic variability in a baseball player with the yips. Frontiers in Sports and Active Living, 7: 1636650, 2025.

Abstract - Despite the high prevalence of the yips, a task-specific movement disorder in athletes, effective exercise therapy remains elusive. This case report aimed to evaluate the impact of task-oriented training on throwing accuracy and kinematic variability in a baseball player with the yips. This study included a 21-year-old baseball player with a 7-year history of the yips. Approximately 50% of the player's typical throws were erratic and uncatchable. However, the frequency of erratic throwing varied depending on the throwing task and its contexts. To address these symptoms, graded task-oriented throwing training was implemented twice a week for 5 weeks. A three-dimensional motion capture system and high-speed camera were employed to assess throwing accuracy and kinematic variability. After the intervention, the frequency of subjective yips symptoms during throwing decreased by approximately one-third. Moreover, the intervention improved the accuracy of the ball arrival position and reduced variability in the ball release angle and shoulder internal rotation angle at ball release. Treating the yips remains challenging owing to concerns regarding doping and side effects. Nonetheless, this study suggests that low-risk physical therapy may have potential clinical utility as a management approach for athletes with the yips.

Do team-level calculations support “the idea of WAR”? Implications for Wins production estimation in baseball. Sports Economics Review, 11: 100055, 2025.

Abstract - We derive three propositions describing what we coin “the idea of WAR” from published and online sources—replacement wins, unit contribution, and comparability across position, team, and time. Using a team win production regression model incorporating the three propositions, team-level data from Baseball-Reference (BRWAR) and FanGraphs (FG-WAR) reject replacement wins and comparability. The unit contribution proposition is rejected for pitcher BR-WAR but not hitter BR-WAR, while the opposite is true for FG-WAR. Hitter and pitcher WAR contributions to wins are not equal to each other for either version of WAR. Finally, the contribution of pitcher FG-WAR to wins exhibits diminishing returns. While our results reject that these two measures adhere completely to the idea of WAR, they do not reject either one as useful measures of player performance. These results are important for sports analytics, the economic estimation of wins production, and a recent Major League Baseball salary arbitration issue.



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How maximal whole-body and segmental angular momenta relate to fastball speeds in high school baseball pitchers. Journal of Biomechanics, 191: 112919, 2025.

Abstract - Generation of whole-body and segmental rotations are important objectives of baseball pitching and may be quantified using angular momentum about the body's center of mass (LCOM). However, the characteristics of LCOM during baseball pitching are not well understood, and it is not known whether generating more whole-body or segmental LCOM would be beneficial for the performance outcome of fastball speeds. We characterized whole-body and segmental LCOM and hypothesized that ball speed would positively associate with maximum whole-body, pelvis, trunk, pitching upper arm, forearm, and hand LCOM. Optical motion capture recorded fastballs thrown by 20 high-school pitchers. LCOM was computed and expressed relative to the global axes with the upward axis as global vertical, the forward horizontal axis from the mound towards home plate, and the leftward axis as the cross product of the upward and forward axes. Associations between ball speed and LCOM were examined using linear mixed models. Ball speed had significant positive associations with maximum whole-body and trunk LCOM about the leftward axis with small effect sizes. Characteristic profiles of LCOM in baseball pitching were identified. Maximum whole-body, trunk, and pitching arm LCOM were largest about the leftward axis and second largest about the upward axis, consistent with the goal to generate rotation in these directions. Segmental LCOM about the leftward and upward axes peaked sequentially, supporting that it was transferred from the lower body to the trunk and the pitching arm, towards maximizing momentum for the pitching arm segments.

Basketball

A comparative analysis of game load and game results in elite collegiate basketball players over a regular season. International Journal of Sports Science and Coaching, Ahead of Print: 1-7, 2025.

Abstract - This study examines external game load parameters and game results in elite collegiate basketball players, with a focus on game-intensity and positional differences. Fourteen male collegiate basketball players (average age: 22.5 ± 1.8 years) were tracked using wearable GPS indoor system devices (Catapult Sports, Catapult T7, Melbourne, Australia) across a 30-game college basketball regular season. Games were categorized by point differentials: Wins by ≥ 10 points, Wins by < 10 points, Losses by < 10 points, and Losses by ≥ 10 points. Descriptive statistics, Pearson correlations, and stepwise regression analyses were used to explore relationships between external load parameters and game results, with additional analysis by player position (Guard, Forward, Center). Significant correlations were



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found between High-Intensity Player Load/Min (HIPL/Min) ($r = 0.278$, $p < 0.001$) and Points Scored/Min (PS/Min) ($r = 0.270$, $p < 0.001$) with score difference, indicating their importance in influencing game results. HIPL/Min alone explained 7.2% of the variance in score difference. These findings suggest that optimizing HIPL could maximize tactical efficiency and PS, which could improve game performance and inform training and match-play strategies in basketball. Future research should investigate additional variables such as internal load and mechanical factors to provide a fuller picture of performance dynamics.

A cross-national survey of basketball strength and conditioning coaches' warm-up practices. International Journal of Sports Physiology and Performance, Ahead of Print: 1-8, 2025.

Purpose: This study investigated the warm-up practices implemented by strength and conditioning coaches in basketball prior to practices and games.

Methods: A total of 88 strength and conditioning coaches from 19 countries, representing leagues such as the NBA, Women's NBA, Euroleague, and International Basketball Federation, completed a semi-structured online survey comprising 15 questions. The survey explored various aspects of warm-up routines, including objectives, components, duration, methods, and equipment used. Data were stratified by team gender and competition level.

Results: The most frequently reported warm-up objectives were injury prevention (83%), general physical preparation (80.7%), and increasing body temperature (69.3%). Pre-practice warm-ups most commonly lasted between 10 and 15 minutes (48.9%), whereas pregame warm-ups lasting more than 30 minutes were reported by 38.6% of coaches in men's teams and 44.4% in women's teams. Strengthening exercises were the most frequently included component, appearing in 93.2% of pre-practice and 84.1% of pregame routines. Basketball-specific drills were predominantly used in pregame warm-ups (92%). A mixed approach combining individual and group exercises was the most commonly adopted format (80.7%). In addition, 82.6% of coaches reported using a variety of equipment including resistance bands and foam rollers.

Conclusions: The findings highlight current warm-up practices employed in basketball settings, underlining the importance of developing structured and context-specific protocols that balance performance optimization and injury prevention. These results provide practical implications for strength and conditioning coaches and serve as a foundation for future research on warm-up strategies in basketball.



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A decade of evolution: Comparative analysis of shooting trends and offensive efficiency in the NBA and EuroLeague: Montenegrin Journal of Sports Science and Medicine, 14(2): 13-19, 2025.

Abstract - The evolution of basketball shooting strategies has become increasingly crucial in understanding the sport's development across different professional leagues. This study compares shooting trends and offensive efficiency between the National Basketball Association (NBA) and EuroLeague over a decade (2012-2013 to 2022-2023). To examine multiple shooting metrics, including two-point and three-point field goal attempts per 100 possessions, shooting percentages, and advanced efficiency indicators, box-score data from 14,688 professional games (12,150 NBA and 2,538 EuroLeague) was used. The Mann-Whitney U test identified significant differences in the offensive strategies between the EuroLeague and NBA. EuroLeague exhibited a higher reliance on three-point shooting, with a greater three-point attempt rate (3PA/FGA%) and more three-point attempts per 100 possessions, while the NBA showed higher two-point field goal attempt rates per 100 possessions. The EuroLeague outperformed the NBA in three-point makes, two-point percentage, and effective field goal percentage, while the NBA maintained an edge in two-point makes per 100 possessions. Both leagues exhibited increasing trends in shooting efficiency, with the NBA displaying a steeper upward trend in efficiency in recent seasons and an ongoing trend of offensive strategies focusing on three-point shooting. The findings suggest distinct strategic approaches to offensive basketball, potentially influenced by court dimensions, defensive schemes, and tactical philosophies. This research provides valuable insights for coaches, analysts, and basketball organizations in understanding the evolving nature of professional basketball across different continental contexts.

A multicenter epidemiologic analysis of the injuries affecting female and male collegiate basketball players. Journal of Experimental Orthopaedics, 12: e70414, 2025.

Purpose: The global rise in popularity of basketball has prompted an increased emphasis on understanding the injury patterns affecting players. This study analyzed injury epidemiology and return to sport outcomes in Division I male and female collegiate basketball players. The authors hypothesize that ankle injuries are amongst the most common in this population and that there are similarly comparable injury rates between genders.

Methods: A retrospective review of a de-identified conference-specific injury database for male and female Division I collegiate basketball players from 2017 to 2021 was conducted. Injuries were stratified by anatomic location, gender,



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time missed from practice/competition, and diagnosis. Injury incidence was normalized per 1000 athlete exposure hours (AEH) and relative risk (RR) assessed gender-based differences.

Results: Of 853 athletes, 663 (77.7%) sustained 4532 injuries. Females were more likely to sustain any injury with injuries per 1000 AEH being 6.27 and 5.55 for males (RR: 1.23, confidence interval [95% CI: 1.15-1.32], $p < 0.001$). The most common injuries were ankle/hindfoot (22.2%), knee (16.5%), head/face (11.7%) and forefoot (9.8%) injuries. Females were significantly more likely to sustain knee (RR: 1.49 [95% CI: 1.27-1.75], $p < 0.001$), head/face (RR: 1.32 [95% CI: 1.09-1.60], $p = 0.005$), or midfoot/forefoot (RR: 1.42 [95% CI: 1.14-1.76], $p = 0.002$) injuries. Females were also significantly more likely to suffer a concussion (RR: 1.75 [95% CI: 1.30-2.36], $p < 0.001$) with 82 of 360 females (22.8%) experiencing a concussion and 64 of 493 males (13.0%). Of all concussions, 12.4% led to absences exceeding 4 weeks.

Conclusions: Female athletes experienced higher overall injury rates and specifically elevated rates of concussive, knee, head/face, and midfoot/forefoot injuries. While lower extremity injuries were most common across both genders, they typically resulted in limited time lost. These findings underscore the need for injury prevention programs addressing multiple body regions and highlight the importance of incorporating gender-specific considerations into training and return to play protocols to ultimately keep our athletes safe.

Level of evidence: Level III, retrospective comparative study.

Football

Athletic performance at the National Football League Scouting Combine after arthroscopic meniscal surgery. The Orthopaedic Journal of Sports Medicine, 13(7): 1-7, 2025.

Background: Meniscal surgery is common and debilitating in National Football League (NFL)-bound athletes. Although statistical performance has been demonstrated after surgery, functional performance as measured at the NFL Combine is not well-defined.

Purpose/hypothesis: The purpose of this study was to determine the functional performance, production scores, athleticism scores, overall scores, and draft position of NFL Combine participants after meniscal surgery compared with a matched control group. It was hypothesized that there would be no difference in functional performance or graded scores between athletes with meniscal surgery compared with controls.

Study design: Cohort Study; Level of evidence, 3.



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Methods: NFL-caliber athletes who had previous arthroscopic meniscal repair or meniscectomy and participated in the NFL Scouting Combine between 2014 and 2024 were compared with a control group. Data included the 40-yard dash, 10-second split, vertical, broad jump, shuttle, 3-cone drill, production, athleticism, and overall scores, prospect grades, and draft position.

Results: A total of 48 athletes were included in the repair group; 43 athletes were included in the meniscectomy group, with the same number of controls after matching. Compared with controls, players in the meniscal repair group had significantly slower 3-cone drill (7.40 ± 0.43 vs 7.20 ± 0.38 seconds; $P = .018$), shuttle drill (4.51 ± 0.26 vs 4.38 ± 0.26 seconds; $P = .016$), lower athleticism (69.74 ± 12.95 vs 76.13 ± 11.28 ; $P = .012$), and overall scores (70.95 ± 14.22 vs 77.47 ± 8.30 ; $P = .007$). There was no significant difference in the 40-yard dash ($P = .439$) or vertical tests ($P = .559$). Players in the meniscectomy group had a significantly slower shuttle compared with controls (4.45 ± 0.31 vs 4.34 ± 0.18 seconds; $P = .047$), lower athleticism (69.62 ± 12.53 vs 76.67 ± 10.84 ; $P = .007$), and overall scores (70.59 ± 10.56 vs 75.24 ± 9.52 ; $P = .035$). There was no significant difference in the 40-yard dash ($P = .164$) or vertical tests ($P = .108$). There was no significant correlation between the NFL Combine performance and time from surgery.

Conclusion: While overall athletic performance remained largely unaffected by arthroscopic meniscal repair or meniscectomy, specific drills, such as the 3-cone and shuttle drills, demonstrated significant declines, suggesting a negative effect on agility and quickness. Metrics used to score NFL prospects were also inferior in the meniscal repair and meniscectomy groups. These findings highlight the potential effects of meniscal surgery on athletic performance, underscoring the need for surgeon guidance on expectant postsurgical functional deficits for NFL-caliber athletes.

Beyond the Hit: Muscle and vascular tissue responses to contact exposure in collision sports – A narrative review. Sports Medicine, Ahead of Print: 1-19, 2025.

Abstract - Contact events in rugby codes such as tackling, running into contact, scrums, rucks, and contact with the playing surface may expose athletes to muscle damage known as impact-induced muscle damage. These repetitive impacts to muscle tissue have the potential to diminish muscle force production and delay recovery following contact-focused training and match-play. Repetitive exposure to contacts may also affect the surrounding vascular and neuronal tissues, an area that has received little attention in the collision sports. Depending on the severity and duration of tissue damage, repetitive contact exposure without sufficient recovery or noticeable adaptation may predispose collision sport athletes to impaired performance and long-term health complications. The aim of this narrative review is to provide a conceptual framework for understanding the physiological implications of contact exposure in collision sports. We

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examine the current understanding of impact-induced muscle damage (IIMD), how it differs from exercise-induced muscle damage (EIMD), and its relationship with contact exposure in collision sports. Drawing on both experimental animal models of contusion injury and limited human observational research, we explore the effects of repeated contact exposure on the microvasculature and its implications for both athletic performance and player welfare. To account for all tissues that may be affected by impacts, including muscle, nerve, vascular, connective tissue, skin, other organs and bones, we recommend impact-induced tissue damage (IITD) as the preferred descriptor rather than IIMD. Finally, we discuss the concept of contact adaptation and provide recommendations for future research on IITD in collision sports.

Comparing sports-related orthopedic injury trends on artificial turf and natural grass: A 20-year nationwide analysis of the NEISS database. Rhode Island Medical Journal, 7: 41-47, 2025.

Objectives: The impact of playing surfaces on sports related injuries remains a subject of debate, with limited research comparing injury patterns across various sports and competition levels.

Methods: This study utilized the National Electronic Injury Surveillance System (NEISS) database from 2004 to 2023. Sports-related injuries that occurred on artificial turf and natural grass playing surfaces were identified and analyzed.

Results: Of 21,868 injuries, 76.3% occurred on grass and 23.7% on turf. Rugby (OR: 8.35) and lacrosse (OR: 8.42) injuries were more common on turf, while soccer and softball injuries were more frequent on grass. Dislocations (OR: 4.73) and lacerations (OR: 5.41) were more likely on grass, while strains/sprains (OR: 1.16) and contusions (OR: 1.96) were more common on turf.

Conclusion: This study reveals significant variations in injury patterns that occur on artificial turf and natural grass playing surfaces across various sports and age, providing valuable evidence on the potential risks and differences in injury patterns associated with each surface.



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Effects of daytime floatation-restricted environmental stimulation therapy on nocturnal cardiovascular physiology, sleep, and subjective recovery in collegiate student-athletes: A comprehensive observational study. Journal of Strength and Conditioning Research, 39(8): 857-867, 2025.

Abstract - The primary aim of this study was to explore the relationship between floatation-restricted environmental stimulation therapy (floatation-REST) and nocturnal cardiovascular physiology and sleep in collegiate athletes. The secondary aim was to describe the perceived changes in soreness, mood, fatigue, energy level, and overall experience after floatation-REST in collegiate athletes. Data included 214 records of nocturnal cardiovascular physiology and sleep collected using an acceptably valid and reliable wearable device (Ōura Ring, Ōura Health, Oulu, Finland) from 97 athletes (52.57% women) on 12 varsity teams, and 2,319 survey responses collected immediately after floatation-REST from 898 athletes (48.88% women) on 36 varsity teams. Nocturnal cardiovascular physiology was assessed through resting heart rate, heart rate variability, and respiration rate, while sleep was summarized using total sleep time, time in bed, and sleep efficiency. The representation of teams was varied, with football and men's and women's swimming heavily represented. Male and female athletes were analyzed separately to prevent overlooking sex-specific physiologic differences. Resting heart rate was significantly lower after floatation-REST than at night immediately before the session in female athletes ($p < 0.001$, effect size [ES] = -0.223) and male athletes ($p < 0.001$, ES = -0.186). Heart rate variability and sleep metrics showed no specific changes. In total, 98.7% of athletes reported an overall positive floatation-REST experience, and 85.3% felt better postsession, citing reduced soreness, stress, and fatigue, with improved energy. Thus, although more research is needed, these data provide a positive outlook for the use of this recovery technology in collegiate athletes.

Effects of reduced training volume of Nordic hamstring exercise on eccentric knee flexor strength, and fascicle length and stiffness of biceps femoris long head. Scandinavian Journal of Medicine & Science in Sports, 35: e70115, 2025.

Abstract - This study investigated whether and how ultralow-volume Nordic hamstring exercise (NHE) training can maintain neuromuscular adaptations achieved through initial moderate-volume training. Specifically, we examined changes in eccentric knee flexor strength, fascicle length, and stiffness of the biceps femoris long head (BFH) across different training volumes. Forty-five resistance-trained males were randomly assigned to three groups: low-volume,



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ultralow-volume, and control ($n = 15$ per group). Training groups performed standardized moderate-volume NHE training (48 repetitions/week) for 2 weeks, followed by low-volume (eight repetitions/week) or ultralow-volume (four repetitions/week) training for 8 weeks. Eccentric knee flexor strength, BFLh fascicle length, and BFLh stiffness assessed via shear wave elastography were measured at four time points: weeks 0 (baseline), 2, 6, and 10. In both training groups, eccentric knee flexor strength increased significantly during the initial 2 weeks and continued to increase through week 6 despite the reduction in training volume, with no further increases beyond week 6. BFLh fascicle length increased, and stiffness decreased significantly after 2 weeks of moderate-volume training, and these adaptations were maintained throughout the subsequent 8 weeks. No significant differences were found between the two training groups for any parameter. The control group showed no significant changes. These findings indicate that neuromuscular adaptations induced by 2 weeks of moderate-volume NHE training can be effectively maintained with as little as four repetitions per week of supramaximal NHE training, providing practical implications for in-season training programming.

Gymnastics

Injuries in Artistic Gymnastics: Etiology, prevention strategies, and multifactorial perspectives – A systematic review. International Journal of Molecular Sciences, 26: 10929, 2025.

Abstract - Artistic gymnastics is one of the most physically demanding sports, characterized by a high incidence of both acute and chronic injuries. Although previous research has primarily focused on biomechanical and training-related factors, the multifactorial etiology of injuries—including molecular and genetic aspects—remains insufficiently explored. This systematic review aimed to synthesize current evidence on the causes, mechanisms, and prevention of injuries in artistic gymnastics, with particular emphasis on biomechanical, molecular, and genetic determinants of injury risk and athletic performance. The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines and was registered in the PROSPERO database (Registration No: CRD420251167521). Electronic databases (PubMed, KoBSON, and Google Scholar) were searched for studies published between 2015 and 2025 using the keywords “gymnastics injuries,” “overuse injuries,” “injury prevention,” “biomechanics,” “IL-6,” “TNF- α ,” and “miRNA biomarkers.” Nineteen studies met the inclusion criteria and were analyzed based on injury incidence, localization, mechanisms, and molecular and genetic associations. The majority of injuries were localized in the joints of both upper and lower extremities, particularly during puberty and at higher competitive levels. Repetitive loading, improper technique, and insufficient recovery were identified as the main etiological factors. Molecular biomarkers such as IL-6, TNF- α , and miRNAs (miR-155, miR-146a) were found to play key



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roles in inflammatory responses, while genetic polymorphisms including ACTN3 R577X, ESR1 rs2234693, and CYP19A1 rs936306 were associated with flexibility, explosive strength, and susceptibility to injury. Injury prevention in artistic gymnastics requires a personalized and multidisciplinary approach that integrates biomechanical, clinical, molecular, and genetic data. Incorporating molecular and genetic profiling into training and rehabilitation programs may enhance early detection of overuse conditions and optimize both health and performance outcomes in gymnasts.

Modifying landing mat properties elicits different lower limb biomechanical responses in gymnasts and non-gymnasts. Scientific Reports, 15(1): 42490, 2025.

Abstract - This study examined vertical ground reaction force (VGRF) and lower-limb kinematics during drop landings on different gymnastics mat types. Responses were compared between skilled female gymnasts ($n = 11$) and untrained young females ($n = 11$). Participants completed six standardized drop landings on a FIG-certified mat, a gymnastics carpet, and three custom-designed mats (TYPE 1-3) varying in layer number and material properties. Kinetic and kinematic data were collected for each trial. A two-way mixed ANOVA examined the effects of mat type and group. Both mat characteristics and participant background significantly influenced landing biomechanics. This included $VGRF_{max}$, time to $VGRF_{max}$, peak ankle and knee joint angles, and peak knee angular velocity. The FIG-certified mat produced the lowest peak forces and the longest time to peak. The carpet surface generated the highest peaks and shortest times. Softer mid-layers, as in TYPE 2, were associated with more favourable force profiles. Stiffer constructions transmitted higher loads. Gymnasts exhibited consistent plantarflexed initial contact, reduced knee flexion, and lower knee range of motion across surfaces. This reflects a joint-stiffening strategy likely developed through training. Non-gymnasts adopted deeper, more compliant landings and adjusted more to softer mats. These findings highlight the role of mat structure and user experience in shaping landing biomechanics. The results underscore the importance of biomechanical analysis in landing mat development to enhance safety across skill levels.



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Golf

Golf-related lower extremity injuries presenting to United States emergency departments – A 10-year analysis (2013-2022). The Orthopaedic Journal of Sports Medicine, 13(11): 1-8, 2025.

Background: Golf-related lower extremity (LE) orthopaedic injuries are frequently seen in emergency departments (EDs) across the United States (US). This study analyzes trends in mechanisms and distribution of these injuries.

Hypotheses: We hypothesized that (1) the LE injury incidence would increase from 2013 to 2022; (2) golf carts would be a significant injury mechanism; and (3) injury patterns would vary by age group.

Study design: Descriptive epidemiology study.

Methods: The National Electronic Injury Surveillance System (NEISS) database was queried for all LE golf-related injuries presenting to US EDs from January 1, 2013, to December 31, 2022. National estimates (NE) were calculated utilizing the NEISS statistical sample weight for each hospital. Linear regressions were used to determine trends in injury patterns—including year, age group, body part, injury mechanism, diagnosis, and disposition.

Results: There were 1949 golf-related LE injuries (NE = 97,492), with men accounting for 67.3% of cases. Injuries were highest among >60 years (49%) and 10 to 19-year-old golfers (11%). Most commonly involved LE body parts were the knee (n = 586; NE = 31,539; 32%), lower leg (n = 498; NE = 24,729; 25%), ankle (n = 453; NE = 21,860; 22%), and foot (n = 263; NE = 12,814; 13%). The most commonly identifiable mechanisms of injury were 38,889 cart-related (40%), 15,287 falls (16%), and 11,181 overuse injuries (11%). There was an increasing annual trend in LE injury involving golf carts (236 per year; $P = .001$). However, there was no statistically significant trend in overall golf-related LE injuries.

Conclusion: Our study revealed that golf cart-related injuries accounted for a disproportionate percentage of LE golf injuries (40%). The lack of increase in overall LE injuries may reflect fewer non-golf cart-related injuries among an increasing pool of younger golfers. Preventive measures should target adolescents and those >60 years. Improved safety measures for golf cart use are also recommended.



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Wearable-derived sleep and physiological metrics are associated with performance in professional golfers. International Journal of Sports Physiology and Performance, Ahead of Print: 1-12, 2025.

Purpose: Elite golf performance hinges on physiological and psychological precision, with success often defined by razor-thin margins. Sleep and cardiac autonomic function, reflected by resting heart rate (RHR) and heart-rate variability (HRV), are indicators of recovery and readiness, yet their role in golf remains understudied.

Methods: We analyzed wearable-derived data from 389 male professional golfers across 521 events, totaling 35,140 nights of monitoring. Key metrics included sleep duration (7.2 [0.7] h), sleep consistency (regularity of sleep/wake times; 69.1% [6.9%]), RHR (55.9 [7.9] beats·min⁻¹), HRV (root mean square of successive differences; 64.2 [28.1] milliseconds), and a composite recovery score (integrating sleep and biometric data; 59.1% [9.9%]). Objective golf performance (total score, great/poor shots, strokes gained) was extracted from a subscription-based database. Models assessed between-persons differences and within-person changes across seasons (using seasonal averages), adjusting for age (34.1 [9.1] y), height (1.81 [0.07] m), and weight (83.2 [10.6] kg).

Results: Golfers with longer and more consistent sleep, lower RHR, and higher HRV performed better ($P < .05$). Between athletes, each additional hour of sleep was associated with a lower score ($b = -0.522$), as was a 10-percentage-point increase in sleep consistency ($b = -0.382$), a 1-beat-per-minute lower RHR ($b = -0.038$), and a 10-percentage-point increase in recovery ($b = -0.476$). Within athletes, improvements in sleep consistency ($b = -0.193$ per 10 percentage points), HRV ($b = -0.016$ per 1 millisecond), and recovery ($b = -0.238$ per 10 percentage points) were also associated with lower scores ($P < .05$).

Conclusions: Sleep and cardiac autonomic function were associated with elite golf performance. Both individual differences and within-athlete improvements were linked to better play, highlighting the potential role of sleep, RHR, and HRV in optimizing performance at the highest level of golf.



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Hockey

Do National Hockey League injury rates increase during the years players participate in the Winter Olympics? The Orthopaedic Journal of Sports Medicine, 13(11): 1-7, 2025.

Background: Every 4 years, the Winter Olympics occurs in the middle of the National Hockey League (NHL) season. The NHL allowed its players to participate in the Olympics during the 2002, 2006, 2010, and 2014 editions. The added game load, travel, and intense exertion over a short period of time may increase players' risk of sustaining injuries.

Purpose: To compare the injury rates between a normal NHL season and an Olympics-interrupted season and to compare the rates of different types of injuries, games missed due to injury, and the incidence of multiple injuries in NHL players.

Study design: Descriptive epidemiology study.

Methods: The study retrospectively evaluated NHL injuries that occurred between 2000 and 2023. Injured players were identified from publicly available online databases: tsn.ca, capfriendly.com, cbssports.com, and sportsforecaster.com. Information regarding the number and characteristics of the injuries was categorized for each season. Injury rates were compared between Olympic and non-Olympic seasons. To evaluate the effect of the Olympics on injuries, multivariate regression models were used, adjusting for position.

Results: No significant difference was found in overall injury rates in Olympic years compared with regular NHL seasons ($P = .94$). The proportion of forwards injured during Olympic seasons increased significantly ($P = .041$). After adjusting for position, the authors noted significantly increased odds of players sustaining multiple injuries (odds ratio [OR], 1.12; $P = .002$), knee injuries (OR, 1.71; $P < .001$), and muscle injuries (OR, 1.65; $P < .001$) during Olympic years. The mean injury rate was 0.671 in Olympic players compared with 0.905 in non-Olympic players during these seasons ($P = .083$).

Conclusion: The study demonstrated no significantly increased rate of injuries overall to NHL players during Olympic seasons compared with regular NHL seasons. However, within Olympic seasons, an increase was noted in certain categories of injuries to players on Olympic rosters versus those who were not. The current findings may help in future discussions for policies on players' participation in the Olympics and/or to help develop awareness and safeguards from injuries during Olympic years.



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Relationship between physical parameters and shooting velocity in elite female rink hockey players. Apunts Sports Medicine, Ahead of Print: 1-7, 2025.

Abstract - The aim of this study was to evaluate various physical parameters and their relationship with shooting velocity in female rink hockey players. Eight female players (age: 24.8 ± 3.88 years, body mass: 62.6 ± 4.67 kg, height: 167 ± 0.04 cm) were measured, weighted and tested for thoracic spine range of motion, spine rotational strength, chop, lift, bench press, and handgrip. Shooting velocity of each participant was measured for both slap and backhand shots. Results showed a significant correlation between slap shot velocity and body mass ($r = 0.76$; $p = .02$; ICC 0.1338 - 0.9532), spine rotation strength to the right with body weight ($r = 0.76$; $p = .04$; ICC 0.0368 - 0.9638) and with 79 % of body weight ($r = 0.84$; $p = .01$; 0.2374 - 0.9759). Interestingly, backhand velocity showed a strong correlation and a close to significant p-value with bench press power at 25 kg ($r = 0.70$; $p = .054$; ICC -0.0141 - 0.9401), 30 kg ($r = 0.53$; $p = .097$; ICC - 0.1415 - 0.9233) and 35 kg ($r = 0.63$; $p = .10$; ICC -0.1568 - 0.8596). Similar results were observed with the estimated one repetition maximum for the bench press ($r = 0.67$; $p = .077$; ICC -0.0892 - 0.9307). Results suggested that including exercises to strengthen the torso rotation muscles and upper extremity strength could improve shooting velocity in female rink hockey players.

Lacrosse/Field Hockey

Cleats may be a risk factor for ACL tears in female lacrosse and soccer players. The Orthopaedic Journal of Sports Medicine, 13(10): 1-5, 2025.

Background: Anterior cruciate ligament (ACL) tears are common in female athletes, with most injuries caused by noncontact mechanisms. Beyond the sex factor, it is important to identify modifiable risk factors for an ACL tear, such as the type of shoe and playing surface.

Purpose: To evaluate the association between shoe type and the risk of ACL injury.

Study design: Case-control study; Level of evidence, 3.

Methods: A retrospective review of 256 female athletes was conducted: 128 female soccer and lacrosse athletes who had torn their ACLs and 128 age- and sport-matched athletes who had never torn their ACL. Sports, level of competition, mechanism of injury, type of shoe, type of stud in the shoe, and playing surface were identified.



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Results: In this study, 75% of participants who tore their ACLs were wearing cleats. In contrast, only 55.5% of the age-matched group with normal ACLs wore cleats. A significant association was found between ACL tear and the type of shoe they were wearing ($P < .05$). In athletes who tore their ACL, 46.4% of their cleats had conical studs, 14.4% had blades, and 15.2% had a mix of the 2, compared with those who have never torn their ACL, with 30.5% having conical studs, 18.8% blades, and 6.3% mixed. The odds of sustaining an ACL tear while wearing conical studs were 2.02 times higher than wearing blades (95% CI, 0.97-4.20) and 2.87 times higher than wearing turf shoes (95% CI, 1.58-5.23).

Conclusion: Female athletes who wore cleats were more likely to tear their ACL when compared with sport- and age-matched athletes who wore turf shoes. Wearing turf shoes as opposed to cleats appears to be associated with a reduced risk of ACL tears in high-level female athletes. Cleats with long, conical studs, especially around the perimeter of the cleat, were associated with increased odds for ACL tear and were more common in the 128 athletes in this study who tore their ACLs. Based on this information, we recommend further exploration for a shoe that prevents shoe wear from being an additional risk factor for ACL injuries in female athletes.

Prevention strategies and modifiable risk factors for concussion: A systematic review and meta-analysis for the Female, woman and girl Athlete Injury pRevention (FAIR) consensus. British Journal of Sports Medicine, Ahead of Print: 1-18, 2025.

Objectives: To examine injury prevention strategies and potentially modifiable risk factors (MRFs) for upper extremity (UE) injuries in female, woman and/or girl athletes (female/woman/girl).

Design: Systematic review with meta-analysis, semiquantitative analyses and Grading of Recommendations Assessment, Development and Evaluation in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Data sources: MEDLINE (Medical Literature Analysis and Retrieval System Online), CINAHL (Cumulative Index to Nursing and Allied Health Literature), APA PsycINFO (American Psychological Association Psychological Information Database), SPORTDiscus (Sports Discus Database), EMBASE (Excerpta Medica Database), and ERIC (Education Resources Information Center) (30 October 2023) and Cochrane Systematic Review Database and the Cochrane Central Register of Controlled Trials (CENTRAL) (25 November 2023).



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Eligibility: Primary data studies with comparison group(s) assessing the association of prevention strategies and/or MRFs for sport-related UE injury, with ≥ 1 female/woman/girl in each study group.

Results: 55 studies (n=20 intervention, n=35 MRF) were included with 33 228 athletes (8642 female/woman/girl; 26%). Of these, 17 (31%) reported female/woman/girl-specific estimates and included five injury locations (n=3 general UE, n=12 shoulder, n=3 elbow, n=3 wrist/hand). One prevention strategy (n=5 shoulder-specific exercise programmes) and seven MRFs were identified, including less range of motion (n=6), less shoulder muscle strength (n=8), high training load (n=1), presence of scapular dyskinesis (n=3), high sport specialisation (n=2), equipment differences (n=1) and less sport-specific conditioning (n=1). Pooled data from three studies suggest that shoulder exercise programmes consisting of strength, stability/control and sport-specific exercises reduce shoulder injury rates by 51% (95% CI 0.30 to 0.79; I^2 0.0%; very-low certainty evidence) across paediatric (≤ 18 years) and adult handball and volleyball players.

Conclusions: Our understanding of female/woman/girl UE injury prevention is limited by heterogeneity across injury outcomes, interventions, MRFs and limited female/woman/girl athlete-specific data. Shoulder-specific strengthening and stability exercise programmes may be beneficial to reduce shoulder injury rates in female/woman/girl handball and volleyball players. Future research should prioritise female/woman/girl athletes to reduce the burden of UE injuries.

Soccer

Perceived recovery and muscle fatigue in professional soccer players during preseason.
International Journal of Exercise Science, 18(8): 1212-1227, 2025.

Abstract - This study aimed to examine weekly variations and within-subject relationships between internal training intensity (ITI), perceived recovery (TQR), neuromuscular performance (CMJ), and perceived muscle soreness (PMS) during a four-week preseason period in professional soccer players. Twenty-three soccer players (age 24.8 ± 4.4 years; height 182 ± 7 cm; body mass 74.6 ± 6.7 kg) classified as Tier 3 athletes from the Croatian Second Soccer League were monitored using session rating of perceived exertion, TQR scales, countermovement jump tests, and PMS questionnaires. A significant reduction in ITI and concurrent improvement in TQR scores were observed across the preseason, with the highest intensity in week 1 and the lowest recovery in week 2. CMJ height performance declined during peak fatigue but rebounded as training intensity tapered. Repeated-measures correlations revealed negative associations between weekly ITI and TQR of the following week ($r_{rm} = -0.72$), and between ITI and CMJ ($r_{rm} = -0.55$), indicating that greater training intensities may impair both perceptual and neuromuscular recovery. The training stimulus–recovery difference index was positively associated with next-day TQR, suggesting it may serve as a sensitive



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marker of session-level readiness. These findings highlight the interplay between intensity, recovery, and fatigue, emphasizing the utility of low-cost subjective and objective tools for monitoring preseason responses and guiding individualized training strategies in elite soccer settings.

The impact of weekly acceleration and deceleration loads on neuromuscular performance in soccer: A session-to-session analysis. Journal of Sports Science and Medicine, 24: 851-860, 2025.

Abstract - This study examined weekly variations in accelerations, decelerations, and neuromuscular performance in male under-19 soccer players. It also explored the relationship between accumulated acceleration and deceleration loads and fluctuations in neuromuscular performance across a weekly microcycle. A repeated-measures observational design was used over two consecutive weeks, involving 39 outfield players monitored via Global Navigation Satellite Systems. Neuromuscular performance was assessed through countermovement jump (CMJ), hamstring strength (HS), and delayed onset muscle soreness (DOMS), measured both before and after training on five days each week, following a consistent training structure. Significant post-training reductions in CMJ (all days $p < 0.001$) and HS (all days $p < 0.001$) were observed, with the greatest impairments occurring on MD4 and MD-5, although CMJ showed a slight rebound on MD-5 compared to MD-4. DOMS ratings peaked on MD-3 ($F = 39.186$, $p < 0.001$), indicating a buildup of midweek fatigue. The highest numbers of accelerations ($F = 248.121$, $p < 0.001$) and decelerations ($F = 227.853$, $p < 0.001$) occurred on MD-4 and MD-5. However, no statistically significant correlations were found between daily acceleration/deceleration counts and changes in CMJ or HS performance. These findings suggest that while neuromuscular performance declines progressively throughout the week, no statistically significant correlations were found between impairments and the acceleration or deceleration load of individual training sessions. Instead, the cumulative effect and timing of high-intensity training may play a more substantial role in contributing to fatigue and neuromuscular decline.



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The influence of competition time on soccer players' performance factors: A scoping review with evidence gap map. Sports Medicine, Ahead of Print: 1-31, 2025.

Background: Performance in team sports is influenced by physical, technical, tactical, and psychological factors. Understanding the disparities in playing time between starters and nonstarters is crucial for optimizing training strategies and performance management.

Objectives: This systematic scoping review with an evidence gap map (EGM) aimed to (i) synthesize findings from studies comparing the performance factors of starters and nonstarters, (ii) identify compensatory strategies for players with reduced playing times and barriers to the implementation of these strategies, and (iii) provide an EGM to guide future research toward addressing the most relevant gaps in the literature. This review followed the PRISMA 2020 guidelines and the respective extension for scoping reviews (PRISMA-ScR). Electronic databases such as the Cochrane Library, PubMed, Scopus, SPORTDiscus, and Web of Science (Core Collection) were searched on 31/08/2023. The RoBANS tool was used to assess the risk of bias. Among 32,613 articles, 57 trials from 70 publications were included.

Results: Female soccer players were represented in only 15.8% of the trials. The physical performance factor ($k = 56$, 98.2%) has been extensively studied in relation to the differences between starters and nonstarters. Few studies have analyzed technical and psychological performance factors, while tactical factors have not been addressed. Starters presented higher values of external absolute intensity (EAI, measured by the total distance and sprint distance), higher internal absolute intensity (IAI, assessed through heart rate-based measures as above 70% maximal heart rate), along with greater improvements in exercise performance measurements (countermovement jump and 20-m sprint), than nonstarters did. The most adopted categorization was based on match participation ($k = 33$, 57.9%), with starters defined as players who played for $\geq 66.7\%$ of a match time (14.0%). The day commonly used for compensatory training was 24 h after a match ($k = 16$; 37.5%). Several strategies attempting to reproduce competitive loads were used, such as small-sided games ($k = 9$; 56.3%), running-based drills ($k = 8$, 50.0%), small-positional games ($k = 3$, 18.8%), tactical-technical drills ($k = 2$, 12.5%), strength training ($k = 2$, 12.5%), and friendly matches ($k = 1$, 6.5%).

Conclusion: This scoping review highlights the necessity of placing increased emphasis on technical, tactical, and psychological performance factors and compensatory training strategies (including the day and types of exercise). These measures aim to replicate the competitive match demands for nonstarters, maintaining or enhancing the physical adaptations, psychological factors, and tactical-technical skills required for performance improvement throughout the season. This review proposes three main future research areas for the topic: (i) investigating the effects of



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compensatory training on nonstarters' weekly loads when distributed across multiple days; (ii) investigating additional cutoffs or more refined time classifications for nonstarters; and (iii) directing more studies toward female soccer players.

Softball

Softball-related injuries. Clinics in Sports Medicine, Ahead of Print: 1-8, 2025.

Abstract - Softball is the fourth most popular sport among female athletes with more than 2 million female athletes of all ages and participation continuing to rise each year. There are now over 1500 collegiate softball programs over a multitude of divisions. As with other high-level sports, there is an association with injuries related to playing softball. Compared to its men's sport counterpart, baseball, softball has overall higher injury rates of all body parts. Additionally, softball has specific injuries related to movements unique to the sport, such as windmill pitching as well as other overuse type injuries similar to baseball. Among 11 collegiate sports, women's softball also has the highest rate of ball-contact injuries resulting in contusions or concussions. Among youth sports, greater than 50% of all injuries are caused by ball-contact.

KEY POINTS

- Softball injuries continue to rise as the sport becomes more popular.
- Softball has distinct injuries specific to movements solely associated with the sport.
- The windmill pitching motion is specifically associated with a certain subset of injuries.
- Injury prevention strategies should continue to evolve to best protect these athletes during competition.

Assessing the feasibility of the Virtual Reality Education and Acceptance Protocol among baseball and softball players. PLOS ONE, 20(11): e0337537, 2025.

Abstract - Research has supported the use of virtual reality (VR) in sport to train skills such as decision-making and anticipation, as well as aid in injury rehabilitation. Despite this, VR is not commonly used as a training tool in sport. Barriers to its adoption include a lack of understanding, low awareness, risk of cybersickness, and cost. As such, there is a critical need to address these barriers and promote acceptance of VR in sport. The purpose of this single-arm, non-

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randomized, mixed-methods feasibility trial was to examine the feasibility of the Virtual Reality Education and Acceptance Protocol (VREAP), which was designed by the study's authors to address barriers to VR adoption. While the VREAP is intended to be used in multiple domains, we assessed its feasibility among baseball and softball players. Specifically, we assessed pre- and post-training attitudes toward VR using the Attitudes toward Virtual Reality Technology Scale (AVRTS), which uses the Technology Acceptance Model (TAM) as a guiding framework. Participants (n=18) completed the VREAP, which includes stages of education, acclimation, and application. Exit interviews provided further insights into participant experiences. Results from quantitative and reflexive content analyses demonstrated feasibility of the VREAP based on recruitment and adherence, acceptability, demand, implementation, and practicality. Statistical analyses from the AVRTS revealed significant pre- to post-training increases in overall attitudes toward VR as well as increases in enjoyment, perceived usefulness, and ease of use. Minimal cybersickness was reported. Our findings demonstrate the feasibility of the VREAP among baseball and softball players and show promise for its future research and application.

Swimming

Swimming-related injuries. Clinics in Sports Medicine, Ahead of Print: 1-13, 2025.

Abstract - Since its induction as an Olympic sport in 1896, the sport of swimming has continued to grow. At the most recent Olympics in Paris, swimming athletes represented the second highest percentage of athletes across all sports with more than 850 registered swimmers. In the United States alone, there are a total of 375,827 members registered to USA Swimming, the major governing body, which although slightly reduced compared to prepandemic numbers, still represents relative growth of the sport over the last several decades. At the collegiate level, more than 23,000 athletes continue to participate and compete, and there are a growing number of individuals who continue or pick up the sport later in life through masters swimming. While the relationship between training loads and musculoskeletal injury has been well defined, most of the research focus on swimming has been limited to the on the shoulder. Only recently has there been a focus on nonshoulder injuries, and unfortunately, the quality of evidence regarding studies of other anatomic sites is poor. Training load, returning to sport after time away, and cross-training are all modifiable extrinsic risk factors, and while there appears to be some evidence of sex-specific differences, sex-specific injury prevention, treatment, and return to sport protocols are lacking.

KEY POINTS

- Swimming injuries in sports are often due to overuse, with an operative rate of approximately 4%.



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- There is little data to suggest a sex-specific difference in rates of injury in the sport of swimming.
- Swimming injuries most frequently involve the shoulder, with the knee, neck, back, and hip often less involved.

Sleep quality impacts training responses and performance in elite swimmers. *European Journal of Sport Science*, 25: e70090, 2025.

Abstract - High-quality sleep is necessary for optimal health and promoting recovery from training, contributing to sport performance. Research suggests a high prevalence of poor sleep duration and quality in athletes. Reduced sleep duration has been shown to be deleterious to performance, but less is known about sleep quality and its relationship to training responses and performance. In 26 elite male ($n = 10$) and female ($n = 16$) collegiate swimmers, we assessed sleep quality (sleep duration (hrs), sleep debt (hrs), slow-wave sleep (SWS_{hrs} and $SWS\%$), rapid-eye movement (REM_{hrs} and $REM\%$)), training measures (strain (AU), average heart rate (HR) ($ExHR_{avg}$) and maximum exercising HR ($ExHR_{max}$)), and swimming performance (200yd time trial swim) during heavy training, preceding championship competition. Collection of sleep data was matched to days of training data collection, and also to the day preceding the performance swim. Pearson correlations were utilized to determine relationships between variables unless sex effects existed in which case linear regression analyses were utilized to control for sex differences in variables. In all swimmers, sleep duration is related to strain ($R = -0.78$; $p = 0.01$), and sleep debt is related to $ExHR_{avg}$ ($R = 0.53$; $p = 0.005$). SWS_{hrs} negatively is related to $ExHR_{avg}$ ($R = -0.42$; $p = 0.032$). Controlling for sex, sleep duration predicted swimming performance ($R^2 = 0.881$; $p < 0.001$), swimmers with greater sleep durations exhibited faster swim race times. Similarly, when controlling for sex, $SWS\%$ predicted swimming performance ($R^2 = 0.883$; $p < 0.001$), swimmers with greater $SWS\%$ exhibited faster times. Sleep quality measures were related to training adaptations and swimming performance was predicted by sleep quantity and quality. Athletes should obtain adequate sleep to support recovery and optimize training and performance.



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Tennis

Early sport specialization and intense training in junior tennis players: A sport-specific review. Sports Health, Ahead of Print: 1-6, 2025.

Context: Early sports participation can provide significant physical, psychosocial, and mental benefits for young athletes. Sports engagement can be via sport sampling or sport specialization. Sport specialization is often encouraged by parents and coaches as it is perceived as a mechanism for achieving elite level play, particularly in tennis.

Evidence acquisition: A search on PubMed, Google Scholar, and Science Direct was conducted for pertinent peer-reviewed studies on sport specialization and overuse injuries in youth athletics and junior tennis using key terms including "junior tennis," "youth sports," "sport specialization," and "overuse injury."

Study design: Clinical review.

Level of evidence: Level 5.

Results: Early sport specialization leads to increased injury risk, decreased athletic career longevity, and higher incidence of burnout without demonstrating significant benefits in terms of improving peak sports performance or the likelihood of reaching elite play.

Conclusion: Youth athletes should avoid specializing in a single sport before age 12, avoid training more hours per week than their age in years, and limit training to 16 hours per week maximum. Specific to tennis, junior players should be at least 12 years old for tournament play, compete in no more than 2 tournaments per month or 12 per year, engage in a maximum of 12 hours per week of organized tennis, a minimum of 2 hours per week of injury prevention training, and consider another off-season sport. Injury may be more likely with early sport specialization, early intense training (before middle or late adolescence) and annual match volume (>40 matches annually). Finally, we provide novel recommendations for safe volumes of training, matches, and tournaments for junior tennis players based on their age and level of play. Strength-of-Recommendation Taxonomy (SORT):B - recommendations based on inconsistent or limited-quality patient-oriented evidence.



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Tennis 10+ Warm-Up and Cool-Down Program: A 1-Year Longitudinal Analysis of Compliance and Injury Rates in Adult Recreational Tennis Players. Sports Health, Ahead of Print: 1-10, 2025.

Background: Injury prevalence among adult recreational tennis players may be >50%, involving injuries to upper extremity, lower extremity, and trunk. No standardized on-court warm-up/cool-down program has demonstrated improved compliance and injury reduction in this population.

Hypothesis: Compliance with the Tennis 10+ warm-up/cool-down program in adult recreational tennis players will improve over time. High compliance with Tennis 10+ will show reduced injury rates versus low compliance over the 1-year study period.

Study design: Longitudinal cohort study.

Level of evidence: Level 3.

Methods: Adult recreational tennis players actively participating in a tennis league and/or competitive tennis were included. Level of compliance by time, injury rate, injury type, sex, and age were assessed at baseline, and at 3, 6, 9, and 12 months. Association between variables was assessed by a 2-sample *t* test or chi-squared statistical test.

Results: A total of 317 adult recreational tennis players (age, 18-75 years [mean, 48]) completed enrollment. Compliance levels improved significantly over time ($P = 0.01$). Men ($P = 0.02$) and players aged 39 to 50 years ($P < 0.01$) showed a significantly higher level of compliance over time. There were no differences in injury rates between low and high compliance groups, except at 12 months, when high compliance was associated with a significant decrease in injury frequency and overuse injuries ($P = 0.01$).

Conclusion: Compliance with the Tennis 10+ warm-up/cool-down program improved from baseline, especially with men and people aged 39 to 50 years. High compliance with Tennis 10+ was not associated with lower overall injury rates, except lower overuse injury rates at 12 months.

Clinical relevance: Tennis 10+ can be implemented as an on-court method before and after tennis play to effectively reduce barriers to warm-up/cool-down in adult recreational tennis players. Further study is necessary to identify the significance of injury reduction with program compliance.



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Volleyball

Assessing the inter- & intra-reliability of a customised volleyball performance analysis system to analyse complexes and the efficacy of the associated skills. PLOS One, 20(11): e0337579, 2025.

Abstract - Within volleyball, performance analysis is employed to identify key performance indicators (KPIs) in relation to success. To date, however, despite the growth in performance analysis, there is little appreciation of the assessment, importance and reporting of reliability of individual variables. This study seeks to establish the inter and intra-reliability of a bespoke notational analysis system designed for assessing volleyball performance, considering complexes, position, skill, type of skill, and skill efficacy. To establish the inter-reliability, two coders analysed 9 matches, randomly selected from a pool of elite international matches. In addition, to establish the intra-reliability, the primary coder re-analysed one match per month over a nine-month data collection period. Cohen's Kappa (κ) were established for nominal data, whilst the values for skill efficacy were reported as a Weighted Kappa alongside an Inter-Class Correlation (ICC). Kappa and Weighted Kappa values for all data were shown to be above the acceptable thresholds ($\kappa=0.75$, $\kappa=0.60$, respectively). The present study demonstrates that it is plausible for a bespoke volleyball coding system, implementing a wide array of variables, to have high levels of inter- and intra-reliability. Findings highlight that it is possible for such a system to be utilised over a prolonged period of data collection.

Effect of lower-limb fatigue on kinematic variables during an unanticipated block among adolescent female volleyball players. BMC Sports Science, Medicine and Rehabilitation, 17: 349, 2025.

Background: Previous studies investigating the effects of muscle fatigue on lower limb kinematics in adolescent volleyball players have reported contradictory findings. Thus, the present study aimed to assess the effect of lower-limb fatigue on the kinematic variables during an unanticipated block among adolescent female volleyball players.

Methods: Given the inclusion criteria, 20 adolescent female volleyball players were selected through a convenience sampling method. In the pre-test stage, each subject performed an unanticipated single-leg jump-landing maneuver, the data of which were recorded by using a motion analyzer. Then, the intervention of a volleyball-specific lower-limb fatigue protocol was applied and the players were re-evaluated.

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Results: The results represented a significant decrease in knee and hip joint flexion, as well as a significant increase in ankle inversion at the initial contact after applying the fatigue protocol ($P \leq 0.05$). However, no significant difference was observed in terms of the other kinematic variables of the knee, ankle, and hip joints at the initial contact and landing peak ($P \geq 0.05$).

Conclusions: Reduced hip and knee flexion, along with increased ankle inversion, were identified as high risk movement strategies observed at initial contact. These findings suggest that fatigue may influence the proper kinematic pattern of lower-limb, leading to changes in movement control during landing and consequently increasing the risk of knee injuries in athletes.

Wrestling/Combat Sports

Upper extremity injuries in combat sports: A comparative analysis from US emergency departments. American Journal of Emergency Medicine, 99: 248-255, 2025.

Background: Combat sports continue to be popular recreational activities in the United States (US). Despite increasing popularity, relatively few studies have characterized patterns, types, and anatomic distributions of combat sport injuries requiring emergency medical care. This study provides updated descriptive epidemiology of upper extremity injuries sustained from combat sports presenting to US emergency departments.

Methods: The study analyzes retrospective data from a nationally representative database, the US Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS; years 2003-2022). A sample of $n = 12,619$ injuries met inclusion criteria and were included for analysis of injury types and injured body regions, effects of specific combat sport (wrestling, boxing, other martial arts), demographic variables (age, gender), reporting hospital type, and variation over time. Statistical methods included chi square tests, logistic regression analysis, and derivation of odds ratios.

Results: Wrestling accounted for 49.4 % of reported injuries, with boxing making up 26.2 %, and martial arts 24.4 %. Fractures (46.5 %) were the most common injury type, followed by strains/sprains (40.7 %) and then dislocations (12.7 %). Shoulders (28.0 %) were most commonly injured, followed by fingers (16.8 %) and hands (16.4 %). Age, gender, and reporting hospital type varied between sports.

Conclusions: This study demonstrates significant variability in pattern and location of injuries sustained from wrestling, boxing, and martial arts. By providing updated insight regarding upper extremity temporal trends and injury patterns in



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boxing, wrestling, and martial arts, this study may assist in efforts to continue advancing safety measures in a group of sports that continues to gain interest in the US, as well as improve the efficiency and effectiveness of care provided to these athletes by emergency medicine physicians.

The impact of recovery time on body mass variations, dietary intake, cognitive aspects, and performance in judo athletes engaging in rapid weight loss practices. Performance Enhancement & Health, 14: 100400, 2026.

Abstract - In 2017, the International Judo Federation (IJF) changed weigh-in rules, shifting the weigh-in to the day before competition and introducing random weigh-ins on competition day. However, the impact of these new rules remains unclear. This study compared the effects of these weigh-in procedures on body mass, nutritional intake, psychological aspects, and performance. Twenty-six judo athletes (night before weigh-in: $n = 13$; same day weigh-in: $n = 13$) were assessed for body mass, nutritional intake, psychological factors, and performance under two weigh-in conditions: the night before and in the same day of competition. No significant differences ($P > 0.05$) were found in the prevalence (77% vs. 75%) or magnitude (4.37% vs. 3.49 %) of rapid weight loss between the night before weigh-in group and the same day weigh-in group, respectively. However, the night weigh-in group presented a higher post-weigh-in energy intake (night weigh-in: 44.8 ± 11.1 kcal.kg⁻¹.day⁻¹ vs. same day weigh-in: 15.6 ± 10.4 kcal.kg⁻¹. day⁻¹) and carbohydrate intake (night weigh-in: 5.62 ± 1.38 g.kg⁻¹. day⁻¹ vs. same day weigh-in: 2.06 ± 1.40 g.kg⁻¹. day⁻¹) ($p < 0.001$). Additionally, the night weigh-in group exhibited higher response times in cognitive tasks at day +1 compared to day 10, in relation to the same day weigh-in group ($p = 0.025$; 95% CI diff = 1.79, 26.07), while technical performance did not differ between groups. These findings highlight the need for better nutrition management and awareness of the psychological risks associated with rapid weight loss practices in judo.

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