Performance Research Reviews

June 2025

Baseball

Chronic adaptations of the ulnar nerve in professional baseball pitchers. Journal of Athletic Training, Ahead of Print: 1-25, 2025.

Context: Screening programs to identify negative ulnar nerve adaptations in throwing athletes can help minimize injury risk and individualize treatment programs prior to the onset of symptoms. However, it is currently unclear how the ulnar nerve structurally adapts chronically in professional baseball pitchers.

Objective: To compare ulnar nerve ultrasound structural characteristics between the throwing (dominant) and non-throwing control (non-dominant) elbows in professional pitchers, with a secondary purpose of comparing ultrasound structural characteristics between subluxating and non-subluxating ulnar nerves.

Design: Cross-sectional study.

Setting: The beginning of the 2022 Minor League Baseball spring training of a single professional baseball organization.

Participants: All asymptomatic professional baseball pitchers from a single organization.

Main Outcome Measures: Bilateral elbow ultrasound examinations by a musculoskeletal radiologist for subsequent image quantification of ulnar nerve properties (echogenicity, area, circularity), as well as to identify ulnar nerve subluxation.

Results: Overall, 67 male professional baseball pitchers were enrolled. No significant bilateral differences in ulnar nerve cross-sectional area (dominant: 0.2 cm2 vs. non-dominant: 0.2 cm2, p=0.4), echogenicity (137 pixel intensity vs. 128 pixel intensity, p=0.07), or circularity (0.67 vs. 0.69, p=0.4) were observed. Ulnar nerve echogenicity was significantly lower in subluxating dominant ulnar nerves compared to non-subluxating dominant ulnar nerves (127 pixel intensity vs. 143 pixel intensity, p=0.006), while no significant differences in ulnar nerve area (0.2 mm2 vs. 0.2 mm2, p=0.1) or circularity (0.68 vs. 0.66, p=0.4) were observed between groups.

Conclusions: The ulnar nerve of the throwing elbow had similar cross-sectional area, echogenicity, and circularity compared to the non-dominant ulnar nerve. Nerve echogenicity was significantly decreased in subluxating ulnar nerves, however further research is necessary to determine why this difference exists and the potential direction of causality.

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Current definitions of return to play after medial ulnar collateral ligament injuries and surgery in professional baseball players prohibit cross-study comparison: A systematic review. Arthroscopy: The Journal of Arthroscopic and Related Surgery, Ahead of Print: 1-44, 2025.

Purpose: To assess the definitions of return to play (RTP) and return to same level of play (RTSP) used in literature describing ulnar collateral ligament (UCL) injuries in professional baseball players.

Methods: A systematic review was performed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. PubMed/MEDLINE, Embase, Web of Science, and Cochrane databases were queried to identify all articles that included UCL injuries between January 2002 and October 2022. Studies of only Major League Baseball (MLB) and Minor League Baseball (MiLB) players were included and summarized descriptively.

Results: We included 29 articles (24 reporting RTP, 23 reporting RTSP). Minimum level of play was not included in 46% of RTP definitions and 26% of RTSP definitions; when defined, return to MLB level only was most common in RTP definitions (25%) and return to either MLB or MiLB level was most common in RTSP definitions (39%). Time to return was frequently not included (96% of RTP and RTSP definitions); when defined, return within 2 full seasons after injury was the sole definition used. Duration of play after return was frequently not included (50% and 61%, respectively); when defined, a one game minimum was most used (42% and 17%, respectively). No study used performance measures (e.g., strikeouts, earned run average, etc.) to define RTP or RTSP.

Conclusions: Definitions of RTP and RTSP in the UCL injury literature for professional baseball players of all positions are vague, heterogenous, and prohibit cross-study comparison.

Clinical relevance: The present study investigates the definitions for RTP and RTSP used across professional baseball UCL injury literature in hopes of identifying common threads to promote future cross-study comparison.

Effects of dry cupping on exercise, autonomic activity and sleep in baseball players during preseason and in-season conditioning. PLOS ONE, 20(2): e0319479, 2025.

Background: Cupping therapy has been shown to alleviate muscle fatigue, sustain exercise capacity, enhance post-exercise recovery of autonomic activity, and improves sleep quality. However, variations in athletes' training intensity,

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competition pressure, and fatigue levels throughout a sports season remain underexplored. Few studies have investigated whether the health benefits of cupping differ across various phases of a sports season. This study aimed to examine the effects of short-term cupping on athletes during preseason conditioning (PSC) and in-season conditioning (ISC).

Methods: Forty university baseball players were recruited and randomly assigned to either the cupping (dry cupping at - 400 mmHg) or sham (dry cupping at - 100 mmHg) group. Cupping was applied to the upper back and shoulders for 15 minutes, twice a week for 8 consecutive weeks (4 weeks each during PSC and ISC).

Results: Cupping had no significant effect on upper-extremity function during either PSC or ISC. Exercise tests during PSC and ISC revealed no postintervention changes in peak power, peak oxygen consumption, or anaerobic threshold. However, cupping during PSC improved postexercise recovery of low-frequency power (LF; P = .013; a component of heart rate variability) and that during ISC improved recovery of the LF/high-frequency power ratio (P = .004) and LF% (P = .037). Additionally, cupping during PSC notably enhanced daytime function, as measured by the Pittsburgh sleep quality index (P = .026).

Conclusions: The benefits of cupping therapy vary between PSC and ISC. Cupping during PSC and ISC notably improved the postexercise recovery of autonomic and sympathetic activities, respectively. However, improvements in sleep quality were only observed during PSC.

Enhanced personalized prediction of baseball-related upper extremity injuries through novel features and explainable artificial intelligence. Journal of Sports Sciences, Ahead of Print: 1-10, 2025.

Abstract - Upper extremity injuries in baseball players demand advanced prevention. Our study analyzed clinical features using machine learning techniques to provide precise and individualized injury risk assessment and prediction. We recruited 98 baseball players and collected data on glenohumeral internal/external rotation, posterior capsule thickness, supraspinatus tendon thickness, acromiohumeral distance, and occupation ratio. Players were monitored for upper extremity injuries throughout a baseball season. We evaluated the predictive accuracy of these clinical variables using five models: Glenohumeral Internal Rotation Deficit (GIRD), Logistic Regression, Random Forest, CatBoost, and Support Vector Machine. SHapley Additive exPlanation (SHAP) analysis was used to clarify each feature's role in injury prediction. During the season, 28 players experienced injuries. CatBoost (accuracy: 0.70 ± 0.05; AUC: 0.66 ± 0.05) and

logistic regression (accuracy: 0.63 ± 0.07; AUC: 0.64 ± 0.08) excelled in bootstrapped evaluations and performed well in independent tests, with CatBoost maintaining an accuracy of 0.70 and an AUC of 0.62. Including GIRD had a negligible effect on CatBoost's accuracy. This integration with SHAP analyses enables a better understanding of each clinical feature's role in predicting injuries, laying the foundation for personalized injury prevention strategies. With these novel approaches, overall and individualized injury prediction can be enhanced, and future research in sports medicine can be advanced.

Linear and angular impulse generated by high school pitchers during fastballs and changeups. Journal of Biomechanics, 181: 112550, 2025.

Abstract - This study revealed how high school pitchers generated momenta during fastballs and changeups at a whole-body level. Baseball pitchers control ground reaction forces to generate whole-body momentum. Pitchers attempt to throw as fast and accurately as possible during fastballs but also need to throw off-speed pitches like changeups to deceive batters. To understand whole-body momenta generation in fastballs and changeups, this study aimed to determine (a) the roles of each leg in impulse generation in high school pitchers, (b) if these impulses differed between fastballs and changeups, and (c) if net impulses related to ball speed. Linear mixed models revealed that the back leg generated significantly more forward linear impulse ($p < 0.0001$) and more angular impulse about the leftward ($p < 0.0001$) and upward axes ($p < 0.0001$) than the lead leg in fastballs and changeups as a group and within each pitcher. However, when comparing fastballs and changeups, there were no significant differences in net forward linear impulse ($p = 0.71$) or net angular impulse about the leftward axis ($p = 0.42$) or about the upward axis ($p = 0.72$) at the group-level, despite significantly greater ball speeds during fastballs ($p < 0.0001$). This study did not detect any significant group-level associations between ball speed and net forward linear impulse ($p = 0.6$ for fastballs, $p = 0.81$ for changeups) or net angular impulse about leftward axis ($p = 0.52$ for fastballs, $p = 0.35$ for changeups) or about the upward axis ($p = 0.76$ for fastballs and changeups) during fastballs or changeups, though some participants exhibited trends between impulses and ball speed individually.

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Basketball

Cardiac screening findings and referral patterns in male African-American basketball players: Analysis of the HeartBytes Registry. The American Journal of Cardiology, 243: 73-80, 2025.

Abstract - Sudden cardiac death (SCD) is the leading medical cause of death in young athletes. Male African American basketball players (MABP) demonstrate particularly elevated risk for SCD. Despite increasing screening and preventative efforts, the incidence of SCD remains elevated in this population. This retrospective analysis of the HeartBytes National Youth Cardiac Registry (2015-2023) aimed to characterize cardiac screening findings, including symptoms, family history, physical exam, and electrocardiogram (ECG) abnormalities in MABP compared to other youth athletes undergoing cardiac screening. We secondarily examined referral patterns based on screening results between the two groups. Of 8,303 individuals screened, 200 MABP were identified. MABP were found to have higher rates of chest pain during exercise (10.0% vs. 4.8%, $p<0.001$), easily tiring with exercise (13.0% vs. 7.0%, $p=0.003$), and heart murmurs (8.9% vs. 4.4%, $p=0.008$) when compared to the rest of the population screened. ECG abnormalities, including T-wave inversions (4.0% vs. 0.8%, $p<0.001$), ST-segment depressions (0.5% vs. 0.05%, $p=0.01$), and nonspecific ST-T wave changes (2.0% vs. 0.4%, $p<0.001$), were more prevalent in MABP. However, positive screening rates leading to referral to a cardiologist were similar (3.5% vs. 3.2%, $p=0.842$) in MABP and the rest of the screened population. In conclusion, MABP exhibited higher rates of concerning cardiac screening findings compared to non-MABP, including symptoms, physical examination findings, and ECG abnormalities, highlighting the need for further investigation into optimizing screening strategies and determining appropriate follow-up in this high-risk group.

Changes in shooting accuracy among basketball players under fatigue: A systematic review and meta-analysis. Frontiers in Physiology, 16: 1435810, 2025.

Objective: To investigate the influence of physical and mental fatigue of different intensities (mild, moderate or severe) on basketball shooting accuracy, with the aim of informing more effective training protocols and competition strategies.

Methods: Literature searches were conducted on Web of Science, PubMed, and EBSCO databases up to 25 June 2024. Inclusion and exclusion criteria were specified, and data extraction sheets were prepared. Study quality was assessed by

using the Cochrane Risk of Bias Tool in Review Manager 5.4, and Stata18.0 software was used for heterogeneity analysis, subgroup analysis, forest plots, stratification analysis, and bias assessment.

Results: Moderate physical fatigue affected two-point shooting accuracy (P < 0.01), severe physical fatigue affected both two-point (P = 0.02) and three-point shooting accuracy (p < 0.01), with severe physical fatigue showing a greater detrimental impact on three-point shooting accuracy, while two-point shooting accuracy may vary under specific conditions. Additionally, adolescent athletes were less affected by severe physical fatigue compared to adult athletes or those with longer training experience. Moderate mental fatigue also significantly reduced free-throw accuracy (p < 0.01).

Conclusion: The shooting accuracy of basketball players was significantly affected by moderate and severe physical fatigue. Severe physical fatigue notably adversely affected the accuracy of three-point shooting relative to moderate fatigue; Additionally, moderate mental fatigue significantly reduced free-throw accuracy, which may be attributed to a decline in cognitive executive functions, highlighting the importance of fatigue management in sports training.

Does experience always make experts? Evaluating the influence of managerial experience on player selection outcomes in the NBA draft. Sport, Business and Management, 15(2): 105-120, 2025.

Purpose: We investigate whether/how various kinds of experience predict managers' selection outcomes.

Design/methodology/approach: Drawing from personnel selection and decision-making research, we used a multilevel model to examine whether various types of experience predict employee selection outcomes in the National Basketball Association. We examined 289 selection events of basketball players by 63 general managers. Measures of general manager experience included tenure, education level, family relations, experience as a college coach, experience as a National Basketball Association Player, experience as a National Basketball Association scout and experience as a National Basketball Association coach.

Findings: College coaching experience, tenure and vicarious experience through family relations improved selection decision outcomes, while experience as a basketball player reduced the quality of selection decision outcomes. Tenure was associated with general managers' ability to select employees who made high individual contribution to team wins; vicarious experience improved ability to select players with high peak individual performance, and college coaching

experience improved general managers' ability to select employees with higher contributions to team wins, higher peak individual performances and higher average performances over the course of players' careers.

Originality/value: Experience's importance is taken for granted, but this paper demonstrates that all experience is not equally effective. Notably, experience as a professional athlete did not seem to make managers better decision-makers about personnel than people who did not have that experience.

Effects of a warm-up injury prevention protocol on risk factors for anterior cruciate ligament injury in elite basketball players. Journal of Modern Rehabilitation, 19(2): 1-14, 2025.

Background: Athletes involved in sports requiring frequent cutting and pivoting movements are at increased risk of anterior cruciate ligament (ACL) injuries. This study investigates the effectiveness of neuromuscular warm-up exercises—including strength, balance, plyometric, and core stability training—in reducing ACL injury risk.

Methods: Thirty adolescent male basketball players (ages 13-18) were randomly assigned to either the control group (CON, n=15; age: 15.66 ± 1.7 years, height: 172.7 ± 9.6 cm, weight: 66.74 ± 11.2 kg) or the neuromuscular training (NMT) group (n=15; age: 14.73 ± 0.70 years, height: 174.0 ± 6.7 cm, weight: 64.79 ± 10.8 kg). The NMT group performed a structured injury prevention warm-up program three times a week for eight weeks before regular basketball training (20 minutes), while the CON group followed their usual basketball practice. Measurements of knee proprioception (including specific motion directions), knee valgus and flexion torque, trunk endurance via the Biering-Sorenson test, and isometric strength of various muscle groups were taken pre- and post-intervention.

Result: Significant improvements in isometric strength were observed in all assessed muscle groups in the NMT group (p < 0.05). However, no significant changes were found in knee valgus, flexion torque, trunk endurance, or knee proprioception (p > 0.05).

Conclusion: While the NMT protocol significantly improves isometric muscle strength in adolescent male basketball players, it does not show a direct effect on other ACL injury risk factors. Therefore, incorporating NMT into training routines may support strength development but should be combined with other targeted interventions to more effectively reduce ACL injury risk.

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Football

'Post-rehabilitation phase' in professional football: Are we optimizing player support after return to play? British Journal of Sports Medicine, Ahead of Print: 1-3, 2025.

Overview:

1. Return to Play (RTP) Decisions: The decision to allow a player to return to play is a balance between risk and reward. Early RTP can enhance team performance but also increases the risk of subsequent injuries.

2. Subsequent Injury: Previous injuries significantly increase the risk of future injuries. Subsequent injuries are a poorly researched area despite their high occurrence rates in professional football. Inadequate rehabilitation or premature RTP often lead to such injuries.

3. RTP Frameworks: Modern RTP frameworks emphasize a competency-based, evolving process rather than a single decision point. The frameworks include a multi-stage process from diagnosis to full RTP.

4. Post-Rehabilitation Phase: A proposed addition to existing RTP frameworks, this phase would run concurrently with final rehabilitation stages and focus on specific monitoring to mitigate subsequent injury risks. Tools like GPS data and neuromuscular diagnostics are suggested for better monitoring.

5. Future Directions: There is a need for more research to understand subsequent injury risks and develop specific monitoring and loading strategies. This research can help inform better rehabilitation practices across various sports.

This editorial underscores the importance of ongoing rehabilitation and monitoring to minimize injury risks after players return to play.

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Characterization of distal biceps tendon and triceps tendon injuries in National Football League players from 2009 to 2022. Journal of Orthopaedics, 68: 20-26, 2025.

Purpose: The purpose of this study is to determine the incidence and impact of distal biceps and triceps tendon injuries in the National Football League (NFL) from the 2009-10 to the 2022-23 seasons. This study explores the impact that player and injury characteristics have on injury risk, return-to-play, and player performance.

Methods: Data from the 2009-10 to the 2022-23 NFL seasons were analyzed for players with distal biceps or triceps tendon tears. Return-to-play (RTP) and performance metrics were recorded for each player during the season before and first two post-injury seasons. Data were analyzed to determine statistically significant differences in proportions using chi-square, Fisher's exact, or McNemar tests. Statistical significance was set at $p < 0.05$.

Results: Fifty tendon ruptures (26 biceps, 24 triceps) were identified. Biceps injuries were more common in defensive players (73.1 %), while triceps injuries predominantly affected offensive players (58.3 %). Significant risk factors for biceps injuries included BMI ≥31 ($p = 0.0008$) and ≥4 seasons of experience ($p = 0.031$, OR = 2.7). Triceps injuries were associated with BMI ≥31 ($p = 0.01$), age ≥26 ($p < 0.0001$), and ≥4 seasons of experience ($p = 0.006$). RTP rates were 73.1 % for biceps and 70.8 % for triceps injuries. However, only 52.6 % and 41.2 % of players with biceps and triceps injuries, respectively, returned to pre-injury performance levels. Younger players (<26 years) and those with fewer years of experience (≤4 years) were more likely to achieve prior performance levels.

Conclusion: Distal biceps and triceps tendon injuries are typically season-ending for NFL players. Significant risk factors include BMI ≥31, ≥4 years of NFL experience, and game exposure, with age ≥26 being an additional risk factor for triceps tendon injuries. RTP rates exceed 70 %, indicating a strong potential for athletes to return to the NFL post-injury.

Does accumulated physical load in different time windows affect hamstring injuries in elite football players? Research in Sports Medicine, Ahead of Print: 1-14, 2025.

Background: This study aims to investigate how accumulated training load over different time windows (7, 14, and 28 days) influences the incidence of hamstring injuries in elite football players.

Methods: A descriptive and longitudinal study was developed in 343 players in three teams (2nd Team, U-19 team, and U-18 team) from the academy of an elite football club in Spanish La Liga that also competed in the Union of European

Football Associations Champions League during four seasons, from 2017/18 to 2020/21. External load variables (total distance, high-speed running, accelerations, etc.) for training and competition have been studied considering the volume variables during three different time windows along the different seasons (7 days, 14 days, and 28 days).

Results: Results did not show differences in the shortest time windows (7- and 14-week periods), showing that strength and conditioning coaches should analyze longer periods of time and compare them to previous periods with the same length in order to improve workload management and reduce injury risk.

Conclusions: It is important consider the accumulated load (chronic) in periods of 28 days to avoid an increase that generates a hamstring injury. The control of the training load in blocks of 28- day time windows seem essential to minimize the injury rate in football players.

Effect of sleep duration and concussion history on neurocognitive testing symptoms for post-injury states. Clinical Journal of Sport Medicine, Ahead of Print: 1-7, 2024.

Objective: Evaluate the influence of sleep duration and concussion history on postconcussion symptoms in adolescent athletes.

Design: Observational retrospective study using the Immediate Post-Concussion Assessment and Cognitive Testing and Post-Concussion Symptom Scale (PCSS). Multivariable linear regression assessed sleep hours against 22 PCSS symptoms, controlling for demographic and health variables.

Setting: Urban concussion centers in Colorado and Florida, 2009 to 2019.

Participants: 11 564 student-athletes aged 12 to 22, categorized by concussion history.

Interventions: Analysis of sleep duration and concussion history in relation to neurocognitive and psychiatric symptom severity.

Main outcome measures: Primary outcomes included neurocognitive, psychiatric, and total symptom scores. Secondary outcomes were specific PCSS symptoms.

Results: Among 5349 student-athletes, 2671 (49.9%) had no prior concussions and 2678 (50.1%) had 1 or more. For those without prior concussions, sleep was negatively associated with age (β = -0.18, 95% confidence interval [CI], -0.22

to -0.13, P < 0.0001), vomiting (β = -0.22, 95% CI, -0.38 to -0.05, P = 0.012), and difficulty concentrating (β = -0.11, 95% CI, -0.19 to -0.35, P = 0.005). In athletes with a history of concussion, less sleep correlated with decreased age (β = -0.11, 95% CI, -0.14 to -0.07, P < 0.0001), headache (β = -0.065, 95% CI, -0.12 to -0.01, P = 0.031), irritability (β = -0.08, 95% CI, -0.15 to -0.01, P = 0.021), and difficulty concentrating (β = -0.08, 95% CI, -0.15 to -0.01, P = 0.031) but increased sensitivity to light (β = 0.10, 95% CI, 0.001-0.137, P = 0.048), numbness/tingling (β = 0.15, 95% CI, 0.04-0.26, P = 0.008), and feeling slowed down (β = 0.13, 95% CI, 0.05-0.21, P = 0.001).

Conclusion: Sleep duration and concussion history are associated with variations in postconcussion symptom severity among adolescent athletes. This data underscores the need for individualized management strategies based on sleep patterns and concussion history.

Head in the game: The impact of cognitive abilities on performance of National Football League quarterbacks. Frontiers in Psychology, 16:1540498, 2025.

Abstract - American football is a multi-billion-dollar industry and source of social identity and national pride. Recruiting top level players is a priority for franchises, coaches, teams, and fans. Utilizing data obtained from 42 National League Football (NFL) quarterbacks, collected at their respective Combine experience, the current study adds to existing research demonstrating that cognitive abilities, as measured by the Athletic Intelligence Quotient (AIQ), namely Visual Spatial Processing, Reaction Time, and Decision Making, all increase the predictive accuracy beyond the role of draft pick at the Combine. Reaction Time; Visual Spatial Processing and Decision Making to a lesser, but notable degree; predicted NFL performance metrics such as Career Approximate Value, Quarterback Rating, passing and rushing yards per game, turnover worthy plays, and throwing accuracy. The role of cognitive abilities, particularly in the critical position of quarterback in American football, is discussed.

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Gymnastics

Prevalence and physical features associated with tendon, bone, and joint pain in young artistic, acrobatic, and rhythmic female gymnasts. Physical Therapy in Sport, 74(5): 39-50, 2025.

Objectives: To evaluate the prevalence of tendon, bone, and joint pain, and to examine the physical features associated with pain, in young artistic, acrobatic, and rhythmic female gymnasts.

Design: Cross-sectional.

Participants: 274 gymnasts, aged 9-16 years.

Main outcome: All gymnasts were clinically assessed for joint, bone, and tendon pain and for training-impact, anthropometric-measures, bone-properties, muscle-strength, and joint range-of-motion (ROM).

Results: Pain was identified in 69.7 % of the participants. Artistic gymnasts suffered a higher prevalence of tendon and bone pain compared to rhythmic gymnasts ($p = 0.011$ and $p = 0.005$, respectively). Logistic-regression showed that greater BMI% and lower plantar-flexor strength were associated with tendon pain; greater BMI%, increased age, menarche, reduced tibial-strength, and reduced muscle strength with bone pain; and, increased age, reduced muscle strength and increased ROM with joint pain ($p < 0.05$). A reduced risk of tendon and joint pain was found in rhythmic and acrobatic gymnasts compared to artistic gymnasts, and reduced risk of bone pain when practicing rhythmic gymnastics compared to artistic gymnastics ($p < 0.05$).

Conclusions: Young female gymnasts are at a high risk of developing pain during training. Physical features are specific to pain categories and to gymnastics disciplines. Clinically, young gymnasts should be routinely screened for physical features and for injuries.

Gymnastics Medicine: A new subspeciality in sports medicine. Current Sports Medicine Reports, 24(5): 126-134, 2025.

Abstract - Despite popularity of gymnastics, there is no independent medical organization/subspecialty group to investigate injuries and prevention, and to make the sport safer for all. Thus, a new sports medicine subspecialty is

proposed: Gymnastics Medicine. Gymnastics injury rates are higher compared to other sports. Common injuries occurring in gymnastics include gymnast wrist, grip lock, osteochondritis dissecans of the elbow, knee, and ankle, shoulder overuse injuries, mechanical low back pain, spondylolysis, pelvic apophysitis, anterior cruciate ligament tears, ankle instability/ankle sprains, symptomatic accessory navicular, os trigonum/posterior ankle impingement, and calcaneal apophysitis. Gymnastics Medicine will help medical clinicians understand injury patterns, return to play protocols, nutritional needs, and the mental aspects of gymnastics. Gymnastics Medicine is a needed subspecialty. There are many medical subspecialties involved with the care of gymnasts who would benefit from a concentrated field, and this field allows those clinicians to collaborate, enhance research, and most importantly, improve the safety and health of athletes in gymnastics.

Golf

Anthropometric and strength characteristics of adolescent golfers with low and high handicaps. PLOS ONE, 20(5): e0324065.

Background: The athletic performance of adolescent golfers is influenced by various factors, among which strength qualities and anthropometric characteristics are key. However, current research on these aspects among adolescent golfers with different handicaps remains limited.

Objective: This study aimed to examine anthropometric and strength characteristics in adolescent golfers of differing handicaps and to explore their relationship with golf performance (handicap).

Methods: This cross-sectional study recruited 40 adolescent golfers (25 males, 15 females) via convenience sampling, divided into low (n = 20) and high (n = 20) handicap groups. Sample size was determined by a priori power analysis. Anthropometric measures (height, shoulder width, hip, thigh, calf circumferences) and standardized strength tests (grip strength, medicine ball throws, standing long jump, countermovement jump) were assessed. Group differences were analyzed via independent t-tests, and correlations between handicap and strength metrics were analyzed using Pearson's correlation ($p < 0.05$).

Results: Golfers with low handicaps demonstrated significantly greater shoulder width ($p = 0.033$), hip, thigh, and calf circumferences ($p < 0.01$), and performed better in all strength tests ($p < 0.01$). Pearson correlation analysis indicated significant negative correlations between handicap and multiple strength metrics (r ranging from -0.324 to -0.556, $p < 0.05$). Multiple regression analysis showed that strength variables explained approximately 60% of handicap variance. No gender comparisons were conducted.

Conclusion: Anthropometric advantages and higher strength/explosive power are associated with better performance (lower handicap) in adolescent golfers. It is recommended that training programs for adolescent golfers emphasize strength and explosive power development to improve competitive performance.

The Yips: An investigation of the causes and treatments in the context of golf. Frontiers in Sports and Active Living, 7: 1563370, 2025.

Aim: When a skill is lost, this can impact a person's career and psychological wellbeing. As this is the case with the yips, preventing, treating, and curing them is important. This study was prompted by the limited information available on the yips, specifically regarding etiologies. The intent of this study was to utilize surveys with both a medical review of systems and psychological questioning to identify commonalities in afflicted players. This could then provide considerations of the causes and guide future research.

Methods: The study recruited experienced golfers for in-person surveys and stroke demonstrations from January 26, 2019 to March 28, 2020. The analyses included statistical methods and discussion. These methods included Yates' chi-squared test and Fisher's exact test targeted toward smaller sample sizes.

Results: Finding participants was difficult and resulted in a small sample size (n = 14). The study had 4 participants with the yips and 10 controls. Statistical methods for small sample sizes found few associations. However, Fisher's exact test showed negative associations between the yips and sore throats (p = 0.0050), fever (p = 0.0150), and physical trauma (p = 0.0150). Yates' chi-squared test also found significance for fever (p = 0.0328), sore throat (p = 0.0105), and physical trauma (p = 0.0328). Qualitative data were also highlighted in the study, including tabulating the treatments tried and the outcomes of the participants.

Conclusion: The yips cause problems, especially for those who have invested significant time into perfecting a skill. Continued research is warranted to elucidate the causes and effective treatments.

Performance Research Reviews

Hockey

Contribution of psychological characteristics to talent identification in ice-hockey. International Journal of Sports Science & Coaching, 30(2): 724-741, 2025.

Abstract - Talent identification and selection are crucial for the success of elite sport organizations. Scouts and managers generally select the most promising young athletes based on their current performances, physiological characteristics, and gut feelings. However, psychological characteristics (including perceptual-cognitive and self-regulation abilities) might still be overlooked by selectors. This study aimed at verifying the relationship between psychological characteristics and performance in elite ice-hockey. Eighty-eight youth elite ice-hockey players (forwards and defensemen) eligible for a Major Junior selection draft participated in the study. They were measured at 15 years old on perceptual-cognitive skills (decision-making and anticipation with eye-tracking at a temporal occlusion task) and self-regulated learning abilities (self-reported questionnaire). In addition, their current (draft rank and scouts' subjective appreciation) and future (points, games played, differential for the following four years) performances were recorded. Multiple linear regression models showed that the scouts' subjective appreciation was the best predictor of current and future performance. However, when scouts' appreciation is removed from the models or when positions are analyzed separately, self-regulated learning abilities (effort, planning and reflection subscales) and decision-making could add to the prediction. Overall, this study shows that psychological characteristics could help scouts in the talent identification and selection process, but measuring these characteristics cannot replace their judgment.

Impedance spectroscopy measures of whole and segmental skeletal muscle quantity associated with strength and power in collegiate ice hockey players. Journal of Strength and Conditioning Research, 39(2): 242-248, 2025.

Abstract - Bioelectrical impedance spectroscopy (BIS) is a promising monitoring tool for body water compartment assessment, particularly intracellular water (ICW), in which acute decreases are associated with increased muscle damage and reduced function, and chronic changes are associated with muscle quantity. Because little is known about the predictive utility of BIS-derived measures in athletes, this study aimed to assess the association between whole-body and segmental compartment water measured by BIS and maximal-intensity exercise performance in athletes. Twenty-five National Collegiate Athletic Association Division I collegiate hockey players completed 2 consecutive testing

sessions. Body water and composition were assessed using a SOZO BIS device. Strength and explosive strength were measured on a force platform during the isometric belt squat and squat jump, respectively. Peak power was assessed using the 6-Second Test on a Wattbike. Pearson's r and partial correlation were used to assess relationships. Select body water and composition BIS variables were strong correlates of strength (r = 0.51-0.63, p < 0.05), moderate correlates of power (r = 0.41-0.44, p < 0.05), and lacked association with explosive strength. Segmental leg variables tended to be the strongest correlates of strength and power. Body water and traditional lean mass variables expressed similar predictive utility. Intracellular water/extracellular water lacked associated with exercise performance in bivariate and adjusted models. We provide evidence of the criterion validity of whole-body (i.e., ICW, fat-free mass, skeletal muscle mass [SMM]) and segmental (i.e., leg ICW, leg SMM) BIS variables, related to the quantity of SMM, to predict body-size dependent maximal-intensity exercise performance. Practitioners can use this information to determine which variables to track for performance readiness monitoring.

Lacrosse/Field Hockey

Epidemiology of upper extremity lacrosse injuries presenting to the United States emergency departments during 2014-2023. Journal of Hand and Microsurgery, 17(4): 100281, 2025.

Background: The epidemiology of upper extremity injuries presenting to emergency departments in the USA is not well studied. The purpose of this investigation was to estimate the incidence rates of upper extremity injuries presenting to emergency departments.

Methods: The National Electronic Injury Surveillance System (NEISS)—a database of emergency department visits based on a sample of hospitals selected and weighted to represent the entire US population in order to allow estimates of overall incidence—was queried for all upper extremity injuries presenting to US emergency departments in 2009. Injury types were analyzed for each region of the upper extremity, and incidence rates were calculated based on population estimates from the US Census.

Results: A query of the NEISS resulted in 92,601 records of upper extremity injury treated at an emergency department in the USA in 2009, which translates to an estimated total of 3,468,996 such injuries that year. This corresponds to an incidence of 1,130 upper extremity injuries per 100,000 persons per year. The most common region injured was the finger (38.4%). The most common upper extremity injury was a fracture (29.2%). Specific injuries with high incidence rates (all per 100,000 per year) included finger lacerations (221), wrist fractures (72), finger fractures (68), and lower arm fractures (64). Home is the most common setting for an upper extremity injury.

Conclusions: The NEISS provides estimates of the incidences of upper extremity injuries that may be useful for public health initiatives.

The influence of substitution strategies on the physical match performance of elite female field hockey players. International Journal of Performance Analysis in Sport, 25(1): 162-173, 2025.

Abstract - The study aims were to i) compare movement demands of different substitution strategies for each position in elite female field hockey and ii) compare the effect substitutions had on match intensities post-substitution. During 19 international matches, movement data from 26 international players were collected. Substitution strategies were categorized into 5-min, 7.5-min, 10-min, at random intervals and full quarter play. Small reductions in work-rate were found from quarter 1 to 4 across positions despite running intensities not differing between quarters. Work-rate was greater for starting players during the opening minute and was also higher when compared to players coming off the bench. However, players coming off the bench had higher running intensities during this first minute with higher work-rates after minute two compared to the quarter average. Small differences in work-rate were found between substitution strategies for strikers and midfielders, with no differences in intensity for any position. In conclusion, a decrease in work-rate during the match suggests fatigue, but because intensity was maintained throughout, pacing strategies could be present. Although the substitution strategy utilized did not produce substantial results, the "first-minute-rush-effect" was confirmed as players coming off the bench were able to match and, in some cases, increase the work-rate.

Soccer

Impact of a congested schedule and player participation on the external workload of top-level soccer players during a competitive season. International Journal of Performance Analysis in Sports, Ahead of Print: 1-14, 2025.

Abstract - This study investigated differences in external workload between non-congested and congested weeks among professional Brazilian male soccer players, considering their participation in the previous match. Thirty-six players from the same team were divided into four groups based on their playing time: G1 (>80 min in non-congested and >110 min in congested), G2 (45–80 min in non-congested and 50–110 min in congested), G3 (1–45 min in non-congested and 1–50

min in congested), and G4 (0 min in both non-congested and congested). Weekly workload was measured using Global Positioning System (GPS) devices, tracking metrics such as total distance (TD), high-speed running (HSR), sprint distance (SR), number of sprints, acceleration (ACC), and deceleration (DEC) actions. G1 players showed high external workload during congested weeks. G3 and G4 players exhibited lower distances at high intensity and recorded more ACC but fewer DEC actions in both types of weeks. These findings indicate the need of reevaluating compensatory strategies for G3 and G4 players to manage match demands better. Moreover, specific recovery strategies and proper periodization are crucial during congested weeks to mitigate fatigue and reduce injury risks for G1 players.

Needs analysis and force-velocity profiling: An individualized four-week program for improving soccer performance. International Journal of Physical Education, Sports and Health, 12(1): 153-161, 2025.

Abstract - This study investigates the application of force-velocity (FV) profiling in soccer athletes, particularly focusing on its role in identifying performance deficits and designing individualized training interventions. The research begins by introducing athlete profiling, detailing its utility in evaluating an athlete's physical, biomechanical, and physiological attributes to establish baseline metrics. FV profiling is explored as a precise tool for assessing mechanical determinants such as maximal force (F_o), maximal velocity (V_o), and maximal power (Pmax) about the Squat Jump test. Needs analysis is conducted before the test to contextualize the athlete's current physical demands, injury risks, and biomechanical movement patterns, supported by case-specific metrics for aerobic and anaerobic capacities. The second part of the research highlights how imbalances in the FV profile can hinder athletic performance, emphasizing the necessity of individualized training programs to address these weaknesses. Using data from a squat jump test performed with varying loads (0%, 20%, 40%, and 60% body weight), the athlete's FV profile is analyzed. The results reveal a velocity-oriented imbalance, prompting a four-week tailored training program focusing on plyometrics, velocity-based resistance training, and progressive overload to improve the athlete's velocity, force production, and power output. This study demonstrates the efficacy of FV profiling as a cornerstone for performance optimization in soccer.

Performance Research Reviews

Deceleration profiles of elite American soccer players obtained from change of direction tests with different approach speeds. Sport Performance & Science Reports, 4: 243, 2024.

This study, conducted by researchers from the United States Soccer Federation and other institutions, investigates the deceleration abilities of elite American soccer players during change of direction (COD) tests with varying approach distances (10-0-5, 20-0-5, and 30-0-5 meters). The aim was to analyze horizontal deceleration profiles and their sub-phases (early and late deceleration) to understand how players perform under different speed conditions and to identify individual variations in deceleration capabilities.

Key Methods and Metrics:

- **COD Tests**: Players performed 10-0-5, 20-0-5, and 30-0-5 tests, which involve sprinting to a point, decelerating to a stop, and changing direction.

- **Deceleration Metrics**:

    o **Average Deceleration**: Calculated as the difference between maximum and minimum speed before COD divided by time-to-stop (measured in $m \cdot s^{-2}$).

    o **Early Deceleration**: Speed reduction from maximum to 50% of maximum speed.

    o **Late Deceleration**: Speed reduction from 50% of maximum speed to stop.

- **Analysis**: The average of left and right foot performance was used. Correlations between deceleration phases were assessed using Hopkins' scale (trivial to almost perfect). Z-scores and Total Deceleration Scores (TDS) were calculated to evaluate overall deceleration performance.

- **Data Visualization**: Quadrant plots showed average deceleration versus peak speed for each test, and z-scores highlighted above- and below-average performers.

Key Findings:

- **Deceleration Performance**:

    o Average deceleration was similar across all tests ($\sim$ -5.03 to -5.36 $m \cdot s^{-2}$), indicating consistent deceleration demands regardless of approach distance.

- o Early deceleration showed lower magnitudes (~ -4.20 to -4.73 m·s⁻²) compared to late deceleration, suggesting different braking strategies.

- **Individual Variations**: Some players excelled in specific tests but not others, indicating distinct deceleration demands due to varying peak speeds and biomechanical requirements. For example, a player might perform well in the 10-0-5 test (lower speed) but struggle in the 30-0-5 test (higher speed).

- **Correlations**:

  - o Large correlations were found within tests (e.g., between average and late deceleration in 10-0-5 and 20-0-5 tests).

  - o Across tests, correlations were mostly small to moderate (e.g., 0.55 between 20-0-5 and 30-0-5 average deceleration), suggesting test-specific deceleration abilities.

- **Braking Strategies**: Players with a deceleration ratio >1 (greater early deceleration than late) demonstrated varied braking strategies, highlighting individual differences in technique.

- **Peak Speed and Deceleration**: Higher peak speeds in shorter tests (10-0-5, 20-0-5) did not necessarily correlate with better deceleration, emphasizing that deceleration is a distinct skill.

Implications and Recommendations:

- **Training**: The study underscores the need for individualized training to enhance deceleration, as players show varied profiles. The Braking Performance Framework (Harper et al., 2024) is recommended for integrating physical, technical, and tactical training to improve horizontal deceleration.

- **Performance Impact**: Effective deceleration is critical for successful play execution in soccer, as it affects a player's ability to stop and change direction quickly.

- **Limitations**: The study notes a limited sample size (elite team squad) and did not explore differences between preferred and non-preferred legs, which could be a focus for future research.

Conclusion: The research highlights that deceleration in elite soccer players varies by test and individual, driven by differences in approach speed and braking strategies. Coaches and performance practitioners should use these insights to tailor training programs, focusing on specific deceleration demands to optimize player performance and reduce injury risk during high-intensity COD movements.

Performance Research Reviews

Associations between internal and external training load measures and neuromuscular performance in elite soccer players. Sport Sciences for Health, Ahead of Print: 1-8, 2025.

Abstract - The study investigates the relationship between internal and external training load and neuromuscular performance in elite soccer players. Twenty-eight professional players from a squad across a season participated. Players performed a countermovement jump as a measure of neuromuscular performance, with tests conducted the day before a game. Training load data were aggregated over 7-, 14-, and 28-day periods to assess their relationship with performance metrics, including reactive strength index modified (RSI-mod), time to take off, and jump height. Internal load was measured using session ratings of perceived exertion, while external load was analyzed with 10 Hz GPS units. External load measures included total distance, high-speed running, sprint distance, and accelerations and decelerations. In the 7-day window, total distance (ES = 0.03) and acceleration (ES = 0.04) showed a weak positive relationship with performance metrics. In the 14-day window, RSI-mod and time to take off significantly interacted with internal load (ES = 1.54) and high-speed running (ES = 1.44). For the 28-day window, jump height was strongly associated with sprint distance (ES = 1.86). Practitioners should use a multi-metric approach with measures of NMP and should evaluate both outcome and strategy metrics within a force–time curve, to gain a deeper understanding of their athletes.

Softball

Applicability of observational standards for softball throwing to handball overhand throwing movements. Journal of Physical Education and Sport, 25(1): 103-109, 2025.

Abstract - Overhand throwing is a fundamental movement that is commonly used to assess basic physical fitness in Japan. Observational evaluation standards have been developed to evaluate, improve, and enhance overhand throwing technique and performance. However, these standards are primarily designed for hand-sized objects such as softballs or tennis balls, and there are no established standards specifically for throwing larger objects, such as handballs. This study investigated whether the key factors of observational movement evaluations are consistent or different when comparing overhand throws of a handball, which is larger than a hand, to those of a softball, which is smaller. The 40 male college students who participated performed handball throwing with maximum effort twice. The farthest throwing distance of the two trials was used for analysis. Participants' motions were recorded by two video cameras and observationally evaluated by four different researchers using established softball standards. Each movement was evaluated on a three-point scale (3, excellent; 2, fair; 1, poor). To determine the impact of each movement on the throw, stepwise multiple regression analysis was conducted, with the throw as the dependent variable and the evaluation results for each movement as independent variables. The kinematic chain of the throwing arm, leading action of the free

arm, and trunk tilt were crucial to the outcome and remained fundamental to effective handball throwing, just as they are in softball throwing. In contrast, the relation between the shoulder and elbow, backswing action, trunk twist, trunk direction, step length, and shifts in body weight were less important for handball throwing, likely due to the ball's diameter and mass. These findings highlight the importance of developing specific observation evaluation standards tailored to overhand throw movements using a large ball.

Predicting injury in collegiate baseball and softball athletes using functional testing: A pilot study. Muscles, 4: 10, 2025.

Abstract - Non-contact injuries are common in collegiate throwing athletes. Identifying musculoskeletal issues that predispose athletes to injuries would be valuable for reducing the associated risk. The purpose of this pilot study was to use binomial logistic regression to identify injury-prone athletes with multiple pre-season functional measures and demographic information. Eighteen Division II baseball and softball athletes underwent pre-season functional testing including measures of manual muscle testing of the dominant shoulder muscles (MMT), the functional movement screen (FMS), and closed kinetic chain upper extremity stability (CKCUES). A certified athletic trainer at the university diagnosed and documented the injuries that these athletes sustained over the course of the season. Binomial logistic regression models were used to assess the effects of FMS composite score, CKCUES normative score, MMT scores, and demographic information on the likelihood that participants would sustain (a) any type of injury and (b) a shoulder injury during the competitive season. The model for injury was not significant (p = 0.822), correctly classifying 72.2% of cases. The model for shoulder injury was significant (p = 0.039) and correctly classified 100% of cases. These results suggest that shoulder injury incidence may potentially be predicted using sport-specific movement tests in baseball and softball athletes. A larger sample size is needed to verify these results in the future.

Swimming

Validity and reliability of 2D video analysis for swimming kick start kinematics. Journal of Functional Morphology and Kinesiology, 10: 184, 2025.

Background: Objective evaluation of the swimming start is crucial for sprint performance improvement. Traditional visual assessment of its phases—reaction, take-off, flight, and underwater glide—lacks precision. This study addresses the need for more integrated and accessible biomechanical tools by validating IQ LAB software (Version 250319), which

is embedded in the SwimPro system and enables immediate video-based motion analysis without external processing. Existing tools like Dartfish (ProSuite 4.0) require separate video handling and licensing, whereas IQ LAB offers a built-in, streamlined solution suitable for applied environments.

Methods: We evaluated the concurrent validity of the IQ LAB software, a desktop 2D motion analysis tool, using Dartfish (ProSuite 4.0) as the gold standard. The reliability was assessed using intrarater temporal stability and interrater agreement, considering selected kinematic parameters related to the swimming kick start (to 5 m). A sample of 13 competitive male swimmers (age 17.2 ± 1.1 years) was analyzed across two sessions. Concurrent validity was assessed by comparing IQ LAB outputs to those from Dartfish software in the sagittal plane. Intrarater reliability was measured using a test–retest design across two sessions spaced 7 days apart. Interrater reliability involved two independent raters analyzing the same video data using IQ LAB.

Results: IQ LAB and Dartfish kinematic parameters demonstrated strong agreement (Pearson r ≥ 0.95), with no significant systematic differences. The intrarater and interrater reliability were excellent (ICC ≥ 0.94, 95% CI included). The test–retest reliability of the selected parameters across seasons also showed excellent reproducibility (ICC ≥ 0.93).

Conclusions: IQ LAB software provides a valid and reliable 2D kinematic assessment of the swimming kick start, offering a practical and accessible tool for coaches and researchers. This study introduces a novel validated software solution for biomechanical analysis in swimming starts.

Longitudinal monitoring of load-velocity variables in preferred-stroke and front-crawl with national and international swimmers. Frontiers in Sports and Active Living, 7: 1585319, 2025.

Abstract - Load-velocity (LV) profiling in swimming provides key metrics, including theoretical maximal velocity (V_0) and theoretical maximal load (L_0); however, longitudinal studies tracking these variables across competitive seasons are limited. This study investigated LV profiling and competition performance in national and international-level swimmers (Level 1-3) over a 15-month period. Twenty-six swimmers participated (16 males: age: 19.8 ± 3.9 years, body mass: 80.3 ± 7.9 kg, height: 1.84 ± 0.07 m; 10 females: age: 20.7 ± 3.6 years, body mass: 68.2 ± 5.7 kg, height: 1.74 ± 0.03 m), all specializing in 50-200 m events. Swimmers completed 4-6 testing sessions, each involving 3 × 10 m sprints against resistances of 1, 5, and 9 kg (males) and 1, 3, and 5 kg (females), in both front-crawl and their preferred-stroke. Linear mixed-effects models assessed changes in LV outputs-V_0, L_0 (absolute and relative to body mass), relative slope (-

V_0/rL_0), and active drag (AD). Smallest worthwhile change (SWC) assessed within-athlete variation, while Pearson's correlations evaluated relationships between race performance and LV outputs. Analysis of preferred-stroke found males exhibited significantly higher values across all variables except the slope (p = 0.607). National-level swimmers had lower L_0 (-2.8 kg, p = 0.019), but no statistical difference in rL_0 (-1.5%, p = 0.244) or slope (-0.002 m/s/%, p = 0.558). AD remained stable across observations, though males produced greater drag (+30.2 N, p < 0.001), while national-level swimmers produced less (-12.8 N, p = 0.045). Analysis of front-crawl performance found males presented higher values across all variables (p ≤ 0.05) while national-level swimmers were lower (p < 0.005). SWC analysis revealed that most within-athlete changes in V_0 and L_0 were trivial or unclear, with only isolated meaningful changes observed. Large to very large correlations existed between race performance and L_0 (r = 0.67, p < 0.05), V_0 (r = 0.73, p < 0.05), and AD (r = 0.58-0.7, p < 0.05) at select observations. These findings highlight the stability of LV profiling metrics over time while reinforcing their relevance in distinguishing between performance levels. This suggests their potential utility in talent identification and informing training prescription.

Tennis

The differences of muscle activation in forehand serve-receiving technique of male tennis players at different skills. PLOS ONE, 20(5): e0323646, 2025.

Abstract - The purpose of this study was to analyze differences in muscle activation of the right upper limb and part of the trunk and differences in stroke performance of forehand receiving in male tennis players of different levels of performance at different serve speeds. Thirty male tennis players (no difference in age, height, weight) were divided into senior (AG, n=15) and intermediate (IG, n=15) groups to perform 6 forehands receive tests at 2 serve speeds: low-speed serve (130-140km/h), high-speed serve (160-170km/h). Muscle activity from the right of biceps brachii (BB), triceps brachii (TB), brachioradialis (BC), deltoid (DT), trapezius (TP), pectoralis major (PM), obliquus externus abdominis (OEA) and latissimus dorsi (LD) were recorded using surface electromyography during the concentric phase of the lift and expressed as a percentage of each muscle's maximal activity, recorded during a maximal isometric contraction. Returned speed and placement were recorded using a high-speed camera. The results showed that the AG had significantly lower muscle activity (p < 0.05) in the backswing, impart, follow-through phases of the receive and more consistent dominant muscles in all phases, while the opposite was true for the IG. At both serve speeds, AG had significantly faster ball speeds (p < 0.05) and higher placement scores (p < 0.05) compared to IG. It is important to develop the athlete's receive action at lower muscle activation and higher joint kinetic energy, which may be an important way to improve receive performance in a short period.

Performance Research Reviews

Impact of mental fatigue on tennis players' attention and groundstroke performance. Frontiers in Psychology, 16: 1544785, 2025.

Objectives: This study aimed to determine the effects of mental fatigue on attention and groundstroke targeting performance in tennis players.

Methods: A total of 66 young male tennis players (age: 24.32 ± 2.46 years) participated in this randomized placebo-controlled crossover trial. Interventions included mental fatigue (MF), non-fatiguing effect (Placebo), and no mental fatigue (Control). The Stroop Attention Test (SAT) and Tennis Groundstroke Targeting Test (TGTT) depth and accuracy sections were administered before and after all interventions. Changes over time in normally distributed homogeneous data were determined using repeated-measures ANOVA (3×2), with Bonferroni correction applied for *p*-values for normally distributed variables and the Friedman test for non-normally distributed variables. Paired samples t-test and Wilcoxon test were used for pairwise comparisons of normally and non-normally distributed data, respectively.

Results: Post-test pairwise comparisons showed that the MF intervention significantly increased SAT completion times and SAT error scores ($p < 0.001$). Post-intervention TGTT scores showed significant differences between MF, Placebo, and Control ($p < 0.001$), with *post hoc* analysis indicating that TGTT scores were significantly lower in the MF intervention compared to Control and Placebo ($p < 0.001$).

Conclusion: This study demonstrates that acute mental fatigue decreases attention and tennis groundstroke targeting performance in male tennis players.

Volleyball

Reliability and validity of measuring shoulder internal and external rotation strength in volleyball specific positions. International Journal of Sports Physical Therapy, 20(4): 532-541, 2025.

Background: Overhead athletes are susceptible to shoulder injuries, among which rotator cuff injuries are common and often directly associated with muscle weakness. Therefore, valid and reliable measures of rotator cuff strength at sport specific positions may be a vital part of sports physical therapy practice. Purpose: The current study aimed to determine the inter- and intra-tester reliability of measuring shoulder internal rotation (IR) and external rotation (ER) strength at a novel testing position, 130° of abduction and compared to the 90°/90° position. A secondary aim was to assess

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concurrent validity between measurements taken with the Humac® Norm™ Isokinetic Dynamometer (IKD) and Microfet® 2 hand-held dynamometer (HHD).

Study design: Inter-Rater and Intra-Rater Reliability and Criterion Validity.

Methods: Twenty-five (n=25) healthy participants were recruited for this study. Exclusion criteria included prior shoulder surgery, shoulder injury within the last three months, and contraindications to exercise according to ACSM guidelines. Participants performed maximal isometric shoulder external and internal rotation strength testing at both 90° and 130° of shoulder abduction. On the first day, participants were tested on the IKD at both positions, followed by each tester using the HHD. Participants returned 7-14 days later for repeat testing using the HHD only. ICC values were calculated for each rater, instrument, and testing position. Bland-Altman plots were created to establish limits of agreement. Minimal detectable change values were calculated.

Results: Inter- and intra-rater reliability for testing isometric strength using a hand-held dynamometer was good to excellent for both shoulder positions with ICC values consistently above 0.8. Concurrent validity between the HHD and IKD was poor to moderate with ICC values ranging from 0.1-0.4. However, Bland-Altman plots demonstrated that the difference in strength measures was within the limits of agreement.

Conclusion: Shoulder IR and ER strength testing at 130° of abduction shows strong inter-rater and intra-rater reliability for measurement in sport specific positions.

Association between pre-season lower limb interlimb asymmetry and non-contact lower limb injuries in elite male volleyball players. Scientific Reports, 25: 14481, 2025.

Abstract - This study aimed to quantify lower limb interlimb asymmetries in elite male volleyball players by assessing key performance measures, including vertical jumps, change of direction, and muscle strength. It further explored the potential association between these asymmetries and the occurrence of non-contact lower limb injuries. Thirty-one elite male volleyball athletes (age: 20.1 ± 1.2 years; training experience: 7.1 ± 2.2 years) participated in the study. Interlimb asymmetries were assessed using the single-leg countermovement jump (SCMJ), squat jump (SSJ), drop jump (SDJ), T-test, and Pro-test to evaluate lower limb power, agility, and change-of-direction ability. Concentric and eccentric strengths of the knee extensors and flexors were measured using isokinetic testing. Athletes were monitored for 8 months to record non-contact lower limb injuries. Significant variability was observed in the lower extremity interlimb asymmetries (ranging from 3.61 to 15.91%) across different tests (P < 0.05). Thirteen athletes sustained at least one

non-contact lower limb injury during the follow-up period. Logistic regression analysis identified significant predictors of injury risk: knee extensor concentric normalized peak torque asymmetry (OR 1.64 [95% CI 1.14-2.37]; P < 0.01), SCMJ height asymmetry (OR 1.18 [95% CI 1.01-1.34]; P < 0.05), and T-test performance asymmetry (OR 1.41 [95% CI 1.07-1.85]; P < 0.05). Interlimb asymmetries in SCMJ, knee extensor strength, and T-test performance are significant risk factors for non-contact lower limb injuries in elite male volleyball players. Systematic evaluation of these asymmetries could contribute to targeted injury prevention strategies and optimized athletic performance.

Wrestling/Combat Sports

Anthropometric Characteristics and Body Composition Changes in a Five-Time Olympic Champion in Greco-Roman Wrestling: A Longitudinal Case Study Towards the Paris 2024 Olympic Games. Journal of Functional Morphology and Kinesiology, 10: 176, 2025.

Purpose: This case study examines the anthropometric characteristics and body composition changes of a 41-year-old Cuban Greco-Roman 130 kg wrestler, a five-time Olympic gold medalist (2008–2024). To optimize his preparation for the Paris 2024 Olympic Games, another athlete participated in the qualifying process, allowing him to train without competition gear.

Methods: The study monitored changes in body composition using anthropometry and bioelectrical impedance analysis (BIA) at three key time points in 2024: January, June, and July. The final assessment occurred 25 days before the Olympic event, coinciding with the final phase of his preparation.

Results: The analysis revealed a significant reduction in total body mass, from 150 kg in January to 138.5 kg in July, with fat mass decreasing from 37.06 kg (24.11%) to 29.7 kg (21.5%). Muscle mass decreased slightly (77.41 kg to 72.3 kg), while bone mass remained stable. The somatotype classification was endomorphic–mesomorphic at all assessments, with slight shifts in its components (4.6–10.4–0.1 in January to 4.4–10.3–0.1 in July), reflecting an improved muscle–fat ratio. Notably, hydration levels and cellular integrity remained stable, as indicated by BIVA analysis.

Conclusions: This study provides insight into the anthropometric characteristics and body composition of an elite Greco-Roman wrestler, as well as the changes observed during his preparation for his final Olympic participation. These data serve as a valuable reference for wrestlers and sports professionals, highlighting the physical profile of one of the most emblematic figures in Olympic history

Performance Research Reviews

Effects of the wrestling + injury prevention program in freestyle wrestlers: a two-arm randomized controlled trial. Journal of Orthopaedic Surgery and Research,20: 486, 2025.

Background: To assess the effectiveness of the Wrestling + injury prevention program on incidence of injuries, neuromuscular mechanisms and dynamic balance of freestyle (FS) wrestler.

Methods: The participants of this study consisted of FS wrestling players in Qom province (Iran). A total of 80 participants were assigned to this study and using simple and random method with computer divided into experimental (EXP, n = 40) and control (CON, n = 40) groups. The groups were blinded against each other. The follow-up period was one season (6 months). EXP replaced their warm-up by Wrestling + program. CON performed a standard warm-up program. The primary outcome was the injury incidence density (injuries per 1000 h of wrestling exposure), compared between groups by incidence rate ratios (RR). Also, the secondary outcome was neuromuscular mechanisms and dynamic balance.

Results: The per-protocol analysis showed a reduction of the overall injury incidence density in the EXP group by 58% compared to the CON group. Additionally, within-group analyses revealed significant improvements in neuromuscular mechanisms and dynamic balance for both the EXP and CON groups following 24 weeks of warm-up programs ($p < 0.05$). Furthermore, between-group comparisons indicated significant differences favoring the EXP group relative to the CON group ($p < 0.05$).

Conclusion: The Wrestling + program is effective in reducing injuries among FS wrestlers with overall injuries reduced by 58%. Moreover, the results indicate that the Wrestling + program is more effective than traditional warm-up routines in improving neuromuscular mechanisms and dynamic balance among FS wrestlers. Therefore, it is recommended that coaches use a Wrestling + program to reduce the incidence of injury in FS wrestlers.

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