



Performance Research Reviews

June 2024

Baseball

***An interval throwing program for baseball pitchers based upon workload data.
International Journal of Sports Physical Therapy, 19(3): 326-336, 2024.***

Background: Interval throwing programs (ITP) have been used for decades to enable baseball pitchers to return to competition after injury or surgery by gradually applying load to the throwing arm. Past programs have been based on personal experience; however, advances in our understanding of the biomechanics and workloads of throwing allow for a more modern data-based program to be developed.

Hypothesis/purpose: To 1) develop a updated ITP for rehabilitation of modern baseball pitchers based upon biomechanical and throwing workload data, and 2) compare the updated program with a past program to determine differences in chronic workload and acute:chronic workload ratios (ACWR).

Study design: Cross-sectional study.

Methods: Workloads (i.e. daily, acute, chronic, and ACWR) for the original ITP were built from the prescribed throwing schedule. Elbow varus torque per throw was calculated based upon a relationship between elbow varus torque and throwing distance. Throw counts, daily/chronic/acute workloads, and ACWR were calculated and plotted over time. A new ITP was built to model current pitcher's throwing schedules and gradually increased ACWR over time.

Results: The original ITP had a throwing schedule of 136 days, final chronic workload 15.0, and the ACWR above or below the "safe" range (i.e. 0.7 - 1.3) for 18% of the program with a peak of 1.61. The updated ITP was built to consist of a 217-day schedule, final chronic workload of 10.8, and deviated from the safe range for 9% of the program, with a peak of 1.33.

Conclusion: The newly created ITP is more familiar to modern baseball pitchers while exhibiting a more gradual buildup of chronic workload than traditional ITP programs. This ITP may be used to return baseball pitchers back to competition as safely and efficiently as possible, and potentially with less risk of setbacks or reinjury. The ITP may be used following common injuries or surgeries to the throwing shoulder and elbow, such as Tommy John surgery, while also serving as a basis for future development of shorter duration ITPs.

Level of evidence: 2c.



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<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10909315/>

Comparison of glenohumeral and scapulothoracic kinematics between fastballs and curveballs during baseball pitching. Sport Biomechanics, Ahead of Print: 1-14, 2024.

Abstract - Shoulder injuries are common in baseball pitchers and primarily involve the glenohumeral joint. Past analyses have examined shoulder biomechanics during different pitch types simply as the motion of the upper arm relative to the thorax. In this study, glenohumeral and scapulothoracic kinematics were compared between fastballs and curveballs at key timepoints throughout a pitch. Upper extremity kinematics of thirteen collegiate pitchers were collected during fastball and curveball pitches with motion capture. A linear model approach was utilized to estimate scapular kinematics based on measurable humerothoracic motion. Glenohumeral kinematics were computed from the scapular and humeral motion data. Comparisons of scapulothoracic and glenohumeral kinematic variables at times of maximum glenohumeral external rotation, ball release, and maximum glenohumeral internal rotation between pitch types were made using paired t-tests with Benjamini-Hochberg corrections. There were no significant differences in glenohumeral kinematics. Fastballs elicited significantly less scapulothoracic internal rotation and more posterior tilt at maximum glenohumeral external rotation. Fastballs produced significantly less scapulothoracic internal rotation and anterior tilt at maximum glenohumeral internal rotation. This study provides further evidence that risk of injury to the glenohumeral joint may be consistent between fastballs and curveballs and offers insights into subtle differences in scapular kinematics between pitch types.

Interval throwing programs for baseball players: Methodological assessment of the quality and construct of publicly available programs. Sports Health, Ahead of Print: 1-9, 2024.

Context: The quality and interprogram variability of publicly available throwing programs have not been assessed.

Objective: To (1) identify publicly available interval throwing programs, (2) describe their components and structure, and (3) evaluate their quality, variability, and completeness.

Data sources: Google, Bing, Yahoo; keyword: "interval throwing program."

Study selection: Baseball-specific publicly available programs.

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Study design: Systematic review.

Level of evidence: Level 4.

Data extraction: Independent evaluation by 2 authors using a novel 21-item Quality Assessment Rubric (QAR).

Results: Of the 99 included programs, 54% were designed for return from injury/surgery; 42% explicitly stated no expected timeline for completion, and approximately 40% did not provide criteria to initiate the program. Program construction was highly variable. There were broad-ranging shortest (mean: 40±8 ft, range: 20-45 ft) and longest (mean: 150±33 ft, range: 90-250 ft) long toss distances, and variable maximum numbers of mound pitches thrown before returning to game play (range: 40-120, mean: 85). Only 63% of programs provided guidelines for handling setbacks, and standardized warm-ups, arm care, and concomitant training were absent in 32%, 63%, and 47% of programs, respectively. Mean QAR completion rate and QAR item response rate were low (62 ± 4% [range, 24-91%], 62 ± 24% [range, 7-99%], respectively). Finally, only 20 (20%) programs provided at least 1 peer-reviewed reference, most of which were published >10 years ago.

Conclusion: Publicly available interval throwing programs are readily available but demonstrate significant interprogram heterogeneity across multiple areas including target audience, program construction, progression, and execution. The quality and consistency of publicly available interval throwing programs is poor at this time, which may limit their utility and effectiveness for baseball players attempting to return to competition. This work identifies a multitude of deficiencies in currently available throwing programs that should be targets of future improvement efforts.

https://journals.sagepub.com/doi/full/10.1177/19417381241237011?casa_token=Bw61C3_t6FAAAAAA:hWda56aQBE7Px2DPUf9E02sUlslyOmmq6eIz0eWWpmmj0yJ9_DPBwCX8F4WCZT56JSBpwDMjAqk

The burden of back and neck strains and sprains in professional baseball players. Clinical Spine Surgery, Ahead of Print: 1-5, 2024.

Study design: A retrospective case series study.

Objective: To analyze the epidemiology of diagnoses of back and neck strains and sprains among Major League (MLB) and Minor League (MiLB) Baseball players.



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Background: Baseball players perform unique sets of repetitive movements that may predispose to neck and back strains and sprains. Data are lacking concerning the epidemiology of these diagnoses in this population.

Materials and methods: De-identified data on neck/back strains and sprains were collected from all MLB and MiLB teams from 2011 to 2016 using the MLB-commissioned Health and Injury Tracking System database. Diagnosis rates of conditions related to cervical, thoracic, and lumbar musculature and their impact on days missed due to injury, player participation, and season or career-ending status were assessed. Injury rates were reported as injuries per 1000 athlete exposures (AEs).

Results: There were 3447 cases of neck/back strains and sprains in professional baseball players from 2011 to 2016. Seven hundred twenty-one of these occurred in MLB versus 2726 in MiLB. Of injuries 136 were season-ending (26 in MLB, 110 in MiLB); 22 were career-ending (2 in MLB, 20 in MiLB). The total days missed were 39,118 (8838 from MLB and 30,280 from MiLB). Excluding season or career-ending injuries, the mean days missed were 11.8 (12.7 and 11.6 in MLB and MiLB, respectively). The median days missed were 4 (3 and 5 in MLB and MiLB, respectively). Combining MLB and MiLB, the pitcher injury rate was 1.893 per 1000 AEs versus 0.743 per 1000 Aes for other position players ($P < 0.0001$).

Conclusion: There was a high incidence of neck/back strains and sprains in MLB and MiLB players, with nearly 40,000 aggregate days missed in our 6-year study period. The median days missed were lower than the mean days missed, indicating rightward outliers. Pitchers had over double the rates of injuries compared with other position players.

Level of evidence: Level III.

Basketball

A cluster analysis of basketball players for each of the five traditionally defined positions. Journal of Sports Engineering and Technology, Vol. 238(1): 55-75, 2024.

Abstract - Determining the players' playing styles and bringing the right players together are very important for winning in basketball. This study aimed to group basketball players into similar clusters according to their playing styles for each of the traditionally defined five positions (point guard (PG), shooting guard (SG), small forward (SF), power forward (PF), and center (C)). This way, teams would be able to identify their type of players to help them determine what type of



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players they should recruit to build a better team. The 17 game-related statistics from 15 seasons of the National Basketball Association (NBA) were analyzed using a hierarchical clustering method. The cluster validity indices (CVIs) were used to determine the optimum number of groups. Based on this analysis, four clusters were identified for PG, SG, and SF positions, while five clusters for PF position and six clusters for C position were established. In addition to the definition of the created clusters, their individual achievements were examined based on three performance indicators: adjusted plus-minus (APM), average points differential, and the percentage of clusters on winning teams. This study contributes to the evaluation of team compatibility, which is a significant part of winning, as it allows one to determine the playing styles for each position, while examining the success of position pair combinations.

Biomechanics analysis of basketball shooting via OpenPose Motion Capture System. Journal of Advanced Research in Applied Mechanics, 112(1): 32-45, 2023.

Abstract - In basketball, it is crucial to understand the optimal shooting pattern for each individual in terms of gender and shooting distances from the basket. However, incorporating biomechanics shooting analysis quantitatively into the learning process is not preferable. Hence, the purpose of this study is to determine the quantitative aspect of basketball shooting for biomechanics analysis using the OpenPose motion capture system. This marker-less motion capture system generated the biomechanical parameter data subjected to a significant difference test for shooting performance. A total of four players – two males and two females, divided into two levels (intermediate and novice) performed ten continuous jump shots from two different shooting distances (4.57 m and 6.40 m) from the basket. Each individual's biomechanical parameters were tested in a statistical or independent t test to determine which significant parameter has a measurable difference in shooting performance. When the effects of different body angles on missed to scored baskets were compared, only the right elbow angle (intermediate female player), the right shoulder angle (novice male player) and the left hip angle (intermediate female player and novice male player) showed a significant difference ($p < 0.05$) towards shooting performance. In the comparison of the velocity of right upper limb key points, only the velocity of the right shoulder (intermediate male player) showed a significant difference ($p < 0.05$) toward shooting performance. In conclusion, the findings of this study suggest that shooting analysis should be done quantitatively to demonstrate a more profound and clear understanding of biomechanics when considering an improvement in shooting performance.

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Effects of plyometric training techniques on vertical jump performance of basketball players. European Journal of Sport Science, 4:1-11, 2024.

Abstract - The aim of our study was to compare the effects of two different plyometric training programs (targeting knee extensors or plantar flexors) on jump height and strength of leg muscles. Twenty-nine male basketball players were assigned to the knee-flexed (KF), knee-extended (KE), or control groups. In addition to regular training, the KF group performed plyometric jumps (10 sets of 10 jumps, 3 sessions/week, 4 weeks) from 50 cm boxes with the knee flexed (90°–120°), whereas the KE group performed the jumps from 30 cm boxes with the knee much more extended (130°–170°). Jumping ability was evaluated with squat jumps (SJs), countermovement jumps (CMJs), and drop jumps from 20 cm (DJ20) and 40 cm (DJ40). Knee and ankle muscles were assessed during maximal isokinetic and isometric tests, and EMG activity was recorded from vastus lateralis and medial gastrocnemius. The KF group increased SJ ($p10\%$, $d = 0.86$) and CMJ ($p11\%$, $d = 0.70$) but decreased DJ40 height (-7% , $d = -0.40$). Conversely, the KE group increased DJ20 ($p10\%$, $d = 0.74$) and DJ40 ($p12\%$, $d = 0.77$) but decreased SJ height (-4% , $d = -0.23$). The reactivity index during DJs increased ($p10\%$ for DJ20, $d = 0.47$; $p20\%$ for DJ40, $d = 0.91$) for the KE group but decreased (-10% , $d = -0.48$) for the KF group during DJ40. Plantar flexor strength increased for the KE group ($d = 0.72-1.00$) but not for the KF group. Negative transfer across jumps is consistent with the principle of training specificity. Basketball players interested to perform fast rebounds in their training should avoid plyometric jumps with large knee flexions and long contact times.

Highlights

- Plyometric training specificity: different jump techniques (knee flexed vs. knee extended) elicited specific adaptations in jumping performance. Training with the knees flexed improved squat jump and countermovement jump height, whereas training with the knees extended augmented drop jump height.
- Negative transfer: the different jump techniques can have a negative influence on jump height and reactivity index. Drop jump height declined after knee-flexed training, whereas squat jump height decreased after knee-extended training.
- Plyometric training exercises should be aligned with sport-specific movements to optimize performance. Basketball players who perform fast, powerful movements should avoid plyometric jumps with large knee flexions and long contact times.

<https://onlinelibrary.wiley.com/doi/pdf/10.1002/ejsc.12097>



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Intensity thresholds for external workload demands in basketball: Is individualization based on playing positions necessary? Sensors, 24:1146, 2024.

Abstract - Currently, basketball teams use inertial devices for monitoring external and internal workload demands during training and competitions. However, the intensity thresholds preset by device manufacturers are generic and not adapted for specific sports (e.g., basketball) and players' positions (e.g., guards, forwards, and centers). Using universal intensity thresholds may lead to failure in accurately capturing the true external load faced by players in different positions. Therefore, the present study aimed to identify external load demands based on playing positions and establish different intensity thresholds based on match demands in order to have specific reference values for teams belonging to the highest competitive level of Spanish basketball. Professional male players ($n = 68$) from the Spanish ACB league were monitored during preseason official games. Three specific positions were used to group the players: guards, forwards, and centers. Speed, accelerations, decelerations, impacts/min, and player load/min were collected via inertial devices. Two-step clustering and k-means clustering categorized load metrics into intensity zones for guards, forwards, and centers. Guards covered more distance at high speeds (12.72–17.50 km/h) than forwards and centers ($p < 0.001$). Centers experienced the most impacts/min ($p < 0.001$). Guards exhibited greater accelerations/decelerations, albeit mostly low magnitude ($p < 0.001$). K-means clustering allowed the setting of five zones revealing additional thresholds. All positions showed differences in threshold values ($p < 0.001$). The findings provide insights into potential disparities in the external load during competition and help establish position-specific intensity thresholds for optimal monitoring in basketball. These data are highly applicable to the design of training tasks at the highest competitive level.

<https://www.mdpi.com/1424-8220/24/4/1146>



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Football

Anterior pelvic tilt increases hamstring strain and is a key factor to target for injury prevention and rehabilitation. Knee Surgery, Sports Traumatology, Arthroscopy, 32:573-582, 2024.

Purpose: Hamstring muscle strain injury is very common in sports involving high-speed running. Hamstring muscles originate from the ischial tuberosity and thus pelvic position may influence hamstring strain during different sports movements like sprinting, but this has only been evaluated by indirect methods. This study tested the hypothesis that a change in anterior pelvic tilt causes elongation of the overall hamstring complex and disproportionately elongates proximal relative to distal muscle regions.

Methods: Seven fresh-frozen specimens (full lower limb with pelvis and lumbar spine) were used for this in vitro study. Specimens were dissected to enable visualization of the hamstring muscles and then fixed into a custom-made testing bench that allowed controlled movement of the pelvis over a fixed femur and tibia. Nine markers were inserted into the hamstring muscles to allow intra- and intermuscle difference measurements. Then, six different anterior pelvic angles were used to measure the difference in hamstring muscle lengthening through a three-dimensional reconstruction system based on stereoscopic machine vision technology.

Results: An increase in anterior pelvic tilt produced a significant non-uniform increase in tissue elongation in all regions of the three hamstring muscles (semitendinosus, semimembranosus [SMB] and biceps femoris long head), which was greater in the proximal (>1 cm every 5°) compared to the distal region (≈0.4 cm every 5°). At the proximal hamstring region, SMB showed significantly greater length changes compared to conjoint tendons with nonstatistically significant elongation differences between muscles at the distal region.

Conclusion: Considering the results of the study, the pelvis segment will likely play a fundamental role as a strain regulator of hamstring muscles. These results will have an impact on injury rehabilitation and prevention processes of hamstring injuries, as well as optimize future musculoskeletal models and avoid potential underestimation of the hamstring muscle-tendon complex lengthening during high-speed running.

Level of evidence: N/A.

https://esskajournals.onlinelibrary.wiley.com/doi/pdf/10.1002/ksa.12045?casa_token=qGPVB4U5cSwAAAAA:PRXx8dgDDIC3WfD6uYJNsHPqKbvPHxO0ueelgbcPUuEdfhOIBYSJH5Js2yIrl1mj3zy-nxcXe_gyag



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Exposures to elevated core temperatures during football training: The impact on autonomic nervous system recovery and function. Sports, 12: 8, 2024.

Abstract - Exercising with elevated core temperatures may negatively affect autonomic nervous system (ANS) function. Additionally, longer training duration under higher core temperatures may augment these negative effects. This study evaluated the relationship between exercise training duration and 24 h ANS recovery and function at ≥ 37 °C, ≥ 38 °C and ≥ 39 °C core temperature thresholds in a sample of male Division I (D1) collegiate American football athletes. Fifty athletes were followed over their 25-week season. Using armband monitors (Warfighter Monitor™, Tiger Tech Solutions, Inc., Miami, FL, USA), core temperature (°C) and 24 h post-exercise baseline heart rate (HR), HR recovery and heart rate variability (HRV) were measured. For HRV, two time-domain indices were measured: the root mean square of the standard deviation of the NN interval (rMSSD) and the standard deviation of the NN interval (SDNN). Linear regression models were performed to evaluate the associations between exercise training duration and ANS recovery (baseline HR and HRV) and function (HR recovery) at ≥ 37 °C, ≥ 38 °C and ≥ 39 °C core temperature thresholds. On average, the athletes were 21.3 (± 1.4) years old, weighed 103.0 (± 20.2) kg and had a body fat percentage of 15.4% ($\pm 7.8\%$, 3.0% to 36.0%). The duration of training sessions was, on average, 161.1 (± 40.6) min and they ranged from 90.1 to 339.6 min. Statistically significant associations between training duration and 24 h ANS recovery and function were observed at both the ≥ 38.0 °C (baseline HR: $\beta = 0.10 \pm 0.02$, $R^2 = 0.26$, $p < 0.0000$; HR recovery: $\beta = -0.06 \pm 0.02$, $R^2 = 0.21$, $p = 0.0002$; rMSSD: $\beta = -0.11 \pm 0.02$, $R^2 = 0.24$, $p < 0.0000$; and SDNN: $\beta = -0.16 \pm 0.04$, $R^2 = 0.22$, $p < 0.0000$) and ≥ 39.0 °C thresholds ($\beta = 0.39 \pm 0.05$, $R^2 = 0.62$, $p < 0.0000$; HR recovery: $\beta = -0.26 \pm 0.04$, $R^2 = 0.52$, $p < 0.0000$; rMSSD: $\beta = -0.37 \pm 0.05$, $R^2 = 0.58$, $p < 0.0000$; and SDNN: $\beta = -0.67 \pm 0.09$, $R^2 = 0.59$, $p < 0.0000$). With increasing core temperatures, increases in slope steepness and strengths of the associations were observed, indicating accelerated ANS deterioration. These findings demonstrate that exercise training under elevated core temperatures (≥ 38 °C) may negatively influence ANS recovery and function 24 h post exercise and progressively worsen.

<https://www.mdpi.com/2075-4663/12/1/8>



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Football practices in hot environments impact subsequent days' hydration. Journal of Strength and Conditioning Research, 38(1):90-96, 2024.

Abstract - The impact of proper hydration to prevent exertional heat illness in American football has not been evaluated during high school preseason football practices in a hot environment (wet-bulb globe temperature = $31.3 \pm 1.8^\circ \text{C}$). The purposes of this study were to examine the accuracy of urinary hydration measures to assess body mass (BM) changes and to examine carryover effects of consecutive practices by comparing postpractice with the next prepractice values. Before and after each of 7 outdoor practices, 31 male high school football players (age = 16 ± 1 years, height = 181.2 ± 12.0 cm, BM = 85.7 ± 19.1 kg, body mass index = 20.8 ± 1.8) provided a urine sample and were weighed to assess hydration. Sensitivity and specificity of urine color (Ucol) and urine-specific gravity (USG) to determine BM changes were determined using receiver operating characteristic (ROC) analysis. Paired samples t -tests assessed carryover effects between practices. Repeated-measures analysis of variance assessed carryover effects across practices. Significance was set at $p < 0.05$. Sensitivity and specificity for using Ucol or USG to determine BM changes was not significant. For Ucol, there was a carryover effect from practice numbers 2 to 3, 6 to 7 am , 7 am to 7 pm ($p < 0.001$ for all), and 10 to 11 ($p = 0.004$); most with less than 24 hours between practices. The %BM loss (%BML) was significantly greater ($p = 0.001$ to 0.024) after 2-a-day practices. Effects of previous days' exercise in the heat, as evidenced by higher Ucol and %BL, are greater after 2-a-day practices, which occurred on later practice days. Athletes must replenish fluids during and between practices to remain euhydrated.

NCAA football players are at higher risk of upper extremity injury after first-time concussion. The Physician and Sportsmedicine, Ahead of Print: 1-16, 2024.

Background: Previous research has demonstrated that concussions increase the risk of subsequent lower extremity musculoskeletal injury in athletes. However, the risk of upper extremity injury in athletes' post-concussion is poorly understood.

Methods: All concussed football players within a National Collegiate Athletic Association (NCAA) Division I conference athletic database were identified between 2017 and 2021. After exclusions, each athlete experiencing their first concussion was then retrospectively reviewed for upper extremity injuries in the year prior to their concussion and in the year beginning at 90 days after their concussion. All upper extremity injuries were identified and the odds ratio, 95% confidence interval, and statistical significance between groups were calculated in Microsoft Excel.



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Results: 160 de-identified football players from a single conference who were first diagnosed with concussions in the seasons from 2017 through 2021 met inclusion criteria. In these athletes the odds of upper extremity injury in year following first diagnosed concussion were 2.36 times higher than in the year prior (95% CI 1.13-4.95, $p = 0.02$). Shoulder was the most common site of injury with 57.7% of injuries compared to 19.2% in the hand, 15.4% in the elbow, 7.7% in the forearm, and 0% in the wrist.

Conclusion: This study demonstrates that collegiate football players are at a 2.36 times greater risk of upper extremity injury in the year following their first diagnosed concussion compared to the year preceding it. The most common site of upper extremity injury after concussion was the shoulder.

Level of evidence: III.

Gymnastics

Key performance indicators of individual medalists in rhythmic gymnastics competing at the 2020 Olympic games. Science of Gymnastics Journal, Vol. 15(3): 409-425, 2024.

Abstract - This study aims to analyze the contribution of each apparatus' score component to the overall score and to identify the key performance indicators that distinguish medalists from non-medalists among the 10 finalists in rhythmic gymnastics at the 2020 Olympic Games, Tokyo. Medalists ($n=3$) and non-medalists ($n=7$) were separated in the sample. Each apparatus (hoop/ball/clubs/ribbon) had seven components [body difficulty (DB), apparatus difficulty (DA), D total, artistic execution (EA), execution technical (ET), E total, total score (TS) of apparatus, and a total final score (TFS-sum of four apparatus scores)]. A total of 350 scores were analyzed. The Mann-Whitney U tests and Cohen's d effect size (ES) calculation were used to calculate differences. The following variables were determined to differentiate the TFS of the medalist and the non-medalist gymnasts: the large effect with Ball-DA/D total/EA/E total/TS (ES=1.550–1.879), Clubs-DA/D total/EA/TS (ES=0.316–2.080), Hoop-DA/D total/TS (ES=1.897–2.316), Ribbon-EA (ES=1.879), and with a low-effect Clubs-AD(ES=0.316) components. Hoop-DA and Hoop-D-TS (ES=2.316, $p < 0.05$) have the greatest impact, while all DB and ET scores ($p > 0.05$) have no effect on TFS. The impact of apparatus-specific score components on Olympic medal outcomes varies significantly. Notably, difficulty scores (both total and apparatus-specific) and artistic scores emerged as key performance indicators for achieving high total scores and securing a medal in rhythmic gymnastics at the Olympic



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Games. Coaches should prioritize choreography planning aimed at enhancing difficulty, particularly the apparatus difficulty score, while also focusing on enhancing artistic quality through flawless execution of routines by the gymnasts.

<https://www.researchgate.net/publication/375263253> KEY PERFORMANCE INDICATORS OF INDIVIDUAL MEDALISTS IN RHYTHMIC GYMNASTICS COMPETING AT THE 2020 OLYMPIC GAMES

Preseason lower extremity range of motion, flexibility, and strength in relation to in-season injuries in NCAA Division 1 gymnasts. *The Physician and Sportsmedicine*, Vol. 52(2): 200-206, 2024.

Objectives: To determine if preseason lower extremity ROM, flexibility, and strength differ in collegiate gymnasts (NCAA Division 1) who do or do not sustain an injury during the competitive season.

Methods: Over four seasons, a total of 15 female gymnasts (age = 20.5 ± 1.0 years) underwent preseason screening (30 gymnast-season). We tested joint ROM (hip: flexion, internal and external rotation; ankle: weightbearing dorsiflexion), muscle flexibility (passive straight leg raise, Thomas, Ober's, Ely's tests) and strength (hip extensors, abductors, and flexors isometric strength via a handheld dynamometer; knee: quadriceps and hamstring isokinetic strength at $60^\circ/\text{sec}$). The team athletic trainer tracked overuse lower extremity injuries (restricted gymnasts from full participation, occurred as from participation in organized practice or competition, and required medical attention) during each season. For athletes that tested multiple seasons, each encounter was considered independent, and each preseason assessment was linked to overuse injuries sustained during the same competitive season. Gymnasts were dichotomized into injured and non-injured groups. An independent t-test was used to measure differences in preseason outcomes between injured and non-injured groups.

Results: During four years, we recorded 23 overuse lower extremity injuries. Gymnasts that sustained an in-season overuse injury demonstrated significantly lower hip flexion ROM (mean difference: -10.6° ; 95% confidence interval: $-16.5, -4.6$; $p < 0.01$) and lower hip abduction strength (mean difference: -4.7% of body weight; 95% confidence interval: $-9.2, -0.3$; $p = 0.04$).

Conclusion: Gymnasts who sustain an in-season overuse lower extremity injury have significant preseason deficit of hip flexion ROM and weakness in the hip abductors. These findings indicate potential impairments in the kinematic & kinetic chains responsible for skill performance and energy absorption during landing.



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https://www.tandfonline.com/doi/pdf/10.1080/00913847.2023.2215775?casa_token=Mvyhj2I6GLcAAAAA:yn-UUzdLN4-Wg739KD6oaOBNz4Mo_pHMRQ0nrwHQpVEzGIY9GdZLUdbfm5RgW36NJMG4TupLNjU

Golf

Injury profiles of elite, semi-elite, and recreational golfers, and their associated risk factors: A systematic review. Journal of Strength and Conditioning Research, 38(6): 1157-1176, 2024.

Abstract - Golf is one of the most participated sports played worldwide. However, how injury distributions change between different golf populations is unknown, and associated injury risk factors are unclear. Therefore, this review aimed to describe the common musculoskeletal injuries in different golf populations and identify their associated risk factors. A systematic search was performed to identify eligible articles through PubMed, SPORTDiscus, EMBASE, and Scopus up until September 4, 2023. Of the 4643 studies identified, 58 satisfied the inclusion criteria. Data from 10,437 subjects were extracted, with the most common area of injury to all golf populations being the lower back. Different injury distributions were found between populations with elite male golfers (n = 1924 injuries, 62% of all injuries) and recreational male golfers (n = 442 injuries, 45% of all injuries) reporting the trunk as the most injured region, whereas upper-extremity injuries were the most prevalent injury in elite female golfers (n = 890 injuries, 42% of all injuries) and recreational female golfers (n = 178 injuries, 47% of all injuries). Range-of-motion deficits at the hip and spine were identified as risk factors for elite golfers, whereas measures of lower-limb and trunk strength endurance were identified as risk factors for recreational golfers, suggesting areas of focus for golf practitioners. However, there is a paucity of robust studies evaluating the epidemiology of musculoskeletal injuries in all golf populations, and because of the variety of methods and measures used, detailed comparisons and definitive recommendations were difficult to make. Nonetheless, this review provides an overview of the common golf injuries and possible risk factors, which can aid practitioners in developing strategies for injury prevention for all golfing demographics.

Practical Applications - This review demonstrates that there is currently a limited number of robust studies and various methods used to identify possible risk factors for injury in golf players. Altered lumbar spine and hip joint mobility were found to be physical risk factors for LB injury for elite players, while reduced strength at the trunk and hips were shown to be physical risk factors for LB injury for recreational players. A variety of measures was used, and most measures focused on ROM or isometric strength, which do not quantify the high levels of torque produced rapidly during a golf swing. Therefore, to get more consistency in the reported measures of injury risk, we have developed recommended



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physical measures that practitioners should incorporate for testing in the online supplementary material. These measures focus on ROM and strength measures at the shoulders, trunk, and hips and attempt to provide a more comprehensive testing battery for assessing injury risk in this population. When conducting biomechanical analysis, practitioners should focus on analyzing the X-factor stretch and the trunk musculature's activation patterns, especially the erector spinae, external obliques, and rectus abdominis. Although there is some conflicting evidence in commercially available measures, such as club head speed, incorporating these measures can make injury risk profiling more inclusive and provide information more readily. Therefore, we recommend measuring club head speed, driving distance, and smash factor on commercial devices when more in-depth biomechanical analysis is unavailable. Finally, golf players of all levels should include a minimum 10-minute warm-up routine that provides mobility and activation exercises for the shoulders, trunk, and hips to help reduce the risk of injury. Although more work is required, there appears to be a considerable increase in injury risk when not incorporating a warm-up before play.

https://journals.lww.com/nsca-jscr/fulltext/2024/06000/injury_profiles_of_elite_semielite_and.23.aspx?casa_token=jNxrHHG2CzUAAAAA:mHuAjWj8qnLs9ihzDcmdx1ZhGo42gRx1jeSg9sSvTe9E_ggn2yz8CvpbUHfUjD6XgLRWPYHFwcFXm4dmVuMSmKAtcFw

Kinematic, kinetic, and temporal metrics associated with golf proficiency. Journal of Strength and Conditioning Research, 38(3): 599-606, 2024.

The biomechanics of the golf swing have been studied extensively, but the literature is unclear on which metrics are indicative of proficiency. The purpose of this study was to determine which metrics identified golf proficiency. It was hypothesized that discrete kinematic, kinetic, and temporal metrics would vary depending on proficiency and that combinations of metrics from each category would explain specific proficiency metrics. Kinematic, kinetic, and temporal metrics and their sequencing were collected for shots performed with a driver in 33 male golfers categorized as proficient, average, or unskilled (based on a combination of handicap, ball velocity, and driving distance). Kinematic data were collected with high-speed motion analysis, and ground reaction forces (GRF) were collected from dual force plates. Proficient golfers had greater x-factor at ball impact and greater trunk deceleration before ball impact compared with average ($p < 0.05$) and unskilled ($p < 0.01$) golfers. Unskilled golfers had lower x-factor at the top of the back swing and lower peak x-factor, and they took longer to reach peak trunk velocity and peak lead foot GRF compared with average ($p < 0.05$) and proficient ($p < 0.05$) golfers. A combination of 2 kinematic metrics (x-factor at ball impact and peak pelvis velocity), 1 kinetic metric (peak lead foot GRF), and 2 timing metrics (the timing of peak trunk and arm velocity)



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explained 85% of the variability in ball velocity. The finding that x-factor at ball impact and trunk deceleration identified golf proficiency points to the potential for axial trunk rotation training to improve performance.

Practical Applications - Understanding the biomechanics of complex movements in sports can provide insights into how best to train athletes to optimize performance. For example, in baseball pitching, peak trunk axial rotation velocity was the best predictor of ball velocity. The practical implication of this finding was that training strategies to improve trunk rotation velocity could theoretically improve ball velocity without having to stress the shoulder and elbow. The fact that x-factor at impact and trunk deceleration identified golf proficiency points to the potential of axial trunk rotation training to improve golf performance. For example, the seated medicine ball throw, a trunk rotation strengthening exercise, has been shown to be an effective exercise for improving driving distance in female golfers. Eccentrically biased trunk rotation exercises, including plyometric exercises, may be effective in improving golf proficiency. Golf-specific training programs have been effective in improving indices of golf performance, but it has been acknowledged that the optimal program will be dependent on the skill level of the player and their training status. Hip and trunk axial rotation flexibility have been shown to be strongly related to golf proficiency. Training programs that address the segmental axial motions of the hips, pelvis, and trunk may be optimal for improving golf performance.

[https://journals.lww.com/nsca-jscr/fulltext/2024/03000/kinematic, kinetic, and temporal metrics.22.aspx?casa_token=ohW4J9PcHQAAAAA:q9aMDlf5zdw9gFF8MduAzagG2mkBDHTNu4N90AgHz2SllIOHVTIUexnExrmg_8-IV62GmTWJjoWp73v_fD6zb9_k](https://journals.lww.com/nsca-jscr/fulltext/2024/03000/kinematic,_kinetic,_and_temporal_metrics.22.aspx?casa_token=ohW4J9PcHQAAAAA:q9aMDlf5zdw9gFF8MduAzagG2mkBDHTNu4N90AgHz2SllIOHVTIUexnExrmg_8-IV62GmTWJjoWp73v_fD6zb9_k)

Hockey

The association of countermovement jump, isometric mid-thigh pull, and on-ice sprint performance in university level female and male ice hockey athletes. International Journal of Strength and Conditioning, Vol. 4(1): 1-11, 2024.

Abstract - On-ice skating sprint performance is a significant predictor and requirement for playing at the highest levels of hockey. The purpose of this study was to determine the relationship between maximum and dynamic strength measures and on-ice sprint performance in university level ice hockey athletes. Both male (n=18) and female (n=13) hockey players participated in this study. The off-ice measures included two assessment procedures utilizing a force plate; an isometric mid-thigh pull (IMTP) to assess maximum strength and a countermovement jump (CMJ) to assess dynamic strength. Both off-ice measures were analyzed from both a relative (CMJr and IMTPr) and absolute (CMJa and IMTPa)

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perspective. The on-ice measures were 7.71m and 15.42m sprint times. Pearson product moment correlations were used to quantify the relationships between variables. CMJa ($r = -0.56$ to -0.61), IMTPa ($r = -0.65$ to -0.67) and IMTPr ($r = -0.55$) were significantly correlated ($p < 0.05$) with on-ice sprint performance. When analyzed by sex, no significant relationships ($p > 0.05$) were observed between CMJ measures and on-ice sprint times. No significant relationships ($p > 0.05$) were observed between IMTP measures and on-ice sprint times when individually analyzing male participants, while significant relationships ($p < 0.05$) were observed in females between IMTPa ($r = -0.70$ to -0.71) and IMTPr ($r = -0.68$ to -0.71) and on-ice sprint times. It is concluded that both maximum and dynamic strength are important factors in on-ice sprint performance in hockey players. Furthermore, maximum strength seems to be an important characteristic in on-ice sprint ability in females.

<https://journal.iusca.org/index.php/Journal/article/view/228>

Linking the preference in a bilateral asymmetric task with handedness, footedness, and eyedness: The case of ice-hockey. PLOS One, 19(5): e0294125, 2024.

Abstract - Most people know whether they are left-handed or right-handed, and usually base this assessment on preferences during one-handed tasks. There are several manual tasks that require the contribution of both hands, in which, in most cases, each hand plays a different role. In this specific case, holding an ice-hockey stick is particularly interesting because the hand placement may have an incidence on the playing style. In this study ($n = 854$), the main objective was to determine to what extent the way of holding an ice-hockey stick is associated with other lateralized preferences. Amongst the 131 participants reporting a preference for the left hand in unilateral tasks, 70.2% reported a preference for shooting right (placing the right hand in the middle of the stick); and amongst the 583 participants reporting a preference for writing with the right hand, 66.2% reported a preference for shooting left. 140 (16.4%) participants were classified as ambidextrous and 61.4% of them reported a preference for shooting right. This preference on the ice-hockey stick is closely correlated (uncrossed preference) to the way one holds a rake, shovel, or broom, or a golf club, but inversely related to the way one holds an ax and a baseball bat. The link between the way of holding the ice-hockey stick and eyedness or footedness is weak. These results are contrasted with the results reported by Loffing et al. (2014) and reveal the need to clarify the exact nature and requirements of the targeted tasks when studying bilateral asymmetric preferences.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0294125>



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Lacrosse

The influence of ball carriage on change of direction speed on male club-level lacrosse players. International Journal of Performance Analysis in Sport, Ahead of Print: 1-16, 2024.

Abstract - This study aimed to determine the effects of ball carriage on change of direction speed in club-level male lacrosse players using an L-run test when compared with two control conditions “no-ball, with-stick” and “no-ball, no-stick”. Thirteen participants ($M \pm SD$; age = 27 ± 7.5 years; height = 179.5 ± 5.8 cm; body mass = 82.9 ± 11.3 kg) conducted a randomized, counterbalanced study. Each completed six trials, performing two repetitions under three conditions: “no-ball, no-stick” (NBNS), “no-ball, with-stick” (NBWS), and “with-ball, with-stick” (WBWS). L-run completion times were not different between NBWS (6.30 ± 0.25 s) and WBWS (6.38 ± 0.28 s) ($p = 0.452$, $M_{diff} = 0.07$ s, 95% $CI_{diff} [-0.06$ to 0.20 s]). There was also no difference from the NBNS (6.22 ± 0.26 s) to the NBWS conditions ($p = 0.095$, $M_{diff} = 0.09$ s, 95% $CI_{diff} [-0.01$ to 0.18 s]). However, completion time was significantly longer in the WBWS condition compared to the NBNS condition ($p = 0.029$, $M_{diff} = 0.16$ s, 95% $CI_{diff} [0.02$ to 0.30 s]). Therefore, carrying a ball in a stick may negatively influence change of direction compared to with no ball or stick. Coaches should implement the lacrosse stick and cradling to better replicate the sport-specific mechanical demands of match-play.

https://www.tandfonline.com/doi/pdf/10.1080/24748668.2024.2317047?casa_token=CcBiehVHaHcAAAAA:TIEUL8F3Jvr4Qw9TtIKXJQS7khYpUNgnEpbwwH4qrnC90fs6ROT4I3sAVMU4FzrHEwDX4KR8p6s

Which performance markers have the greatest impact on lacrosse point production? A review. Journal of Sport and Performance, 3(3): 302-313, 2024.

Purpose: The purpose of this literature review was to explore what performance markers have the greatest impact on lacrosse point production.

Method: A literature search was performed using the Google Scholar database. All articles were accessed through a combination of the Lasell University Library and Indiana University Purdue University Indianapolis Library. Some journals that were included in this paper are Journal of Strength and Conditioning Research, The Journal of Sports Medicine and Physical Fitness, Journal of Athletic Enhancement, International Journal of Exercise Science and many others. The initial criteria for sources were set for peer reviewed articles within the last 10 years. Due to a void in research, older sources were included to help provide a bigger picture of the research.

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Results: Of the 32 studies, 12 looked at men's lacrosse, 16 looked at women's lacrosse, 2 studies collected data from both men's and women's teams, and lastly 1 included article looked at sports that were not lacrosse. Of the 32 studies, 24 of them explore performance markers, 2 studies explored exclusively point production variables, and 6 studies looked at the relationship between performance markers and point production.

Conclusion: All studies included in this paper create a fundamental base of research for the sport of lacrosse. The base of suggestions from this article appears to be improvements should focus on decreasing body fat percentage, improving anaerobic training, and increasing muscular strength. All three of which could be linked together physiologically.

<https://sjsp.aearedo.es/index.php/sjsp/article/view/performance-markers-impact-lacrosse-point-production-review>

Soccer

Circadian rhythm in sportspersons and athletic performance: A mini-review. Chronobiology International: The Journal of Biological and Medical Rhythm Research, 41(2): 137-181, 2024.

Abstract - Circadian rhythms in the physiological and behavioral processes of humans play a crucial role in the quality of living and also in the magnitude of success and failure in various endeavors including competitive sports. The rhythmic activities of the body and performance in sportspersons do have a massive impact on their every cutthroat competition. It is essential to schedule sports activities and training of players according to their circadian typology and time of peak performance for improved performance and achievement. In this review, the focus is on circadian rhythms and diurnal variations in peak athletic performance in sportspersons. Accuracy and temporal variability in peak performance in an individual could be attributed to various factors, namely chronotype, time of the day, body temperature, jetlag, hormones, and prior light exposure. Circadian rhythm of mood, alertness, T-core, and ultimately athletic performance is not only affected by sleep but also by circadian variations in hormones, such as cortisol, testosterone, and melatonin. There are, however, a few reports that are not consistent with the conclusions drawn in this review. Nevertheless, circadian rhythm and performance among sportspersons and athletes are important areas of research. This review might be useful to the managers and policymakers associated with competitive sports and athletic events.

https://www.tandfonline.com/doi/pdf/10.1080/07420528.2024.2305663?casa_token=plpWN3VN3D8AAAAA:fdW_XidB_pbk3BXVjTd24UTyi2w7THi-fLBEvZtMRITsUsDKKWFd_j2oM0ugBwRACj-mi0pOZSKw



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Current evidence on common dietary supplements for sleep quality. American Journal of Lifestyle Medicine, Ahead of Print: 1-5, 2024.

Abstract - Poor sleep quality impacts nearly 70 million adults in the United States, resulting in nearly 1 in 5 adults regularly utilizing some sleep aid, either prescription or over-the-counter. Common dietary supplements utilized to improve sleep quality include nitrates, melatonin, magnesium, zinc, vitamin D, and L-theanine. While underlying physiologic mechanisms support the potential impact these compounds have on sleep quality, evidence from clinical trials varies widely. Melatonin and magnesium are two of the more widely researched supplements, which have numerous studies, with conflicting results. Other compounds such as nitrates, zinc, vitamin D, and L-theanine are less supported. Additional research is needed in order to more appropriately recommend these dietary supplements for sleep improvements.

https://journals.sagepub.com/doi/full/10.1177/15598276241227915?casa_token=I23q1TYaqAAAAAAA:T8EAo3_SNvWmQXm1ykuQt-NccceissWM5i05n-qHMX2oVBTYZOAUlxPEE9a79JUQvBSzoHT_hQE

Effects of mindfulness-based interventions on promoting athletic performance and related factors among athletes: A systematic review and meta-analysis of randomized controlled trial. International Journal of Environmental Research and Public Health, 20:2038, 2023.

Abstract - In recent years, mindfulness-based interventions (MBIs) have been widely applied in competition sports with respect to athletic performance and mental health promotion, whereas evidence of randomized controlled trials (RCTs) has not been well summarized. Therefore, this study aimed to systematically review and meta-analyze the existing evidence on the effects of MBIs on improving athletic performance, mindfulness level, mindfulness-related psychological components (e.g., acceptance, self-compassion, flow), and mental health (e.g., burnout, stress, psychological well-being) among athletes. Following the PRISMA guidelines, a literature search was implemented on five electronic databases (Web of Science, PubMed, Scopus, ProQuest, and ScienceDirect) and relevant review papers. The article selection, risk of bias assessment, and data extraction were performed by two investigators independently. The standardized mean difference (SMD) was calculated to evaluate the effects of interventions using the random effect model. Among the 1897 original hits, thirty-two eligible RCT studies were included in the systematic review, of which seven were involved in the meta-analysis. The results showed that MBIs were effective in promoting athletes' athletic performances (by narrative synthesis), mindfulness-level ($n = 3$; $SMD = 0.50$, $95\% CI = [0.17, 0.83]$; $I^2 = 45\%$, $p = 0.16$), and mindfulness-



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related psychological components ($n = 5$; $SMD = 0.81$, 95% $CI = [0.53, 1.10]$, $I^2 = 77\%$, $p = 0.001$), while no significant intervention effects were found on the mental health of athletes ($n = 4$; $SMD = -0.03$, 95% $CI = [-0.35, 0.29]$, $I^2 = 89\%$, $p < 0.001$). Our findings preliminarily support the potential effectiveness of MBIs, whereas more high-quality RCTs were needed in the future.

<https://www.mdpi.com/1660-4601/20/3/2038>

Implementing velocity-based training to optimize return to sprint after anterior cruciate ligament reconstruction in soccer players: A clinical commentary. International Journal of Sports Physical Therapy, 19(3):355-365, 2024.

Abstract - After anterior cruciate ligament reconstruction (ACLR), return to sprint is poorly documented in the literature. In soccer, return to sprint is an essential component of return to play and performance after ACLR. The characteristics of running in soccer are specific (velocity differences, nonlinear, intensity). It is important to address these particularities, such as curvilinear running, acceleration, deceleration, changes of direction, and variations in velocity, in the patient's rehabilitation program. Force, velocity, and acceleration capacities are key elements to sprint performance. Velocity-based training (VBT) has gained much interest in recent years and may have a role to play in optimizing return to play and return to sprint after ACLR. Force, velocity, and acceleration can be assessed using force-velocity-power and acceleration-speed profiles, which should inform rehabilitation. The purpose of this commentary is to describe a velocity-based return to sprint program which can be used during ACLR rehabilitation.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10909314/>



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Mechanical and metabolic power in accelerated running – Part 2: Team sports. *European Journal of Applied Physiology*, 124:417-431, 2024.

Purpose: This manuscript is devoted to discuss the interplay between velocity and acceleration in setting metabolic and mechanical power in team sports.

Methods: To this aim, an essential step is to assess the individual Acceleration-Speed Profile (ASP) by appropriately analyzing training sessions or matches. This allows one to estimate maximal mechanical and metabolic power, including that for running at constant speed, and hence to determine individual thresholds thereof.

Results: Several approaches are described and the results, as obtained from 38 official matches of one team (Italian Serie B, season 2020-2021), are reported and discussed. The number of events in which the external mechanical power exceeded 80% of that estimated from the subject's ASP ([Formula: see text]) was 1.61 times larger than the number of accelerations above 2.5 m s^{-2} ([Formula: see text]). The difference was largest for midfielders and smallest for attackers (2.30 and 1.36 times, respectively) due to (i) a higher starting velocity for midfielders and (ii) a higher external peak power for attackers in performing [Formula: see text]. From the energetic perspective, the duration and the corresponding metabolic power of high-demanding phases ([Formula: see text]) were essentially constant (6 s and 22 W kg^{-1} , respectively) from the beginning to the end of the match, even if their number decreased from 28 in the first to 21 in the last 15-min period, as a consequence of the increased recovery time between [Formula: see text] from 26 s in the first to 37 s in the last 15-min period.

Conclusion: These data underline the flaws of acceleration counting above fixed thresholds.

<https://link.springer.com/article/10.1007/s00421-023-05286-1>



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Softball

A national survey on the relationship of youth sport specialization behaviors to self-reported anxiety and depression in youth softball players. Sports Health, 16(2): 184-194, 2024.

Background: There are little to no data on whether any associations exist between sport specialization and mental health in youth softball athletes.

Hypothesis: Highly specialized youth softball athletes will have worse self-reported depression and anxiety symptom scores compared with low and moderate specialized athletes.

Study Design: Cross-sectional survey.

Level of Evidence: Level 4.

Methods: An online cross-sectional survey was distributed in the fall of 2021 to a national sample of female youth softball athletes between the ages of 12 and 18 years. Sport specialization status was determined using a 3-point specialization scale that classifies either low, moderate, or high. The patient health questionnaire-9 (PHQ-9) and the 7-item general anxiety disorder scale (GAD-7) were used to assess self-reported symptoms of depression and anxiety. Comparison also included sports participation and specialization behaviors between specialization groups.

Results: A total of 1283 subjects (mean age, 15.1 ± 1.7 years) fully completed the survey. After adjusting for covariates, lower scores were reported on both the PHQ-9 and GAD-7 by highly specialized athletes compared with moderate or low specialization athletes (PHQ-9, high = 8.6 ± 0.4 ; moderate = 11.2 ± 0.3 ; low = 10.9 ± 0.5 ; $P < 0.01$; GAD-7, high = 6.5 ± 0.4 ; moderate = 8.6 ± 0.3 ; low = 8.4 ± 0.4 , $P < 0.01$). Conversely, higher scores were reported on both scales for athletes who received private softball coaching compared with those who did not (PHQ-9, 11.5 ± 0.3 vs 9.0 ± 0.3 ; $P < 0.01$; GAD-7, 8.8 ± 0.3 vs 6.9 ± 0.3 , $P < 0.01$). Finally, athletes who reported an arm overuse injury in the previous year reported higher PHQ-9 scores (10.8 ± 0.3 vs 9.8 ± 0.3 ; $P < 0.01$).

Conclusion: While sport specialization, as measured by the validated 3-point scale, was not associated with increased anxiety and depression symptom scores, other aspects of specialization behavior such as private coaching or overuse injury history were associated with worse scores on these scales, indicating potential concern for anxiety and depression. However, although the differences we observed were statistically significant, they did not exceed the minimal clinically important difference values that have been established for the PHQ-9 (5 points) or GAD-7 (4 points).



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Clinical Relevance: This project is a first step toward understanding the sport specialization behaviors and their influence on the mental health of youth softball athletes. Focusing on investigating specialization behaviors further may reveal to be a better indicator of risk of developing anxiety and depression symptoms compared with utilizing the 3-point specialization scale.

<https://journals.sagepub.com/doi/epub/10.1177/19417381241228539>

Results of a national survey on sport specialization behavior and throwing arm injury in youth softball players. Sports Health, 16(3): 327-332, 2024.

Background: There are few data on throwing arm and shoulder injury in youth softball athletes, and no data on the influence of sport specialization on injury in softball.

Hypothesis: We hypothesized that highly specialized athletes, and pitchers in particular, demonstrating various sport specialization behaviors would be more likely to report an upper extremity overuse injury in the previous 12 months.

Study design: Cross-sectional survey.

Level of evidence: Level 4.

Methods: An online, anonymous, cross-sectional survey was distributed to a national sample of female youth softball players between the ages of 12 and 18 years in fall 2021. Topics included were indicators of sport specialization and self-reported injuries to the throwing arm.

Results: A total of 1309 participants (mean age, 15.1 ± 1.7 years) completed the survey; 19.4% (N = 254) scored as highly specialized, 69.7% (N = 912) as moderately specialized, and 10.9% (N = 143) with low specialization. Of all participants, 27.3% (N = 357) pitched in the previous year. A minority of all players (43.7%; N = 572) reported arm injury in the previous 12 months, with 45.9% of pitchers (N = 164) reporting the same. Multivariate regression showed increased adjusted odds ratio (aOR) of injury history for athletes playing >30 games per year (aOR, 1.74; 95% CI, 1.26-2.40), participating on a club team (aOR, 3.36; 95% CI, 1.85-6.07), and in pitchers participating on club teams (aOR, 2.97; 95% CI, 1.18-7.45). Decreased aOR of injury was noted in those participating in >8 months of softball per year (aOR, 0.25; 95% CI, 0.12-0.51) and in pitchers who were moderately specialized (aOR, 0.39; 95% CI, 0.17-0.92) and playing >8 months per year (aOR, 0.33; 95% CI, 0.11-0.96).

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Conclusion: This sample provides a large proportion of athletes classified as high or moderately specialized in youth softball (89%). A large proportion (43.7%) of subjects reported arm injury in the past year, and insight into injury risk is provided. The results present conflicting data on the risk versus protective effect of specialization in youth softball athletes.

Clinical relevance: This project is a first step toward understanding sport specialization behavior and its influence on injury in youth softball.

<https://journals.sagepub.com/doi/epub/10.1177/19417381231171356>

Swimming

Understanding the effects of training on underwater undulatory swimming performance and kinematics. Sports Biomechanics, 23(6): 772-787, 2024.

Abstract - In swimming, the underwater phase after the start and turn comprises gliding and dolphin kicking, with the latter also known as underwater undulatory swimming (UUS). Swimming performance is highly dependent on the underwater phase; therefore, understanding the training effects in UUS and underwater gliding can be critical for swimmers and coaches. Further, the development of technique in young swimmers can lead to exponential benefits in an athlete's career. This study aimed to evaluate the effects of a training protocol on UUS and underwater gliding performance and kinematics in young swimmers. Seventeen age group swimmers (boys = 10, girls = 7) performed maximal UUS and underwater gliding efforts before and after a seven-week training protocol. Time to reach 10 m; intra-cyclic mean, peak, and minimum velocities; and gliding performance improved significantly after the training protocol. The UUS performance improvement was mostly produced by an improvement of the upbeat execution, together with a likely reduction of swimmers' hydrodynamic drag. Despite the changes in UUS and gliding, performance was also likely influenced by growth. The findings from this study highlight kinematic variables that can be used to understand and quantify changes in UUS and gliding performance.

https://www.tandfonline.com/doi/pdf/10.1080/14763141.2021.1891276?casa_token=fHEYMeWA0RYAAAAA:kYSjBm8iUv-ViGnxJEvogWAZgjkGu2PoxoPt9GZNYjKDJKdC3-hoNSHy2Sqf3i2R39_BX5m8a1A



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Effect of the pre-taper level of fatigue on the taper-induced changes in performance in elite swimmers. *Frontiers in Sports and Active Living*, 6:1353817, 2024.

Introduction: In swimming, performance gains after tapering could be influenced by the pre-taper level of fatigue. Moreover, this level of fatigue could be associated with sleep. This study aimed to assess (1) the effect of tapering on performance according to the pre-taper level of fatigue in swimmers and (2) the association between sleep and pre-taper level of fatigue.

Methods: Physiological, psychological and biomechanical profiles were evaluated in 26 elite swimmers on 2 occasions to estimate the pre-taper level of fatigue: at T0 and T1, scheduled respectively 10 and 3 weeks before the main competition. Sleep quantity and quality were also evaluated at T0 and T1. Race time was officially assessed at T0, T1 and during the main competition. The level of significance was set at $p \leq .05$.

Results: Fourteen swimmers (17 ± 2 years) were allocated to acute fatigue group (AF) and 12 swimmers (18 ± 2 years) to functional overreaching group (F-OR). From T1 to the main competition, performance was improved in AF ($+1.80 \pm 1.36\%$), while it was impaired in F-OR ($-0.49 \pm 1.58\%$, $p < 0.05$ vs. AF). Before taper period, total sleep time was lower in F-OR, as compared to AF. Conversely, the fragmentation index was higher in F-OR ($p = .06$). From wakefulness to sleep, body core temperature decreased in AF but not in F-OR.

Discussion: Performance gain after tapering was higher in AF swimmers than in overreached. Moreover, pre-taper sleep was poorer in overreached swimmers, which could contribute to their different response to the same training load. This poorer sleep could be linked to a lower regulation of internal temperature.

<https://www.frontiersin.org/articles/10.3389/fspor.2024.1353817/full>



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Tennis

Does time of day and player chronotype impact tennis-specific skills and physical performance? International Journal of Sports Science & Coaching, 19(1): 315-322, 2024.

Abstract - Tennis players' success relies on tennis skills, such as groundstrokes and serves, and physical attributes, such as strength, speed and endurance. This study aimed to determine if players' tennis skills and physical attributes are influenced by time of day, chronotype or sleep-wake behavior (SWB). Twelve male tennis players (age (years): 28.17 ± 7.85) competing in state-level competitions wore a wrist-worn activity monitor (GT3X, Actigraph) and completed a modified version of the Consensus Sleep Diary to measure SWB. The Chalder Fatigue Scale and Morningness and Eveningness Questionnaire were used to measure players' fatigue and preferred chronotype. Mid-sleep with a sleep correction was used to determine players' current chronotype. After the baseline period, players were tested at 8:00 am, 2:00 pm and 8:00 pm, with the order of testing sessions randomized for each player. Testing sessions were separated by at least 48 hours. Players' groundstrokes, serve speed, agility, overhead medicine ball throw and Hit and Turn Test performance were measured in each session. General linear modelling revealed that backhand consistency was less in the evening compared to the morning by 17% ($p=0.020$) and afternoon by 15% ($p=0.040$). Maximal service velocity was less in the evening compared to the afternoon by 10.5 km/h ($p=0.041$). Chronotype did not influence tennis skills or physical performance. Average and maximal backhand velocities were reduced for every hour that time at lights out, and sleep-onset time was postponed. Tennis skills, but not physical performance tests, were influenced by time of day and SWB.

https://journals.sagepub.com/doi/full/10.1177/17479541221136023?casa_token=LpYc6boPlqkAAAAA:3TxNIG7cVFHoHq6FHBjclBVmdc9ZjUeKxaSPbV5HvzGeGpafgdKyJzh9e4FbgGY9w5hJ78dT7pE

Does motor imagery training improve service performance in tennis players? A systematic review and meta-analysis. Behavioral Sciences, 14:207, 2024.

Abstract - Motor imagery training is a common mental strategy used by tennis players and coaches to improve learning and performance; however, the effect of motor imagery training on service performance in tennis players is questionable. This review aims to consolidate existing research regarding the effects of motor imagery training on the service performance of tennis players. A systematic search was conducted following the PRISMA guidelines, using



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PubMed, Web of Science, SCOPUS, and SPORTDiscus to identify articles published until December 2023. Eligible studies comprised controlled trials that investigated the impact of motor imagery on service performance outcomes in tennis players. The methodological quality of individual studies was assessed using the Cochrane RoB-2 and ROBINS-I tools. GRADE was applied to assess the certainty of the evidence. Nine trials including 548 participants met the inclusion criteria. The results indicated that motor imagery training improved service accuracy and technique but did not affect service speed or return accuracy in tennis players. In conclusion, the certainty of the evidence that motor imagery training may be effective in improving service accuracy and technique in tennis players is low to very low. However, more experimental work is needed to obtain stronger conclusions.

<https://www.mdpi.com/2076-328X/14/3/207>

Volleyball

Validity and reliability of the volleyball serve accuracy-test. Journal of Human Sports and Exercise, 19(2): 570-578, 2024.

Abstract - This study aimed to examine the content, face, and sensitive validity, and test-retest reliability of a volleyball overhand serve accuracy-test. Four experts – university professors evaluated the content validity; 50 volleyball coaches, teachers, and athletes were enrolled in the face validity. Thirty-three undergraduate students (18 experienced and 15 novices) participated in the study to assess the test capability to detect different performance levels. The sensitive validity was examined by comparing differences in the serving accuracy among experience levels using the t-test for independent samples. A cluster analysis (hierarchical cluster) was conducted using the between-groups linkage method and the Euclidean quadratic distance measure. The test-retest reliability was analyzed using intraclass correlation coefficients and the standard error. Satisfactory results were found for experts' agreement regarding the test's accuracy and content validity. Face validity was adequate regarding clarity, pertinence, and applicability (78% to 86% of agreement). A high degree of test-retest reliability was observed for both novices (ICC = 0.81) and experienced (ICC = 0.84) participants; experienced group ($p = .001$) had higher means. The volleyball serve accuracy-test is a viable alternative to assess beginners' performance in a teaching-learning context.

<https://www.jhse.ua.es/article/view/validity-reliability-volleyball-serve-accuracy-test>



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A multidimensional approach to talent identification in youth volleyball through declarative tactical knowledge and functional fitness. Journal of Functional Morphology and Kinesiology, 9:29, 2024.

Abstract - This study aimed to assess which multidimensional performance indexes were the best predictors of talent identification in volleyball. Fifty-five female players (age: 13.8 ± 1.81 years; mass: 55.12 ± 8.12 kg; height: 158.23 ± 7.62 cm) were clustered into two groups according to some physical characteristics (i.e., the first group included players with more favorable performance predictors). Musculoskeletal Fitness (MSF), Functional Motor Competence (FMC), and Declarative Tactical Knowledge (DTK) were measured as multidimensional indexes of performance. Moderately-large differences between groups were found for each index in favor of the first group. Regression analyses were performed to examine the variance explained by MSF, FMC, and DTK in the two groups. A model with FMC components explained slightly more variance in the group predictor variables ($R^2 = 0.53$) than a model using only MSF components ($R^2 = 0.45$). Among FMC components, the score of the Throw-and-Catch test resulted in the best predictor (Odds Ratio = 1.58) for determining group selection, followed by the score of the Supine-to-Stand-and-Go test (Odds Ratio = 0.02). An additional model composed by MSF and FMC significant predictors (i.e., functional fitness index) and DTK explained 63% of the variance ($R^2 = 0.63$), and these were significant predictors of group membership (Odds Ratio = 6.32 and Odds Ratio = 1.51, respectively). A more comprehensive multidimensional analysis of youth performances is warranted to identify and monitor the best players in a youth volleyball context.

<https://www.mdpi.com/2411-5142/9/1/29>



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Wrestling/Combat Sports

An investigation of some motoric characteristics of national elite wrestling athletes. Science, Movement and Health, Vol. 24(1): 51-57, 2024.

Aim: This study reveals the data of the analysis of the motoric characteristics of thirty National A wrestling athletes, ten Greco-Roman, ten freestyle and ten female.

Methods: The study included 10 national wrestling athletes, 10 freestyle and 10 female National A wrestling athletes.

Results: These data show a high level of training of the athletes and confirm the specificity of these tests for single fights. The applied tests are informative for the estimation of the functional state of athletes. The dynamics of their results gives the necessary information to predict the success of athletes and can be used in monitoring their condition.

Conclusions: As a result of the tests performed in elite athletes, it is recommended to give special exercise movements for muscle groups with muscle imbalances.

<https://openurl.ebsco.com/EPDB%3Agcd%3A9%3A21839865/detailv2?sid=ebsco%3Aplink%3Ascholar&id=ebsco%3Agcd%3A175221997&crl=c>

Sport-related concussions in wrestling: Does mechanism of injury affect recovery? Journal of Sports Medicine and Physical Fitness, Ahead of Print: 1-7, 2024.

Background: Sport-related concussions (SRC) represent a significant concern for athletes. While popular contact sports such as football and soccer have been the focus of much SRC research, wrestling has received comparatively little attention. The current study aimed to: 1) describe the mechanisms of injury leading to SRC in wrestling; and 2) compare recovery outcomes based on mechanism of injury.

Methods: A retrospective, cohort study of wrestlers aged 12-18 who sustained a concussion between 11/2017-04/2022 was performed. Contact mechanism was defined as what initiated contact with the athlete's head/body. Player mechanism was defined as the activity the injured athlete was performing when the concussion occurred. Recovery outcomes were compared using Mann-Whitney-U Tests and multivariable regression analysis.

Results: Seventy-three (age=15.8±1.4 years; boys=73 [100.0%]) wrestlers were included. SRCs occurred more often in competition than in practice (66.2% vs. 33.8%, respectively). Head-to-ground/wall (56.2%) and takedown (58.9%) were



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the most common contact and player mechanisms, respectively. Bivariate analysis showed that head-to-head/body SRCs had longer time to symptom resolution compared to head-to-ground/wall SRCs (23.0 [14.8-46.5] vs. 14.0 [6.0-30.0] days; $U=149.00$, $P=0.029$), though the difference did not persist in multivariable analysis. For player mechanism, non-takedowns SRCs had longer time to symptom resolution than takedown SRCs (15.0 [6.0-24.0] vs. 28.5 [13.0-49.3]; $U=166.5$, $P=0.019$), but the difference also did not persist in multivariable analysis. Bivariate analysis revealed no significant difference in RTL between takedown and non-takedown SRCs (3.0 [2.0-6.0] vs. 4.0 [1.5-7.0]; $U=484.50$, $P=0.708$); however, in multivariable analysis, takedown SRCs were associated with longer RTL ($\beta=0.23$, 95% CI: 0.02, 9.27; $P=0.049$).

Conclusions: The current study found that SRCs occurred more commonly during competitions, and head-to-ground/wall and takedown were the most common contact and player mechanism, respectively. SRCs that occurred during takedowns were associated with longer RTL.

UPCOMING USCAH EVENT!

ATHLETEALIVE2025 is a student athlete safety initiative, steered by a collaboration of the following organizations: The Coalition for the Registration of Exercise Professionals (CREP), NATA Intercollegiate Council on Sport Medicine (ICSM) and the U.S. Council for Athletes Health (USCAH). The purpose of this initiative is to reduce the prevalence of preventable student athlete injuries and deaths, associated with conditioning and training; inclusive of proper emergency management. This initiative reflects the requirements associated with the NCAA Interassociation Recommendations Preventing Catastrophic Injury and Death in Collegiate Athletes. The goal is to reach full compliance by all collegiate Strength and Conditioning Coaches by January 1, 2025.

For Additional Information on this important topic visit: <http://athletealive2025.org/>