FAST BREAK

Publication for team medical personnel

Pre-participation medical evaluation

September 2024

ISSUE 16

WELCOME to FAST BREAK!

Welcome to Fast Break, the official quarterly news bulletin of the FIBA Medical Commission. Our goal is to introduce our FIBA sports medicine and sports science community to newsworthy research topics and develop a community of practice among physicians and clinicians involved with basketball at every level of play across the globe.

We hope this publication will foster friendly communication and discussions within the world of basketball. We welcome and encourage your questions, comments, suggestions, and contributions to this publication.

MESSAGE FROM THE EDITOR

Basketball was invented to keep youth active indoors during the long, cold North American winters. September marks the start of the basketball season in many countries, which means physicians and team staff are busy conducting pre-participation evaluation (PPE) of fitness to play. There are innumerable positions, policies and procedures when considering medical evaluations in basketball. What is done for and during an evaluation, and the extent of ancillary biomedical testing varies greatly depending on the age of the athlete, competitive level of play, and financial resources of the team. The PPE is done to ensure the health of the player to withstand the rigors of training and competition in basketball, as well as identify injury risk factors and evaluate performance capacity. A thorough approach that considers the broader bio-psycho-social aspect of athlete health and wellness can be incredibly taxing on team medical and training staff, resources and time.

In this edition of the Fast Break, Dr. Anik Shawdon, FIBA Medical Commission member, will discuss the overarching concepts to the pre-participation medical evaluation. We also present bit of a deeper-dive with a selection of validated measures and evaluation tools for your practice that may assist you in assessing the athletes' fitness to play. Our guest editorial this month is provided by Lauren Buschmann, MSc, CSAC. Ms. Buschmann is a certified strength and conditioning specialist with Canada Basketball. She will address the assessment and measurement of physical fitness for performance in basketball. We hope this edition of the Fast Break will help you to foster a more effective and inclusive preseason assessment of fitness for sport participation.

Marni Wesner, MD, MA, CCFP(SEM), FCFP, Dip Sport Med
Editor, Fast Break
Email: medical@FIBA.basketball

IN THIS ISSUE

UPCOMING WEBINAR SESSIONS

The FIBA medical commission would like to invite you to join our two last webinar sessions for 2024. These are a practical session to support team doctors with common eye injuries and ENT and maxillofacial injuries in basketball.

Eye-injury in basketball

Thursday, 17 October at 11am CET

Doctor Ibrahim Dunia, FIBA Medical Commission member and Consultant in Ophthalmology with subspecialty in Paediatric Ophthalmology and Strabismus. He has been practicing since 1995 in Lebanon and different Arab countries where he earned a strong reputation for his esteem medical competence, high ethical standards and treasured patient care. He also played professionally for several years.

In this session, Dr Dunia will present common eye injuries in basketball and discuss their management.

Please find *here* the link to register to this session.

Ear Nose and Throat, and Maxillo-Facial injuries in Basketball

The session will be scheduled on 9 December and the time will be confirmed.

Professor Darryl Tong, Maxillofacial surgeon, and Mr Dean Ruske, ENT/ORL surgeon both at the University of Otago in Dunedin, NZ. Both have a passion for basketball, and education.

Please find *here* the link to pre-register to this session.

FIBA MEDICAL COMMISSION EDITORIAL

Pre-Participation Evaluation in Basketball

Dr Anik Shawdon, MBBS, FACSEP

Sport and Exercise Physician, Melbourne, Australia

FIBA Medical Commission Member

Introduction

Pre-participation evaluation (PPE) or pre-participation screening (PPS) is an important part of the medical management of a sports team. While there is general agreement on the need for such a process, the wording of the questionnaire, extent of the clinical examination, investigations and timing of the evaluations remain widely debated and varies between healthcare practitioners. The PPE also can vary depending on the age and level of the player, as well as the resources available both to perform the evaluation and to provide appropriate follow up.

What is the purpose of the PPE?

Firstly, and possibly most importantly, the PPE aims to identify any previously undiagnosed conditions, in particular cardiac, which may lead to a sudden cardiac arrest or other serious adverse outcome. These might include identification of Marfan's syndrome with aortic root or cardiac valve abnormality, a cardiomyopathy or rhythm disorder such as Wolff-Parkinson-White, Brugada or long QT syndrome. In a 'worst case' scenario a player may be advised to stop participating in high intensity sport, but in other cases of identified pathology, therapeutic intervention or medication may enable a long and successful sporting career.

Another important component of the PPE is to perform baseline concussion testing against which recovery from a concussion can be assessed. Our increasing awareness of both the short- and longer-term effects of concussion has led to more rigour in both our assessment and rehabilitation of concussions in basketball. Baseline tests should be performed in the pre-season and should be accompanied by an education session by the club or team doctor which highlights the importance of concussion and the rationale behind the graded return to play process.

Evaluation of a player's mental health is a valuable component of the PPE both to assist you in your management of the player, but also to ensure that any issues are being appropriately managed. We do recommend establishing a link with a good sports psychiatrist or psychologist to assist in the assessment and management of mental health issues in your players.

Further objectives of the PPE include assessment of any conditions (medical, musculoskeletal or other) that might impact training or performance, as well identification of predisposing factors for injury. In particular it is important to carefully go through any previous injuries that your player might have sustained. It is important to ensure that they have fully recovered and have no residual functional deficits that could predispose to recurrence or other injury.

For medical staff travelling with teams, it is vital that they know any medical conditions that might affect participation (e.g.: Type 1 diabetes, anaphylaxis, allergies to medications) or personal issues that might impact the player in the context of travelling with a team (fear of flying, travel sickness). Recognition of use of WADA prohibited medications that require a therapeutic use exemption is important.

The less 'objective' reasons, but in my view important, are to 'get to know' your player, make sure that they know your role and how to contact you and to initiate a trusting, working relationship.

When to do the PPE?

The PPE is best done in the pre-season to ensure that there is adequate time to address any issues identified before the season starts. A limited PPE can also be useful prior to travel with a team. The purpose of this is to ensure that the travelling medical team are aware of any medical issues, medications or other concerns that could pose problems in the travelling/competition environment as well as confirming fitness to travel and play. The PPE process takes time and should not be rushed so it is important to ensure that adequate time is set aside in the training schedule for this purpose. In general, an initial PPE for a new or rookie player will require a more in-depth assessment than the PPE for returning or veteran player's PPE where the physician is already aware of the much of the player's history.

What comprises the PPE?

At the outset, it is vital that the parameters for sharing and storage of medical information collected in the PPE process should be established. The player/parents/guardian should sign written consent to undergo the PPE after explanation of how, and on what basis, the information would be used or shared. Some medical information might be shared with physical therapists, sports science personnel and other allied team medicine staff but this is usually limited and always upon appropriate clinical rationale. What information may be shared with coaching staff, and for what purpose, needs to be explicitly outlined to the athlete, and consent to share that information must be documented. The player should also be offered a copy of the results for their own records.

The PPE starts with a basic past medical health and symptom questionnaire, which can be modified depending on the age, gender and level of your players. It should include (at least but not limited to) questions relating to potential cardiac issues (based upon the American Heart Association guidelines), pre-existing medical conditions and symptoms of all body systems, medications, supplements, allergies, injury and concussion history and a basic mental health screen. Additional questions relating to bone and pelvic floor health, nutritional history, Relative Energy Deficiency screening and menstrual health can also be added. **Here** is the link to the Pre-Participation Evaluation in Basketball Screenin, noting that the club doctor can add questions or examination details depending on the unique circumstances of their playing cohort and personal preference.

Clinical examination is important and at the least should include a poly-system screen, as well as a detailed cardiorespiratory assessment, screening for Marfan's and a full assessment of all previously injured areas. A physical therapist may do a more in-depth musculoskeletal assessment, which for basketball would focus on lower limb joints, strength and biomechanics, as well as shoulder and spine evaluation. Further examination should be tailored to the responses in the questionnaire

The inclusion of a 12 lead ECG screening as a component of the PPE remains debated and varies widely around the world, as does the age of starting testing. At one end of the spectrum, all participants in organised sport (defined by regular training and competition) from the age of 7 years in Italy undergo a Nationally funded annual 12 lead ECG and stress testing. In 2020 Harmon et al compared two screening protocols in US college athletes; one with history and physical examination alone and one including ECG. Their group concluded that the addition of ECG resulted in a 6-fold increase in likelihood of detecting a cardiovascular condition, and improved cost efficiency by 5-fold.
https://www.sciencedirect.com/science/article/abs/pii/S1547527120304069
Routine 12 lead ECG is recommended every 2 years in elite athletes over the age of 16 in Australia (https://www.acsep.org.au/icms_docs/340701_position-statement-on-pre-participation-

cardiac-evaluation-in-young-athletes.pdf), with echocardiography, electrophysiology studies or other tests based upon the clinical history, examination (e.g. murmur or Marfanoid features) and ECG findings. If ECGs are performed, they should be assessed by a physician experienced with the nuances of the athletic heart, consistent with the International Criteria for Electrocardiographic Interpretation in Athletes: consensus statement https://bjsm.bmj.com/content/bjsports/51/9/704.full.pdf. It is important to note, that if ECG is not feasible as a routine part of the PPE (funds, access to devices or specialist reporting), there is still value in taking a comprehensive history of cardiac issues in the player and their immediate family, as well as clinical examination.

Baseline concussion tests can include the SCAT 6 or computerised programs such as Cognigram or ImPACT. They should, at least, include a symptom checklist, cognitive evaluation and testing of balance and vestibulo/ocular function. Budget, clinical availability and expertise will influence what type of baseline concussion tests are performed. Further information is available in the Consensus Statement on Concussion in Sport, October 2022
https://bjsm.bmj.com/content/57/11/695

There is much debate about how best to screen for mental health and wellbeing in athletes, and this can depend upon age, level of play and gender of the cohort as well as demographic factors. Use of the IOC SMHAT-1 is recommended as a screening for mental health issues in your players. This is a great tool and starts with the ASPQ as a screen. If the player scores <17 no further assessment is required, but if ≥ 17, a further series of psychological tests are indicated. https://olympics.com/athlete365/app/uploads/2021/06/BJSM-SMHAT-1-Athlete365-2020-102411.pdf.

What to do with results?

It is important to note that the PPE is only as good as the follow up and ensuring that all required interventions are performed in a timely manner before the athlete is required to be on the court or in the training room. Any issues identified should firstly be discussed with your player and then a plan created for follow up before they are cleared to play. An important part of the discussion with the player should include who, if any other team members, need to know about a concern (physical therapist, sports scientist, coach etc) and what details that discussion will disclose.

Information collected in the PPE should be stored in a secure [electronic] medical record and a copy of the PPE offered to the player.

From the medical perspective the PPE assists in confirming that there are no identified contraindications to high intensity training and that any medical conditions are being treated optimally and with anti-doping in mind. If required, a TUE might be required to enable a player to participate while using a WADA prohibited medication (e.g. Insulin for type 1 diabetes or stimulants for ADHD). Injury history and a comprehensive musculoskeletal assessment (usually in combination with the team physical therapist) can ensure that there are no residual functional deficiencies following an injury and that any obvious predisposing factors for injury are addressed with a suitable exercise-based rehabilitation program. Baseline assessments (medical history, physical examination, concussion testing) will be valuable if any issues emerge in the player's career. Referrals to specialists can be made following the PPE, aiming to have clearances or a management plan prior to the start of the season/competition.

A final word is a reminder that a 'normal' PPE, including clinical and investigation results, does not guarantee that no adverse events will happen in a player's career, but a thorough PPE will reduce the risks substantially. In addition, the team doctor will have a good snapshot of the health of their players and in turn have a more rewarding experience in the role.

GUEST EDITORIAL

In this edition, Lauren Buschmann, MSc., CSCS, discusses the importance of pre-season physical fitness assessment in basketball.

Strength and Conditioning Considerations for Basketball

Lauren Buschmann, MSc., CSCS

As athletes begin to arrive for many professional clubs around the world, medical, paramedical, and physical performance staff are preparing for intake assessments (i.e., pre-participation evaluations and physical/physiological testing batteries) upon their arrival. There are a wide variety of considerations when designing and developing physical testing batteries: the qualities that need to be assessed, the metrics that best reflect those qualities, and the tests that are best able to capture those metrics. The data from intake assessments is used to inform training program priorities, exercises, and adaptations that need to be targeted within a periodized strength and conditioning program. A critical approach to optimizing both the intake assessment and strength and conditioning program development is reverse engineering the demands of the sport; meaning, how are the physical preparation staff preparing athletes for the demands of a game, full season, or specific competition (1). A high percentage of injuries occur in pre-season training and practices (2,19) possibly due to insufficient preparation of intensity/volumes to match on-court demands. To effectively reverse engineer the on-court sporting demands, physical performance staff must consider what the athlete needs to be able to physically execute (movements, volumes, intensities) as an outcome measure, and determine the athlete's starting point through initial assessment.

A standard physical testing battery should assess the key components required for the performance staff to develop individual, sport specific training programs that will inform strength training and energy system development while preparing athletes for the rigours of a professional, collegiate, or international training schedule (or in some instances, all 3 schedules within a singular calendar year). When designing initial intake assessments and physical/physiological testing batteries, two streams within strength and performance training need to be prioritized concurrently: programming for on-court performance, and athlete health. When considering sport-specific performance, training programs should be designed to address the physiological qualities of the sport, positional considerations, and individual physical strengths/gaps. When considering athlete health, common injuries/mechanisms, individual movement screening, corrective programming, previous injury history, and compensatory patterns (9) must be accounted for.

Basketball's physiological profile consists of a mixture of (3,4, 5,6,7,17) :

- low intensity activities (standing, walking, jogging) typically lasting up to 60 seconds,
- moderate intensity activities (running, lateral shuffles) typically lasting up to 15 seconds,
- high intensity activities (sprinting, accelerations/decelerations, change of directions, jumping) typically lasting less than 10 seconds.

Within this physiological profile, strength and conditioning programs should aim to prepare athletes for the demands of game volume and intensity. Training programs and intake assessments should consider the total output for external and internal training load that athletes will need to replicate during games throughout the length of the season. External training load is the physical work being completed by the exercise task – both in volume/quantity, and intensity. Depending on the nature of the task (e.g. on-court versus weight room) external load could be measured by indicators of intensity (e.g. tonnage or load during a weight room session, percentage of one repetition maximum [%1RM], etc.), speed (e.g., high speed distance, maximal or average velocity), or volume (e.g., total distance, total repetitions, total duration, time on feet, etc.)[18]. Internal training load is the individual athlete's physiological response to training (e.g., heart rate recovery, maximal heart rate, time spent in %HRmax zones, etc.) [18]. Over the course of a competitive match, elite basketball players demonstrate an ability to cover large amounts of total distance in game – with upwards of six kilometres of distance covered in competition. [3,4] Due to the intermittent nature of basketball, this accumulated distance is comprised of a mixture of low-, moderate- and high-intensity activities. Basketball players need to be able to perform high velocity movements (jump, sprint, change direction) through physical contact, and rapidly in response to the environment around them. Previous studies using accelerometry data have quantified external load volumes, including a varying range of total accelerations (43-105) and total decelerations (24 to 95) per game [4]. Previous studies have shown internal training load, measured as a percentage of game time spent above 85% HRmax, to be upwards of 76-93% of game time in collegiate and professional basketball players [8]. It is paramount that physical preparation staff consider these volumes, intensities, and actions when designing and developing their processes and programs. Intake assessments and training programs should incorporate aspects of high velocity training to address these components that athletes will need to execute repeatedly in game. Conditioning assessments and programming should target the varying durations of activity and the intensity at which they are executed in practice and games.

When athletes report for pre-season, it is necessary to determine the baseline fitness level athletes are presenting relative to key metrics identified by performance staff. Comparing the initial findings to the demands of the game will help to inform how the strength and conditioning program will be structured to align team and individual physical preparation for optimal performance. Once this information is collected at baseline, a structured approach to training adaptations should include foundational strength and hypertrophy development, speed, and power development (both in the weight room and on court) and change of direction ability to appropriately prepare the players for the demands of training sessions and games.

From a performance perspective, strength and conditioning programs should aim to identify the physical profiles needed in basketball. This should include lower/upper body strength and stability, plyometrics, elasticity/power, and lumbopelvic strength/stability. Dynamic movement patterns including accelerations, decelerations (ability to stop, start, and change direction) should be included in a comprehensive training program. Positional differences and training needs should also be accounted for during program design. For example, the physical movements and skills that a ball-dominant point guard needs to prepare to execute on court vary significantly from that of a back-to-the-basket centre.

From a health perspective, strength and conditioning training should address individual athlete history (training age, previous injury history), as well as work to address common injury patterns/risks, volumes and mechanisms that may occur in the sport. Strength and conditioning training cannot eliminate all injuries, but training programs can provide the athlete with tissue durability and robustness [10] that allows the athlete to withstand repeated high velocity sprint, deceleration and change of direction events that occur over the course of a game [4, 10, 11]. This can help to mitigate the risk/occurrence of acute soft tissue injuries by preparing the tissues for the intensity, velocity and range of motion that will be experienced on the field of play. Pre-season intake assessment and testing aids in determining a baseline for athlete readiness that will inform future training program exercise intensity and volume prescription. It has been previously established that athlete availability is one of the biggest determinants of team/program success [12,13]. The ability to test, assess, re-test and refine strength and conditioning programs to address the needs of individual players and build robustness to withstand, and recover from high-intensity efforts over the course of a collegiate or professional basketball season is critical to supporting continued athlete availability throughout weekly and monthly training cycles.

When designing a structured training program for basketball players, emphasis should be placed on gradual, progressive training programs that address the most common injury risks that exist within the sport. Targeted training to address lower body strength to mitigate the risk of hip, knee, and ankle joint sprains, strains and tendinopathy are extremely important to include in a basketball-specific strength and conditioning training program. It has been previously observed that lower body injuries account for ~64% of injuries in basketball players [11]. Additionally, considerations in training programs should include focused programming to address repeated overhead movements (shoulder strength, stability), and lumbopelvic strength/stability to maintain longevity and availability of basketball players.

If the only testing occurs at baseline intake, the physical performance staff is only capturing a snapshot of the athlete in that specific moment in time. Monitoring efficacy of training programs through frequent planned re-assessment is necessary to adapt/adjust training programs based on individual response. Test-retest allows the physical performance staff to determine impact and progress on the physical/physiological qualities and key performance indicators that the training programs was designed to improve. The adage in strength and conditioning is "if you're not assessing, you're guessing". It is like throwing a dart in the dark. Without baseline testing, and re-assessment, it is difficult to know if the training program is having the desired impact. Using pre-season and continued in-season physical testing assessments is necessary to assess baseline, monitor progress and efficacy of training programs throughout the microcycles, mesocycles and macrocycles within the season for both individual and positional groups training goals/needs. Microcycles are the shortest period of training in a training program – typically comprised of 1 training week. Mesocycles refer to the training block that is comprised of several microcycles (e.g. a 4-week training phase with an emphasis on strength development). Macrocycles refer to the longest phase of periodized training, in the case of basketball this would be the length of the training and competitive season. Continued testing and re-assessment allows for the ability to pivot and adjust as needed without squandering time during a defined period of training, such as a macrocycle. It is important to be aware of the time-course required for sufficient development of the training qualities that the strength and conditioning program is aiming to target and ensure that re-testing occurs at a sufficient interval for worthwhile adaptation to occur. The physical preparation staff can review testing data from re-assessment and determine if the training program is effective in creating the desired training adaptations. If not, the re-assessment allows a checkpoint for necessary adjustments to be made to further refine and target the training goals of the individual athlete and/or team.

When designing a physical testing battery, the physical performance staff should consider including assessments for maximal or relative strength lower body strength, lower body power, agility/change of direction, speed / repeated sprint ability. Lower body strength and lower body power have been demonstrated to have a strong correlation with change of direction ability [14, 15], and given the high volume of change of directions within a basketball game, the two qualities should be closely assessed and monitored within a training program. From a conditioning perspective, the intermittent nature of basketball means that there are significant anaerobic and aerobic energy system demands at varying times of the game [4, 6, 16]. Physical testing batteries should consider assessments that quantify both aerobic and anaerobic measures to appropriately structure energy system development in training programs.

To provide further context, an example to consider is incorporating lower body power assessment into a physical testing battery. Lower body power is applicable to the sporting needs (players jump for rebounds, to block shots, catch passes, and when they shoot, etc.), can provide significant information on training need or focus, and is a training quality that translates to several other movement skills or training qualities important to basketball (lower body strength, speed, change of direction ability). Assessing vertical jumps can be a simple and effective method for quantifying lower body power for basketball players. There are several different methods of vertical jumps that can be incorporated into a testing battery in a time-efficient manner, with a variety of equipment and/or desired outcomes. Vertical jumps are relatively simple to implement in a testing battery across large groups of athletes, which can be particularly useful in academy or youth sport settings. It is a movement that can be measured with simple tools (tape measure, Vertec, jump mat) or more complex (force plates). Vertical jumps are incredibly versatile movements to incorporate into physical testing batteries depending on the desired outcome or parameters for assessment. As an example, if the priority of testing is measuring inter-limb asymmetry, performance staff could incorporate single leg countermovement to compare left versus right leg jump height differences, or if using force plates, performance staff can assess take-off and landing asymmetries between limbs during countermovement jumps.

Testing-retesting also allows for adjustments to training programs in a timely manner – to ensure that maximal impact/outcome is being achieved. Strength and conditioning (both availability and priority of) is often limited relative to on-court hours during the competitive season. The need to assess the efficacy of the program and adapt to best suit the individual or team needs is paramount to a successful strength and conditioning training program.

Ultimately, physical performance staff should consider several factors pertaining to physical performance and athlete health when designing, implementing, and refining their physiological testing battery, and subsequent strength and conditioning programs. These considerations should include health and performance factors specific to basketball, time-course for development of physiological training qualities, appropriate re-testing interval, and appropriate exercise prescription/selection to address the identified gaps from testing data. At the end of the day, if the physical preparation staff is not checking the baseline where the athlete is starting from, and the impact of the training program, they're guessing when it comes to the periodization, and resulting training adaptations from the training program. A comprehensive intake assessment, periodized strength and conditioning program, and appropriate re-assessment battery (both in composition and timing) is fundamental to physical preparation and performance optimization for basketball players throughout their pre-season, in-season, and post-season training process

References:

1. Turner, A., Read, P., Maestroni, L., Chavda, S., Yao, X., Papadopoulos, K., Virgile, A., Spiegelhalter, A., and Bishop, C. Reverse engineering Strength and Conditioning: Applications to Agility Training. *Strength and Conditioning Journal, 2022; Vol 44 No. 4. P. 85-94.*
2. Mateos Conde J, Cabero Morán MT, Moreno Pascual C. Prospective epidemiological study of basketball injuries during one competitive season in professional and amateur Spanish basketball. *Phys Sportsmed*. 2022;50(4):349-358. doi:10.1080/00913847.2021.1943721
3. Scanlan A, Dascombe B, Reaburn P. A comparison of the activity demands of elite and sub-elite Australian men's basketball competition. *J Sports Sci*. 2011;29(11):1153-1160. doi:10.1080/02640414.2011.582509
4. Petway AJ, Freitas TT, Calleja-González J, Medina Leal D, Alcaraz PE. Training load and match-play demands in basketball based on competition level: A systematic review. *PLoS One*. 2020;15(3):e0229212. Published 2020 Mar 5. doi:10.1371/journal.pone.0229212
5. Ben Abdelkrim N, El Fazaa S, El Ati J. Time-motion analysis and physiological data of elite under-19-year-old basketball players during competition. *Br J Sports Med*. 2007;41(2):69-75. doi:10.1136/bjsm.2006.032318
6. Gottlieb R, Shalom A, Calleja-Gonzalez J. Physiology of Basketball - Field Tests. Review Article. *J Hum Kinet*. 2021;77:159-167. Published 2021 Jan 30. doi:10.2478/hukin-2021-0018
7. Torres-Ronda L, Ric A, Llabres-Torres I, de Las Heras B, Schelling I Del Alcazar X. Position-Dependent Cardiovascular Response and Time-Motion Analysis During Training Drills and Friendly Matches in Elite Male Basketball Players. *J Strength Cond Res*. 2016;30(1):60-70. doi:10.1519/JSC.0000000000001043

8. Power CJ, Fox JL, Dalbo VJ, Scanlan AT. External and Internal Load Variables Encountered During Training and Games in Female Basketball Players According to Playing Level and Playing Position: A Systematic Review. *Sports Med Open*. 2022;8(1):107. Published 2022 Aug 19. doi:10.1186/s40798-022-00498-9
9. Gamble, Paul. 'Strength and conditioning' theory and practice-a need to know." *New Zealand Journal of Sports Medicine*, 2015; 42(1):24-27
10. Lauersen JB, Andersen TE, Andersen LB. Strength training as superior, dose-dependent and safe prevention of acute and overuse sports injuries: a systematic review, qualitative analysis and meta-analysis. *Br J Sports Med*. 2018;52(24):1557-1563. doi:10.1136/bjsports-2018-099078
11. Andreoli CV, Chiaramonti BC, Buriel E, Pochini AC, Ejnisman B, Cohen M. Epidemiology of sports injuries in basketball: integrative systematic review. *BMJ Open Sport Exerc Med*. 2018;4(1):e000468. Published 2018 Dec 27. doi:10.1136/bmjsem-2018-000468
12. Hägglund M, Waldén M, Magnusson H, Kristenson K, Bengtsson H, Ekstrand J. Injuries affect team performance negatively in professional football: an 11-year follow-up of the UEFA Champions League injury study. *Br J Sports Med*. 2013;47(12):738-742. doi:10.1136/bjsports-2013-092215
13. Williams S, Trewartha G, Kemp SP, et al. Time loss injuries compromise team success in Elite Rugby Union: a 7-year prospective study. *Br J Sports Med*. 2016;50(11):651-656. doi:10.1136/bjsports-2015-094798
14. Cabarkapa D, Fry AC, Lane MT, Hudy A, Dietz PR, Cain GJ, et al. The importance of lower body strength and power for future success in professional men's basketball. *Sports Sci Health*. (2020) 10:10–6. doi: 10.7251/SSH2001010C

15. Andreoli CV, Chiaramonti BC, Buriel E, Pochini AC, Ejnisman B, Cohen M. Epidemiology of sports injuries in basketball: integrative systematic review. *BMJ Open Sport Exerc Med*. 2018;4(1):e000468. Published 2018 Dec 27. doi:10.1136/bmjsem-2018-000468
16. Hägglund M, Waldén M, Magnusson H, Kristenson K, Bengtsson H, Ekstrand J. Injuries affect team performance negatively in professional football: an 11-year follow-up of the UEFA Champions League injury study. *Br J Sports Med*. 2013;47(12):738-742. doi:10.1136/bjsports-2013-092215
17. Williams S, Trewartha G, Kemp SP, et al. Time loss injuries compromise team success in Elite Rugby Union: a 7-year prospective study. *Br J Sports Med*. 2016;50(11):651-656. doi:10.1136/bjsports-2015-094798
18. Cabarkapa D, Fry AC, Lane MT, Hudy A, Dietz PR, Cain GJ, et al. The importance of lower body strength and power for future success in professional men's basketball. *Sports Sci Health*. (2020) 10:10–6. doi: 10.7251/SSH2001010C
19. Ramirez-Campillo R, García-Hermoso A, Moran J, Chaabene H, Negra Y, Scanlan AT. The effects of plyometric jump training on physical fitness attributes in basketball players: A meta-analysis. *J Sport Health Sci*. 2022;11(6):656-670. doi:10.1016/j.jshs.2020.12.005
20. de Araujo GG, de Barros Manchado-Gobatto F, Papoti M, Camargo BH, Gobatto CA. Anaerobic and aerobic performances in elite basketball players. *J Hum Kinet*. 2014;42:137-147. Published 2014 Oct 10. doi:10.2478/hukin-2014-0068
21. Montgomery PG, Pyne DB, Minahan CL. The physical and physiological demands of basketball training and competition. *Int J Sports Physiol Perform*. 2010;5(1):75-86. doi:10.1123/ijspp.5.1.75
22. Impellizzeri FM, Marcora SM, Coutts AJ. Internal and External Training Load: 15 Years On. *Int J Sports Physiol Perform*. 2019;14(2):270-273. doi:10.1123/ijspp.2018-0935
23. Tummala SV, Hartigan DE, Makovicka JL, Patel KA, Chhabra A. 10-Year Epidemiology of Ankle Injuries in Men's and Women's Collegiate Basketball [published correction appears in Orthop J Sports Med. 2019 Mar 29;7(3):2325967119837985. doi: 10.1177/2325967119837985].

In this edition of the Fast Break, we are making a departure from the traditional listing of academic publications related to basketball; instead, we are including a host of common, empiric and validated measures that you may find helpful for your pre-season evaluation of basketball athletes.

Pre-participation health evaluation in adolescent athletes competing at Youth Olympic Games: proposal for a tailored protocol.

Adami PE, Squeo MR, Quattrini FM, et al. Br J Sports Med 2019;53:1111–1116. https://doi.org/10.1136/bjsports-2018-099651

Objective: To promote sports participation in young people, the International Olympic Committee (IOC) introduced the Youth Olympic Games (YOG) in 2007. In 2009, the IOC Consensus Statement was published, which highlighted the value of periodic health evaluation in elite athletes. The objective of this study was to assess the efficacy of a comprehensive protocol for illness and injury detection, tailored for adolescent athletes participating in Summer or Winter YOG. **Methods**: Between 2010 and 2014, a total of 247 unique adolescent elite Italian athletes (53% females), mean age 16±1,0 years, competing in 22 summer or 15 winter sport disciplines, were evaluated through a tailored pre-participation health evaluation protocol, at the Sports Medicine and Science Institute of the Italian Olympic Committee. **Results**: In 30 of the 247 athletes (12%), the pre-participation evaluation led to the final diagnosis of pathological conditions warranting treatment and/or surveillance, including cardiovascular in 11 (4.5%), pulmonary in 11 (4.5%), endocrine in five (2.0%), infectious, neurological and psychiatric disorders in one each (0.4%). Based on National and International Guidelines and **Recommendations**: none of the athletes was considered at high risk for acute events and all were judged eligible to compete at the YOG. Athletes with abnormal conditions were required to undergo a periodic follow-up. **Conclusions:** The Youth Pre-Participation Health Evaluation proved to be effective in identifying a wide range of disorders, allowing prompt treatment, appropriate surveillance and avoidance of potential long-term consequences, in a significant proportion (12%) of adolescent Italian Olympic athletes.

The LEAF questionnaire: A screening tool for the identification of female athletes at risk for the female athlete triad.

Melin A, Tornberg AB, Skouby S, Faber J, Ritz C, Sjodin A, et al. Br J Sports Med. 2014; 48: 540–545.

Background: Low energy availability (EA) in female athletes with or without an eating disorder (ED) increases the risk of oligomenorrhoea/functional hypothalamic amenorrhoea and impaired bone health, a syndrome called the female athlete triad (Triad). There are validated psychometric instruments developed to detect disordered eating behaviour (DE), but no validated screening tool to detect persistent low EA and Triad conditions, with or without DE/ED, is available. AIM: The aim of this observational study was to develop and test a screening tool designed to identify female athletes at risk for the Triad. **Methods**: Female athletes (n=84) with 18-39 years of age and training ≥5 times/week filled out the Low Energy Availability in Females Questionnaire (LEAF-Q), which comprised questions regarding injuries and gastrointestinal and reproductive function. Reliability and internal consistency were evaluated in a subsample of female dancers and endurance athletes (n=37). Discriminant as well as concurrent validity was evaluated by testing self-reported data against measured current EA, menstrual function and bone health in endurance athletes from sports such as long distance running and triathlon (n=45). **Results**: The 25-item LEAF-Q produced an acceptable sensitivity (78%) and specificity (90%) in order to correctly classify current EA and/or reproductive function and/or bone health. **Conclusions**: The LEAF-Q is brief and easy to administer, and relevant as a complement to existing validated DE screening instruments, when screening female athletes at risk for the Triad, in order to enable early detection and intervention.

The idea of the female athlete triad has been supplanted in sport and exercise medicine by the concept of Relative Energy Deficiency in Sport (REDs) as it is well appreciated that low energy availability impacts upon all body systems in male and female athletes.

The International Olympic Committee has published a number of papers and clinical tools on this topic:

1. International Olympic Committee Relative Energy Deficiency in Sport Clinical Assessment Tool 2 (IOC REDs CAT2). British Journal of Sports Medicine. 57(17):1068-1072, 2023 Sept.

2. 2023 International Olympic Committee's (IOC) consensus statement on Relative Energy Deficiency in Sport (REDs). British Journal of Sports Medicine. 57(17):1073-1097, 2023 Sep.

3. Review of the scientific rationale, development and validation of the International Olympic Committee Relative Energy Deficiency in Sport Clinical Assessment Tool: V.2 (IOC REDs CAT2)-by a subgroup of the IOC consensus on REDs. British Journal of Sports Medicine. 57(17):1109-1118, 2023 Sep.

4. Best practice recommendations for body composition considerations in sport to reduce health and performance risks: a critical review, original survey and expert opinion by a subgroup of the IOC consensus on Relative Energy Deficiency in Sport (REDs). British Journal of Sports Medicine. 57(17):1148-1158, 2023 Sep.

5. Intersection of mental health issues and Relative Energy Deficiency in Sport (REDs): a narrative review by a subgroup of the IOC consensus on REDs. British Journal of Sports Medicine. 57(17):1127-1135, 2023 Sep.

6. Primary, secondary and tertiary prevention of Relative Energy Deficiency in Sport (REDs): a narrative review by a subgroup of the IOC consensus on REDs. British Journal of Sports Medicine. 57(17):1119-1126, 2023 Sep.

The Athlete Sleep Screening Questionnaire: a new tool for assessing and managing sleep in elite athletes.

Samuels C, James L, Lawson D*, et al*. *British Journal of Sports Medicine* 2016;**50:**418-422.

Background: The purpose of this study was to develop a subjective, self-report, sleep-screening questionnaire for elite athletes. This paper describes the development of the Athlete Sleep Screening Questionnaire (ASSQ). **Methods** A convenience sample of 60 elite athletes was randomly distributed into two groups; 30 athletes completed a survey composed of current psychometric tools, and 30 athletes completed a revised survey, and a sleep specialist structured

clinical interview. An item analysis was performed on the revised survey with comparison to clinical decisions regarding appropriate intervention based on a sleep specialist assessment. **Results:** A comparison of existing sleep-screening tools with determination of clinical need from a sleep specialist showed low consistency, indicating that current sleep-screening tools are unsuitable for assessing athlete sleep. A new 15-item tool was developed (ASSQ) by selecting items from existing tools that more closely associated with the sleep specialist's reviews. Based on test-retest percentage agreement and the κ-statistic, we found good internal consistency and reliability of the ASSQ. To date, 349 athletes have been screened, and 46 (13.2%) identified as requiring follow-up consultation with a sleep specialist. Results from the follow-up consultations demonstrated that those athletes identified by the ASSQ as abnormal sleepers *have* required intervention. **Conclusions:** The research developed a new athlete-specific sleep-screening questionnaire. Our findings suggest that existing sleep-screening tools are unsuitable for assessing sleep in elite athletes. The ASSQ appears to be more accurate in assessing athlete sleep (based on comparison with expert clinical assessment). The ASSQ can be deployed online and provides clinical cut-off scores associated with specific clinical interventions to guide management of athletes' sleep disturbance. The next phase of the research is to conduct a series of studies comparing results from the ASSQ to blinded clinical reviews and to data from objective sleep monitoring to further establish the validity of the ASSQ as a reliable sleep screening tool for elite athletes.

The Clinical Validation of the Athlete Sleep Screening Questionnaire: an Instrument to Identify Athletes that Need Further Sleep Assessment.

Bender AM, Lawson D, Werthner P, Samuels CH. Sports Med Open. 2018 Dec; 4: 23. Published online 2018 Jun 4. doi: 10.1186/s40798-018-0140-5

Background: Previous research has established that general sleep screening questionnaires are not valid and reliable in an athlete population. The Athlete Sleep Screening Questionnaire (ASSQ) was developed to address this need. While the initial validation of the ASSQ has been established, the clinical validity of the ASSQ has yet to be determined. The main objective of the current study was to evaluate the clinical validity of the ASSQ. **Methods:** Canadian National Team athletes (*N* = 199; mean age 24.0 ± 4.2 years, 62% females; from 23 sports) completed the ASSQ. A subset of athletes (*N* = 46) were randomized to the clinical validation sub-study which required subjects to complete an ASSQ at times 2 and 3 and to have a clinical sleep interview by a sleep medicine physician (SMP) who rated each subjects' category of clinical sleep problem and provided recommendations to improve sleep. To assess clinical validity, the SMP category of clinical sleep problem was compared to the ASSQ. **Results:** The internal consistency (Cronbach's alpha = 0.74) and test-retest reliability (*r* = 0.86) of the ASSQ were acceptable. The ASSQ demonstrated good agreement with the SMP (Cohen's kappa = 0.84) which yielded a diagnostic sensitivity of 81%, specificity of 93%, positive predictive value of 87%, and negative predictive value of 90%. There were 25.1% of athletes identified to have clinically relevant sleep disturbances that required further clinical sleep assessment. Sleep improved from time 1 at baseline to after the recommendations at time 3. **Conclusions.** Sleep screening athletes with the ASSQ provides a method of accurately determining which athletes would benefit from preventative measures and which athletes suffer from clinically significant sleep problems. The process of sleep screening athletes and providing recommendations improves sleep and offers a clinical intervention output that is simple and efficient for teams and athletes to implement.

International Olympic Committee (IOC) Sport Mental Health Assessment Tool 1 (SMHAT-1) and Sport Mental Health Recognition Tool 1 (SMHRT-1): towards better support of athletes' mental health

Gouttebarge V, Bindra A, Blauwet C*, et al*. *British Journal of Sports Medicine* 2021;55:30-37.

Objectives To develop an assessment and recognition tool to identify elite athletes at risk for mental health symptoms and disorders. **Methods** We conducted narrative and systematic reviews about mental health symptoms and disorders in active and former elite athletes. The views of active and former elite athletes (N=360) on mental health symptoms in elite sports were retrieved through an electronic questionnaire. Our group identified the objective(s), target group(s) and approach of the mental health tools. For the assessment tool, we undertook a modified Delphi consensus process and used existing validated screening instruments. Both tools were compiled during two 2-day meeting. We also explored the appropriateness and preliminary reliability and validity of the assessment tool. **Sport Mental Health Assessment Tool 1 and Sport Mental Health Recognition Tool 1** The International Olympic Committee Sport Mental Health Assessment Tool 1 (SMHAT-1) was developed for sports medicine physicians and other licensed/registered health professionals to assess elite athletes (defined as professional, Olympic, Paralympic or collegiate level; aged 16 years and older) potentially at risk for or already experiencing mental health symptoms and disorders. The SMHAT-1 consists of: (i) triage with an athlete-specific screening tool, (ii) six subsequent disorder-specific screening tools and (iii) a clinical assessment (and related management) by a sports medicine physician or licensed/registered mental health professional (e.g., psychiatrist and psychologist). The International Olympic Committee Sport Mental Health Recognition Tool 1 (SMHRT-1) was developed for athletes and their entourage (e.g., friends, fellow athletes, family and coaches). **Conclusion** The SMHAT-1 and SMHRT-1 enable that mental health symptoms and disorders in elite athletes are recognised earlier than they otherwise would. These tools should facilitate the timely referral of those athletes in need for appropriate support and treatment.

Marfan syndrome
Spencer M. *Nursing* 54(4):p 19-25, April 2024.

This article provides a comprehensive review of Marfan Syndrome (MFS), covering its epidemiology, etiology, clinical presentations, diagnostics, complications, and treatment modalities. The Ghent II Nosology of MFS criteria are crucial in MFS diagnosis, guiding clinicians in identifying high-risk patients. Nursing implications underscore the importance of screenings, assessments, and close follow-ups to optimize the continuum of care for individuals with MFS.

Training Logs can be a very useful tool for keeping track of workouts, training load, and recovery, and to help identify changes in physical or mental function that may portend injury. There are many online resources that discuss aspects to record in a training log. Here are just a few from the North American popular press you may want to review:

a) https://www.urmc.rochester.edu/encyclopedia/content.aspx?contenttypeid=1&contentid=1037
b) https://www.urmc.rochester.edu/encyclopedia/content.aspx?contenttypeid=1&contentid=1037
c) https://www.polar.com/blog/workout-log/
d) https://www.journalmenu.com/perfect-training-log/

Or consider making up your own training log that considers the metrics you feel are important for tracking the physical and mental health of your basketball athletes. Included herein is a generic and basic example:

TRAINING LOG SAMPLE TEMPLATE

(athlete may record daily or weekly data)

Name: ____________________________ Week ending: ______________________

Training location: ___________________________ Altitude: ___________________

Fill in the table below with the number of minutes and sessions of training activity you did in the past week and your perceived level of intensity of the training session:

	SPORT-SPECIFIC TRAINING	CARDIO TRAINING	RESISTANCE TRAINING
DURATION OF TRAINING			
FREQUENCY OF TRAINING			
TRAINING INTENSITY (0-10)			

What was your resting morning heart rate today? _______________ bpm

What was your heart rate 2 minutes after getting out of bed? ___________ bpm

Sleep Quality: (Place a mark along the line to indicate how well/poorly you slept this week.)

I slept very well I didn't sleep at all

How many hours of sleep did you get last night? _________________ hours.

How many hours do you usually sleep each night? ________________ hours.

Yes or No: I have been feeling fatigued this week.

Yes or No: I have more than usual muscle soreness this week.

Yes or No: I think I am coming down with something.

Yes or No: Training right now feels monotonous.

List all your current stressors (i.e. work, school, family, financial, sponsor...):

____

____

____

On a scale of 0 – 3, rank the following statements (0= agree, 3= strongly disagree)

1. I feel happy. _____
2. I am encouraged about the future. _____
3. I feel successful. _____
4. I get pleasure from things I do. _____
5. I have confidence in myself. _____
6. I criticize/blame myself. _____
7. I cry more than usual. _____
8. I am restless. _____
9. I have lost interest in things. _____
10. I can make decisions easily. _____
11. I feel worthy _____
12. I have energy to do what I need to do. _____
13. My need for sleep has changed. _____
14. I am irritable. _____
15. My appetite has changed. _____
16. I have no difficulty concentrating. _____
17. I am tired/fatigued. _____
18. I have lost interest in sex. _____

Recovery Methods (check all that apply):

_____ massage

_____ cold tub

_____ physical therapy

_____ social activity (family/friends)

_____ other (please list):

____

____

Beyond acute concussion assessment to office management: a systematic review informing the development of a Sport Concussion Office Assessment Tool (SCOAT6) for adults and children.

Patricios JS, Schneider GM, van Ierssel J*, et al.British Journal of Sports Medicine* 2023; 57:737-748.

Objectives To systematically review the scientific literature regarding the assessment of sport-related concussion (SRC) in the subacute phase (3–30 days) and provide recommendations for developing a Sport Concussion Office Assessment Tool (SCOAT6). **Data sources** MEDLINE, Embase, PsycINFO, Cochrane CENTRAL, CINAHL, SPORTDiscus and Web of Science searched from 2001 to 2022. Data extracted included study design, population, definition of SRC diagnosis, outcome measure(s) and results. Eligibility criteria (1) Original research, cohort studies, case–control studies, diagnostic accuracy and case series with samples >10; (2) SRC; (3) screening/technology that assessed SRC in the subacute period and (4) low risk of bias (ROB). ROB was performed using adapted Scottish Intercollegiate Guidelines Network criteria. Quality of evidence was evaluated using the Strength of Recommendation Taxonomy classification. **Results** Of 9913 studies screened, 127 met inclusion, assessing 12 overlapping domains. Results were summarised narratively. Studies of acceptable (81) or high (2) quality were used to inform the SCOAT6, finding sufficient evidence for including the assessment of autonomic function, dual gait, vestibular ocular motor screening (VOMS) and mental health screening. **Conclusion** Current SRC tools have limited utility beyond 72 hours. Incorporation of a multimodal clinical assessment in the subacute phase of SRC may include symptom evaluation, orthostatic hypotension screen, verbal neurocognitive tests, cervical spine evaluation, neurological screen, Modified Balance Error Scoring System, single/dual task tandem gait, modified VOMS and provocative exercise tests. Screens for sleep disturbance, anxiety and depression are recommended. Studies to evaluate the psychometric properties, clinical feasibility in different environments and time frames are needed.

Language Matters: Comparisons of Concussion Assessments Among English- and Spanish-Speaking Middle School Athletes.

Journal of Athletic Training. 59(5):493-498, 2024 May 01.

Context: The Child Sport Concussion Assessment Tool, fifth edition (Child SCAT5), is among the most widely used international pediatric concussion evaluation tools. However, the tool's English-only aspect may limit its use for patients who speak different languages. Prior researchers have suggested one's preferred language (i.e., home language) could be associated with concussion assessments in adults, yet how this might affect pediatric athletes is not well understood. **Objective:** To compare baseline Child SCAT5 assessment outcomes between middle school athletes whose home language was Spanish and matched control athletes whose home language was English. **Design:** Case-control study. **Setting:** Middle school athletics. **Patients or other participants**: Athletes self-reported their home language (i.e., language spoken at home). Those indicating their home language was Spanish were individually matched to athletes who spoke English at home on age, sex, sport, school, and pertinent comorbidities (e.g., concussion history). The final sample consisted of 144 athletes (Spanish home language = 72, English home language = 72). **Main outcome measure(s)**: We used Mann-Whitney U tests to compare the Child SCAT5 component scores of the home language groups (i.e., Spanish versus English). **Results**: Athletes in the Spanish home language group scored lower on the Standardized Assessment of Concussion-Child version ($P < .01$, $r = -0.25$), Immediate Memory

(P < .01, r = -0.45), and total modified Balance Error Scoring System scores (P < .01, r = -0.25) than the English home language group. **Conclusions**: Matched athletes whose home language was Spanish versus English scored differently on baseline Child SCAT5 assessment components. Those with the home language of Spanish scored lower on cognitive and balance tasks than those whose home language was English. These findings may serve as a rationale for the development of future concussion assessment tools to properly capture clinically relevant data regarding language differences among pediatric athletes.

Evaluation of the SCAT 5 tool in the assessment of concussion in Para athletes: a Delphi study.

British Journal of Sports Medicine. 58(12):655-664, 2024 May 31.

Objectives: To investigate if the sport concussion assessment tool version 5 (SCAT5) could be suitable for application to Para athletes with a visual impairment, a spinal cord injury, or a limb deficiency. **Methods**: A 16-member expert panel performed a Delphi technique protocol. The first round encompassed an open-ended questionnaire, with round 2 onwards being composed of a series of closed-ended statements requiring each expert's opinion using a five-point Likert scale. A predetermined threshold of 66% was used to decide whether agreement had been reached by the panel. **Results**: The Delphi study resulted in a four-round process. After round 1, 92 initial statements were constructed with 91 statements obtaining the targeted level of agreement by round 4. The expert panellist completion rate of the full four-round process was 94%. In the case of athletes with a suspected concussion with either limb deficiencies or spinal cord injuries, the panel agreed that a baseline assessment would be needed on record is ideal before a modified SCAT5 assessment. With respect to visual impairments, it was conceded that some tests were either difficult, infeasible or should be omitted entirely depending on the type of visual impairment. **Conclusion**: It is proposed that the SCAT5 could be conducted on athletes with limb deficiencies or spinal cord injuries with some minor modifications and by establishing a baseline assessment to form a comparison. However, it cannot be recommended for athletes with visual impairment in its current form. Further research is needed to determine how potential concussions could be more effectively evaluated in athletes with different impairments.

EDIFICATION FROM FIBA MEDICAL COMMISSION

This is a new segment for the Fast Break. Each quarter we will feature an editorial from a member of the FIBA Medical Commission on topics relevant to basketball.

FIBA Concussion Guidelines

The FIBA Medical Commission has recently published concussion guidelines for the 2024-2025 basketball season. Those guidelines are available with **this link**, and are reproduced below:

Aim

To provide guidance to team medical personnel in the management of sport related concussion (SRC) for FIBA events and protect the short- and long-term health of players.

These guidelines are for FIBA and other elite competitions to provide acute concussion management guidance.

Introduction

Concussion is a traumatic brain injury, induced by biomechanical forces to the head, or anywhere on the body, which transmit an impulsive force to the head. It usually results in rapid onset and short-lived neurological impairment, but the symptoms may evolve over the minutes, hours or days following the injury. The symptoms generally resolve without specific medical intervention. A brief period of relative rest for 24-48 hours followed by gradual return to activity, is the main treatment, and return to play should be overseen by the Team Doctor, who is familiar with the guidelines for management of concussion.

Any Player with a diagnosed concussion may *not* continue to play in that game (or continue to train) and should be cleared by the Team Doctor before returning to full training or playing.

Any Player with a suspected concussion should be removed from training or play and be assessed by the Team Doctor or other suitably experienced Medical Practitioner prior to return to training or play.

Preseason baseline testing of all Players is required (SCAT6, Cognigram, ImPACT or other). Formal neuropsychological assessment may be considered for players with a history of multiple or complex concussions.

Diagnosis

The diagnosis of concussion is clinical, with the presence of symptoms and signs suggestive of neurological dysfunction following direct trauma to the head or a transmitted force to the head. These might include loss of consciousness (which is relatively uncommon), convulsions or difficulty balancing or walking. Other symptoms and signs *may be* less obvious but include headache, dizziness, tinnitus, sensitivity to light or noise, nausea, poor concentration or memory. A full list of possible symptoms and signs can be found in the Sports Concussion Assessment Tool 6 (SCAT6). All Team medical staff should be familiar with the SCAT6.

The Concussion Recognition Tool 6 (CRT6) is a simple guide outlining how to recognize and manage concussion. This can be used by Team medical staff as well as other non-medically trained team members including coaches, high performance staff or referees.

Being clinical, a concussion diagnosis or its' exclusion cannot be made by non-healthcare trained individuals, e.g. players or coaches.

Game management

Any Player with a suspected or confirmed concussion should be removed from play or training for a medical assessment. If a concussion is confirmed, the Player cannot return to play in that game or continue training. If there is any doubt, the Player must not continue to participate that day.

If there is no doctor on site, then any Player with suspected or confirmed concussion may not continue to play or train and should be assessed by a doctor before being allowed to return to play.

In all cases of head trauma, first aid principles apply including consideration of emergency referral if there is suspicion of spinal injury (neck pain or weakness/tingling/burning in the arms or legs), increasing confusion, repeated vomiting, seizures or a deterioration of conscious state.

The SCAT6 is the recommended concussion assessment tool. It should be used in addition to the usual medical assessment of an injured Player. Ideally it should be performed by the Team Doctor, but it is acknowledged that a physiotherapist might be the sole medical staff member in attendance. All Team Doctors and Physiotherapists should be familiar with use of the SCAT6. The assessment should ideally be off the court, in a quiet area. If some cases, the SCAT6 assessment can be delayed to half or full time to enable a more thorough assessment, as long as the Player is not permitted to play in the interim and is monitored to ensure there is no deterioration of mental state or development of symptoms.

If concussion is excluded after a full assessment by a Doctor, the Player can return to play but must be regularly monitored for symptoms.

When video of the incident is available, it should be reviewed by the assessing practitioner to confirm the mechanism of trauma and assist with detecting any subtle signs of concussion that might have been missed on the initial direct observation.

Concussion is a clinical syndrome that can have a delayed onset (up to 48 hours) or evolve over time. The Player should be instructed on what symptoms and signs to look for and instructed to report these should they occur.

Immediate and obvious signs of concussion, directly observed or on video review:

1. Loss of consciousness or prolonged immobility
2. No protective action in fall to floor
3. Impact seizure or tonic posturing one or more limbs
4. Confusion, disorientation
5. Memory impairment
6. Balance disturbance or ataxia
7. Player reports concussion symptoms
8. Dazed, blank stare, not their normal selves
9. Behaviour change atypical of the Player

The Player should be immediately removed from play and take no further part in the game.

Text Box 1. Signs and symptoms of Concussion.

Emergency care

A Player diagnosed with concussion should have a through medical and neurological examination to exclude more serious structural injuries to the brain, head and neck. If there are signs of a more serious condition being present, then the Player should be immediately transferred to a hospital which has an emergency neurosurgical service. Signs suggesting a more serious injury might include repeated vomiting, altered conscious state, convulsions, severe headache, altered sensation in the arms of legs, double or blurred vision or a deterioration of any of these with time.

Return to Play

A Player diagnosed with concussion requires a clearance from a Medical Practitioner, ideally a Team Doctor, to return to full team training and playing. Under no circumstance is a Player with confirmed concussion allowed to return to play or training on the day of the injury. For the avoidance of doubt, the Team physiotherapist cannot clear a Player to return to training or playing on the day of injury or following the Graduated Return to Play (GRTP) process.

In general, a Player will recover in 7 to 10 days, but this can vary from individual to individual and in exceptional cases, the Player might be cleared to train and play sooner. This will only be at the clinical discretion, and upon approval from the Team Doctor. In many cases, the return to play will take considerably longer than 10 days. If the player is 18 years of age or younger, the priority will be return to school first and the process of return to play takes about a week longer.

An initial period of 24 – 48 hours relative physical and cognitive rest is required. Strict rest until complete resolution of symptoms has not been shown to be beneficial following sports related concussion.

Following the initial 24–48-hour period of relative rest, the Player may enter the GRTP program which is outlined in Text Box 2 below. Entry to this program can start even with some mild persistent symptoms.

The GRTP process, which starts after the 24-48 hours of relative rest, comprises five stages. All Players are expected to proceed through this process, with at least 24 hours per stage, and medical clearance prior to return to play.

In the first two stages of the GRTP, some symptoms are acceptable, but these should be mild and short lived (i.e.. worsen no more than 2 points on a 10-point scale and last for less than one hour).

In the final 3 stages of the GRTP, the Player must have no symptoms, either at rest or with intense activity. If there is recurrence of symptoms, they should return to stage 2.

The clearance to fully train and return to play should be made by the Team Doctor.

Baseline testing (e.g., SCAT6, Cognigram, ImPACT or other cognitive assessment) must have returned to baseline before a Player can return to play.

From a practical perspective, in rare instances where there is no Team Doctor, the Player will require at least two medical assessments. The first to confirm the diagnosis and commence the rehabilitation and the second to clear the Player for full training and play.

Graduated Return to Play (GRTP) – each stage to take at least 24 hours, can be longer (following the 24-48 hours of relative cognitive and physical rest)

1. Light/moderate aerobic exercise (up to approx. 70% max HR), such as walking, slow jog or stationary bike
2. Simple basketball skills such as free throws and shooting as well as *jumping, sprints change of direction including head and neck movements,* away from team

ONLY progress to Step 3 once symptom free at rest and with exertion

3. Full intensity team training, for a limited duration, with no body contact, e.g. half court scrimmage for 20 to 30 minutes followed by basketball skills
4. Full *training*, including possible contact, *following* medical clearance
5. Return to play

Any return of symptoms requires a return stage 2

Text Box 2. Graduated Return to Play (GRTP)

Young players

Players 18 years of age or younger require a more conservative approach and will usually take a little longer recovery time, typically 3 weeks or longer. The primary aim of rehabilitation of a younger player is to ensure cognitive recovery and consideration of their educational considerations.

This means that to compete in a FIBA Underage Competition a basketball player will have been through a thorough and uncomplicated rehabilitation period that will typically take 3 weeks.

Complex concussion cases

If the clinical symptoms or signs resulting from a concussion persist beyond that which were anticipated, the Team Doctor could consider referral to a neurologist, neurosurgeon, SEM physician or other specialist in the management of concussion. Players with history of multiple concussions, or where the apparent mechanism of injury appears to be very low impact might also benefit from a Specialist review.

The Player may be referred for a full neuropsychological assessment and may require a standard MRI to exclude structural brain damage. Other investigations will be undertaken as determined by the specialist examination. The Team Doctor should facilitate referral to a specialist upon specific request by the Player.

In difficult cases, the specialist is responsible for clearing the Player to return to full training and competition.

Education

All players, coaches and team support personnel should be briefed by the Team Doctor regarding the importance of appropriate management of concussion, the importance of being honest regarding symptoms and the short- and long-term risks of head trauma. All team personnel should be aware that the diagnosis and management of concussion is the exclusive domain of team healthcare personnel.

Professional leagues

In a professional league affiliated with FIBA, the same principles for the management of concussion exist as for a FIBA competition.

Authors

Dr Anik Shawdon and Dr Peter Harcourt

FIBA Medical Commission

References

Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport

https://bjsm.bmj.com/content/57/11/695

CRT6

https://bjsm.bmj.com/content/bjsports/57/11/692.full.pdf

SCAT6

http://www.sportsconcussion.co.za/sportconcussion/wp-content/uploads/2023/07/SCAT6-v6.pdf

SCOAT6

http://www.sportsconcussion.co.za/sportconcussion/wp-content/uploads/2023/07/SCOAT6-Instructions-v6.pdf

Child SCAT6

http://www.sportsconcussion.co.za/sportconcussion/wp-content/uploads/2023/07/Child-SCAT6-v5.pdf

Child SCOAT

https://bjsm.bmj.com/content/bjsports/57/11/672.full.pdf

Dr Ruben Echemendia, PhD, University of Michigan Concussion Centre Clinic: presentation on the 2022 Consensus and changes to the concussion recognition and assessment tools

https://www.youtube.com/watch?v=5P0Jj5wT9GY

Clark & Olson SCAT6 Application Demonstration: a useful example of the SCAT6 examination

https://www.youtube.com/watch?v=ASA-o29HWHI

FROM THE HISTORY BOOK

''The Chechen," Uvays Akhtaev, was born in 1930; he endured deportation at the age of 14 and survived hardship but after he was caught stealing, he found his calling in sport when he was taken to a sport club instead of jail. Standing at 2.36 meters tall, Uvays declined to participate in the 1952 Olympics and, to honour his nationality, he never competed internationally. He passed away in 1978, requesting a modest burial to avoid attracting visitors.

To watch him play, click here

SHARE YOUR PHOTOS

Please send us your funny, interesting, or remarkable basketball pictures that we can share with the medical and sport science basketball community.

Email: medical@FIBA.basketball

Olympic 3x3 venue, Place de la Concorde, Paris, France

By Dr Diego Grippo

NEWS AND NOTABLE FROM THE FIBA MEDICAL COMMISSION

Report from the Paris Olympics:

Supervisory Doctor Report
Dr Diego Grippo, FIBA Medical Commission
Paris 2024 Olympic Games. 3X3, Place de la Concorde

Most of the teams had a physiotherapist or trainer. In general, there were no team doctors. They usually used the doctor provided by the organizing committee or services at the Olympic village. Support medical services provided by the LOC were good. Medical services on site were close to the venue and to the player's locker rooms. The staff included doctors and paramedics. Every day a different medical team was at the venue. They were well placed close to the court. The medical room was very well equipped for first aid and emergencies. The staff at the court was fully equipped and close to the field play. There were also paramedic staff at the warmup areas. One ambulance service was provided by the LOC, fully equipped at the competition venue.

3x3 is a very competitive and physically demanding sport with a high chance of related injuries. When considering the location for the FIBA supervisory doctor at the event, it is very important to be close to the court to be able to see the mechanism of injury and to be readily available to assist if needed. Injuries sustained during competition included a fractured nose, finger sprains, minor cuts/abrasions and an adductor tendon strain.

The doping control station was located too far from the venue; players were transported by electric cars. The doping control station was consistent with the published standards.

Supervisory Doctor Report
Dr Peter Harcourt, FIBA Medical Commission
Paris 2024 Olympic Games. 5x5, Lille and Pairs, France

The Paris 2024 Olympic Games FIBA 5X5 competition involved 12 Men's and Women's teams and some of the best basketball players in the world. It was a very tight competition and tremendously enjoyable to watch. The anti-doping effort and healthcare oversight for players and match officials was overseen by Souheil Sayegh, Linda Voigt and myself. There were no serious injuries from the competition, however, there were a few moderate injuries:

- 2 ankle sprains (no time loss)
- Lacerated forehead requiring sutures (managed in the first aid room)
- 2 players with rib injuries following heavy collisions (no time loss)
- 1 player with suspected concussion, later diagnosed as a neck injury (no time loss)
- 1 player with confirmed concussion (missed 2 games)

The local medical personnel did a fantastic job supporting the team doctors and attending to match officials and FIBA staff - many thanks to Dr. Jean-Charles Delgarde.

This space is intended for sport science and medical students, residents, and fellows to contribute to our knowledge and conversation.

Please encourage your students to contribute to the Fast Break on a topic of their choosing related to basketball injury, rehabilitation or sport science. The work published here is reviewed and approved for submission by the student's preceptor.

Artificial Intelligence and Sport Medicine

Dr. Sofia Solar Caffaggi, B.Eng, MMT, MD, CCFP(SEM), Dip Sport Med
University of Alberta

Artificial Intelligence

The notion of using computers to simulate human intelligence was first described by Alan Turing in 1950. In his book Computers and Intelligence, he described his now famously known *"Turing test"*, a simple test to determine whether computers are capable of human intelligence. Several years later, in 1956, John McCarthy coined the term "artificial intelligence" (AI) during the Dartmouth Conference, birthplace of AI as a discipline [1]. Early AI research focused on developing algorithms that could mimic human reasoning. It began with simple "if, then" rules, and has since significantly advanced over several decades. The late 20th century saw significant advancements in machine learning (ML), a subset of AI that focuses on developing algorithms that can learn from and make predictions based on data. These advancements were facilitated by increased computational power and the availability of large datasets, which allowed for the development of more sophisticated AI models. ML has advanced into what is now commonly known as deep learning (DL), which is composed of algorithms to create an artificial neural network (ANN) that can then learn and make decisions on its own, analogous to the human brain.

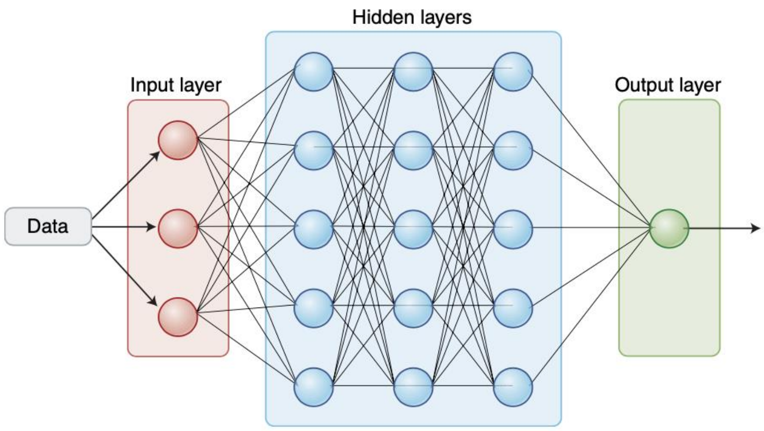

Fig. 1: A simplified deep neural network. Credit: Debbie Maizels/Springer Nature

A note on terminology:
AI refers to the broad field of study of the development of intelligent systems.
ML is a subset of AI that uses statistical models to allow computers to learn patterns from data.
DL refers to a subset of ML that uses a specific type of algorithm known as a neural network to recognize complex patterns in data without being explicitly programmed to do so. Most state-of-the-art ML systems in radiology today use DL, including ML systems for musculoskeletal (MSK) imaging [2].

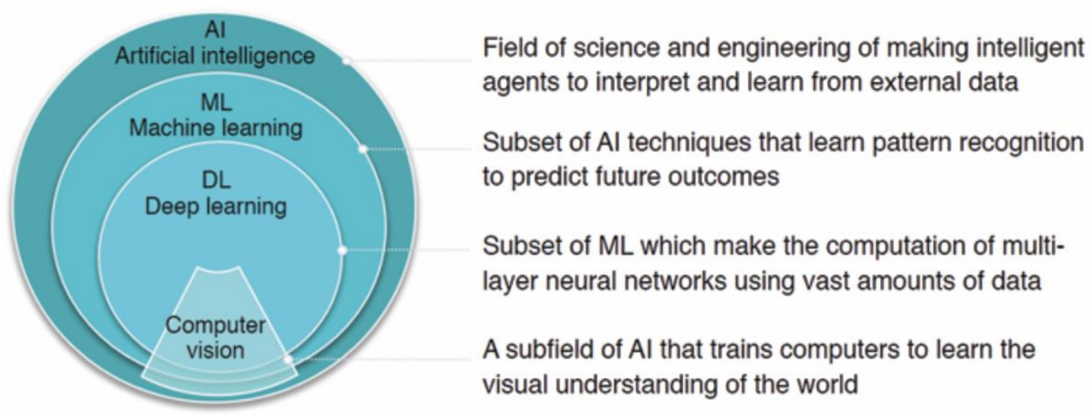

Fig. 2: Diagram depicting relationships of terms: AI, ML, DL. Reproduced from Shin Y. Et. Al. 2021 [3]

This academic project explores the history and evolution of AI in medicine, exploring its evolving role in sports medicine, focusing in MSK ultrasound and use of biosensor data for injury prediction and prevention.

Artificial intelligence in Medicine

Artificial intelligence in medicine dates back to the 1970s with the development of expert systems designed to emulate the decision-making abilities of human clinicians. Early systems such as MYCIN, which assisted in diagnosing bacterial infections, and INTERNIST-1, aimed at diagnosing complex internal diseases, set the foundation for AI's medical applications. Over subsequent decades, advancements in machine learning, neural networks, and natural language processing significantly expanded AI's capabilities, enabling more sophisticated analyses and predictions from vast datasets.

In the 21st century, AI's application in medicine has grown exponentially, driven by the proliferation of electronic health records (EHRs), advanced imaging technologies, genomic data, and advanced natural language processing applied to AI-powered medical scribes. AI has been integrated into various medical fields, including radiology, oncology, cardiology, and neurology, enhancing diagnostic accuracy, treatment personalization, and operational efficiency [4]. For example, a systematic review by Liu et al. found that deep-learning AI algorithms had equivalent sensitivity and specificity to radiologists [5]. Another study demonstrated that an AI algorithm was capable of ruling out cancer in pathology specimens with high sensitivity using computational histopathology [6].

AI's evolution in medicine is marked by its transition from theoretical constructs to practical tools used in clinical settings. Today, AI-powered systems are used for predictive analytics, personalized medicine, and automated image analysis.

Artificial Intelligence in Sports Medicine

In the field of sport medicine, AI is still in its early stages. Progress has lagged behind other fields likely due to the hands-on nature of the specialty, which relies on a thorough physical examination. Ideally, adoption of AI will eventually allow clinicians to improve injury diagnosis and management, optimize athlete performance, prevent injuries, and expedite recovery processes.

Diagnostics and Treatment: Musculoskeletal Ultrasound

Advancements in artificial intelligence have led to advancement of algorithms and machine learning techniques to improve MSK imaging. To date, the majority of this progress has been reflected in AI use in radiography, where algorithms have been developed to automate diagnosis of hip fractures and knee osteoarthritis among other bony conditions [7, 8, 9]. In contrast, use of AI in MSK ultrasonography (US) has been relatively underdeveloped. Challenges in this imaging modality include significant variability in image acquisition due to its heavy operator-dependence, and practical limitations in image processing and annotation [2]. However, there has been recent progress in the development of ML models to aid MSK US, specifically in the assessment of tendons [10], synovial tissue [11], and nerve identification [3]. A ML algorithm examining these structures can recognize an area of interest, localize it, and using a segmentation process, will attempt to highlight the precise contour of the structure of interest [12]. As mentioned previously, any machine learning algorithm is only as good as the quality of the original data provided, in this case, raw MSK US images. Therefore, an image pre-processing step prior to input into the algorithm is also essential [13].

Commercially available tools

The examples of AI use in MSK US applications mentioned previously are drawn from research group and published studies. Commercially available tools also exist, which although limited, demonstrate the possibility of applying AI tools to clinical practice. In 2020, MEDO.ai, an AI technology start-up company dual headquartered in Edmonton, and Singapore, received 510(k) clearance from the U.S. Food and Drug Administration for the world's first tool using Artificial Intelligence to detect hip dysplasia on neonates. ARIA (Automated Real-time Intelligent Assistant) automatically reviews hip ultrasound images, selects the optimal image to calculate standard measurements, and assists clinicians in classification and diagnosis of hips as normal or dysplastic [14].

On March 2024, Clarius, a company that manufactures portable ultrasounds, obtained Health Canada approval for its MSK AI model, which automatically identifies and measures tendons in the foot, ankle, and knee using AI [15]. This tool is of particular interest to the field of sport and exercise medicine, as it can provide valuable information when performing point-of-case MSK ultrasound assessments. It can help reduce interobserver variability, improve precision of measurements, and help speed up learning for beginners. Additionally, it can help improve accuracy when performing ultrasound-guided injections of a variety of MSK structures, and potentially optimize workflow. There is also promise that AI and ML algorithms may help predict which patients are more likely to benefit from biologics, offering exciting potential in improving outcomes and reducing expenditures. [23]

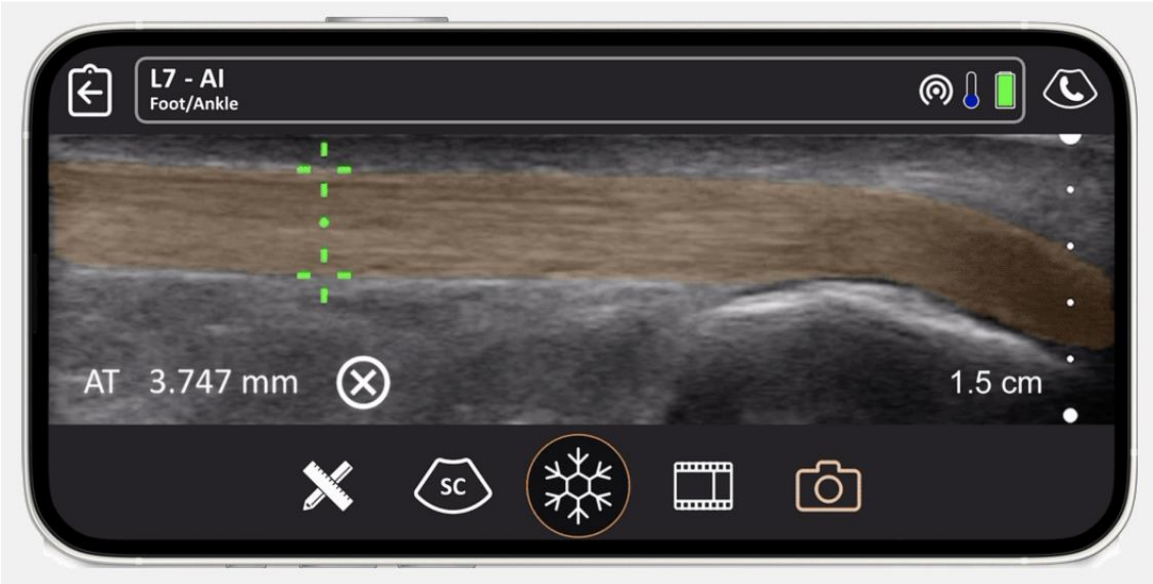

Fig. 3: Example of an AI-powered ultrasound scan of the Achilles tendon, with automatic identification and measurement of the Achilles tendon. From Clarius.

Injury Prevention and Prediction

AI technologies are being utilized to predict and prevent sports-related injuries by analyzing biomechanical data and identifying risk factors. Machine learning models can process data from wearable devices, video analyses, and athlete medical histories to detect patterns that precede injuries.

In 2020, the Cleveland Clinic's Machine Learning Orthopedics Laboratory applied ML techniques to predict next-season injury risk for National Hockey League and Major League Baseball players. For hockey players, Luu et al. compiled yearly injury data and player-specific metrics, trained multiple ML algorithms on this data, and compared predictions for next-season injury. The best-performing algorithm predicted next-season injury with an accuracy of 94.6% (SD=0.5%), outperforming logistic regression and demonstrating excellent reliability.[24] Karnuta et al. performed a similar study on MLB baseball players. The best of 84 algorithms tested demonstrated an accuracy of 70% (SD = 2%) at predicting next-season injury [25]. In both studies, ML techniques were superior to logistic regression at predicting future player injury.

A systematic review done by Chidambaram et. al. highlighted that AI techniques to process data from sensors can detect patterns in physiological variables as well as positional and kinematic data to inform how athletes can improve their performance [16]. AI tools may also help with monitoring athlete mental health. A study by Coutts et al. recorded heart rate variability using fitness bands with biosensors and trained deep neural networks to characterize an individual's mental health with up to 83% accuracy [17].

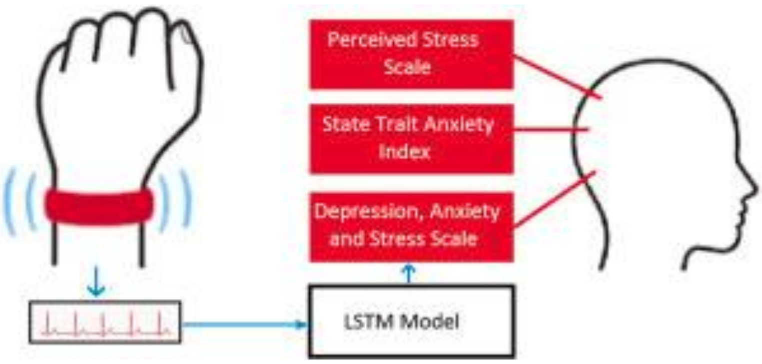

Figure 4: Schematic depicting the use of wearable biosensors an DL to predict changes in mental health. [17]

With the rapid development and improvement of AI and ML models, there is hope and anticipation that clinical applications will be tenable in the near future. For example, AI and ML models could estimate the likelihood of injuries based on an athlete's training load, previous injury history, and physical fitness levels. It could also help identify athletes at risk of overtraining, based on training loads, sleep quality, signs of physiological stress. There is also significant work being conducted in the movement analysis space, with the goal to use athlete's movement patterns to predict and prevent potential injuries [18].

Future Directions and Challenges

The use of AI in medicine and sport medicine will continue to grow as AI-based solutions provide synergistic results and help provide quality medical care. However, there are various challenges to its successful widespread implementation.

The first is data availability. As mentioned previously, an AI and ML models are only as good as the data it is trained on. As such, this data requires external validity and continuous availability of progressively larger datasets. For example, the requirement of large volume of MSK US images is a critical bottleneck in developing AI models for this imaging modality.[2]

There is also the issue of data bias. Predictions generated via AI may have limited applicability to patient populations historically underrepresented in clinical trials, such as women and minorities. Cases of data bias have been reported and can lead to biased ML models [19]. There needs to be concerted efforts to ensure ML models are trained on validated, non-biased data, to ensure clinical application is legitimate and appropriate.

Another source of concern is the "black-box" problem associated with AI. ML algorithms self-iterate and self-improve, with the specific methodology behind an output being unclear. Some advocate for increased transparency and model simplicity at the expense of predictive power. Others argue that, when our knowledge of causal systems is incomplete, the ability to explain why an intervention benefits a patient can be less important than the ability to provide such benefits [20]. In medicine, clinicians often make decisions based on experience and empirical evidence without having an exact understanding as to why certain interventions work.

Whether it be non-representative data sources or unclear algorithm methodologies, healthcare providers must be aware of the caveats in using AI. Otherwise, they risk becoming complacent, which negatively impacts decisions and care. Providers should understand the basics of the methodology behind AI in order to be able to critically examine its results and synergistically work with them.

Conclusion

Artificial intelligence has the potential to revolutionize sports medicine by enhancing diagnostic and treatment modalities, injury prevention, optimizing performance, and personalizing rehabilitation and treatment.

The adoption of AI is already transforming the field of medical imaging. A subset of this field and an area known for its dependence on operator skill, MSK ultrasonography is ripe for AI-led innovation. Research on this field has already been translated into some clinical applications, and rapid advancements are anticipated.

Research in injury prevention has demonstrated that AI can also improve the way injury prediction models work, increase the diagnostic accuracy of risk stratification systems and provide a reliable method for the continuous monitoring of patient health data. This technology is still in its early stages and needs further work, larger clinical trials, and data validation.

As AI technologies continue to evolve, their application in sports medicine holds significant promise for improving musculoskeletal and athlete care. Continued research and collaboration between AI experts and sports medicine practitioners will be essential in harnessing the full potential of AI in this dynamic field. Widespread adoption of AI into clinical practice will not solely be shaped by scientific progress, but also by legislation of regulatory and health policies. Much like how risks and benefits are weighed for anything in medicine, the same must hold true for the use of AI. The promise this technology holds, when used adequately within substantiated frameworks, will be worth the substantial effort needed to integrate it into practice.

References

1. *Kaul V, Enslin S, Gross SA. History of artificial intelligence in medicine. Gastrointest Endosc. 2020 Oct;92(4):807-812.*
2. *Yi PH, Garner HW, Hirschmann A, Jacobson JA, Omoumi P, Oh K, Zech JR, Lee YH. Clinical Applications, Challenges, and Recommendations for Artificial Intelligence in Musculoskeletal and Soft-Tissue Ultrasound: AJR Expert Panel Narrative Review. AJR Am J Roentgenol. 2024 Mar;222(3):e2329530.*
3. *Shin Y, Yang J, Lee YH, Kim S. Artificial intelligence in musculoskeletal ultrasound imaging. Ultrasonography. 2021;40(1):30-44.*
4. *Esteva A, Robicquet A, Ramsundar B, Kuleshov V, DePristo M, Chou K, Cui C, Corrado G, Thrun S, Dean J. A guide to deep learning in healthcare. Nat Med. 2019 Jan;25(1):24-29.*
5. *Liu X, Faes L, Kale AU, Wagner SK, Fu DJ, Bruynseels A, Mahendiran T, Moraes G, Shamdas M, Kern C, Ledsam JR, Schmid MK, Balaskas K, Topol EJ, Bachmann LM, Keane PA, Denniston AK. A comparison of deep learning performance against health-care professionals in detecting diseases from medical imaging: a systematic review and meta-analysis. Lancet Digit Health. 2019 Oct;1(6):e271-e297.*
6. *Campanella, G., Hanna, M.G., Geneslaw, L. et al. Clinical-grade computational pathology using weakly supervised deep learning on whole slide images. Nat Med. 2019 July; 25:1301–1309*
7. *Norman B, Pedoia V, Noworolski A, Link TM, Majumdar S. Applying densely connected convolutional neural networks for staging osteoarthritis severity from plain radiographs. J Digit Imaging 2019; 32:471–477*
8. *Krogue JD, Cheng KV, Hwang KM, et al. Automatic hip fracture identifica- tion and functional subclassification with deep learning. Radiol Artif Intell 2020; 2:e190023*
9. *Badgeley MA, Zech JR, Oakden-Rayner L, et al. Deep learning predicts hip fracture using confounding patient and healthcare variables. NPJ Digit Med 2019; 2:31*
10. *Jahanifar M, Tajeddin NZ, Hasani M, Shekarchi B, Azema K. Automatic recognition of the supraspinatus tendinopathy from ultrasound images using convolutional. Neural Netw. (2020).*
11. *Mielnik P, Fojcik M, Segen J, Kulbacki M. A novel method of synovitis strat- ification in ultrasound using machine learning algorithms: results from clinical validation of the MEDUSA Project. Ultrasound Med Biol 2018; 44:489–494*
12. *Gutiérrez-Martínez J, Pineda C, Sandoval H, Bernal-González A. Computer-aided diagnosis in rheumatic diseases using ultrasound: an overview. Clin Rheumatol. (2020) 39:993–1005*
13. *Dinescu SC, Stoica D, Bita CE, Nicoara AI, Cirstei M, Staiculesc MA, Vreju F. Applications of artificial intelligence in musculoskeletal ultrasound: narrative review. Front Med (Lausanne). 2023 Nov 21;10:1286085*
14. *MEDO.ai (2020 June 16). MEDO.ai receives FDA approval to automatically detect hip dysplasia, preventing the leading cause of early hip osteoarthritis and hip replacement surgery. [Press release]. URL: hyperlink*

15. *Clarius (2024 March 26). Health Canada Approves Clarius MSK AI for Automating Musculoskeletal Measurements During an Ultrasound Exam [Press release]. URL: hyperlink*
16. *Chidambaram, S.; Maheswaran, Y.; Patel, K.; Sounderajah, V.; Hashimoto, D.A.; Seastedt, K.P.; McGregor, A.H.; Markar, S.R.; Darzi, A. Using Artificial Intelligence-Enhanced Sensing and Wearable Technology in Sports Medicine and Performance Optimisation. Sensors **2022**, 22, 6920.*
17. *Coutts, L.V.; Plans, D.; Brown, A.W.; Collomosse, J. Deep learning with wearable based heart rate variability for prediction of mental and general health. J. Biomed. Inform. **2020**, 112, 103610.*
18. *Reis FJJ, Alaiti RK, Vallio CS, Hespanhol L. Artificial intelligence and Machine Learning approaches in sports: Concepts, applications, challenges, and future perspectives. Braz J Phys Ther. 2024 May 21;28(3):101083.*
19. *Kleinberg J, Ludwig J, Mullainathan S, Sunstein CR. Discrimination in the age of algorithms. J Legal Anal. 2018;10:113 174.*
20. *Artificial Intelligence and Black-Box Medical Decisions: Accuracy versus Explainability. Hastings Center Report. 2019 Feb; 49(1)*
21. *Bellini V, Cascella M, Cutugno F, Russo M, Lanza R, Compagnone C, Bignami EG. Understanding basic principles of Artificial Intelligence: a practical guide for intensivists. Acta Biomed. 2022 Oct 26;93(5):e2022297.*
22. *Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019 Jan;25(1):44-56.*
23. *Ramkumar PN, Luu BC, Haeberle HS, Karnuta JM, Nwachukwu BU, Williams RJ. Sports Medicine and Artificial Intelligence: A Primer. Am J Sports Med. 2022 Mar;50(4):1166-1174.*
24. *Luu BC, Wright AL, Haeberle HS, Karnuta JM, Schickendantz MS, Makhni EC, Nwachukwu BU, Williams RJ 3rd, Ramkumar PN. Machine Learning Outperforms Logistic Regression Analysis to Predict Next-Season NHL Player Injury: An Analysis of 2322 Players From 2007 to 2017. Orthop J Sports Med. 2020 Sep 25;8(9):2325967120953404.*
25. *Karnuta JM, Luu BC, Haeberle HS, Saluan PM, Frangiamore SJ, Stearns KL, Farrow LD, Nwachukwu BU, Verma NN, Makhni EC, Schickendantz MS, Ramkumar PN. Machine Learning Outperforms Regression Analysis to Predict Next-Season Major League Baseball Player Injuries: Epidemiology and Validation of 13,982 Player-Years From Performance and Injury Profile Trends, 2000-2017. Orthop J Sports Med. 2020 Nov 11;8(11):2325967120963046.*

BASKETBALL CME OPPORTUNITIES

A listing of varied sport medicine and basketball meetings and conferences you may be interested in attending:

A listing of all the American Medical Society for Sports Medicine conferences can be found here:

https://www.amssm.org/Conferences.php

The South African Sports Medicine Association hosts several events throughout the year:

https://www.sasma.org.za/events/

The Society for Sport Exercise and Performance Psychology website lists a number of mental performance educational opportunities:

https://www.apadivisions.org/division-47/about/resources/conferences

Conference Locate.com allows you to search globally for conferences on an extensive array of medical topics:

https://www.clocate.com

A listing of exercise physiology conferences across the world can be found here: **https://conferenceindex.org/conferences/exercise-physiology**

And for something a little different:

https://unconventional.com.au/conferences/south-america/medical-conferences/2024/

If you prefer self-study to earn CME credits while you are on vacation, have a look at these options: **https://www.americanseminar.com/?gad_source=1&gclid=Cj0KCQjw5cOwBhCiARIsAJ5njuavUXdPzpk4LULqCfKx1tp5tulliGrFPaki0M-Hjk6RjD6Vb4EGtGQaAtMTEALw_wcB**

Date	Location	Event website
July 2-5, 2024	Glasgow (Scotland)	European College of Sport Science
Sept 12-15, 2024	Cape Town (South Africa)	World Physical Therapy Africa Region Congress
Sept 30-Oct 1, 2024	London (England)	International Conference on Physiotherapy, Physical Rehabilitation and Sports Medicine
Oct 15-18, 2024	Montreal (Canada)	The Association for Applied Sport Psychology annual conference
Oct. 21-24, 2024	Online	IOC 15th Advanced Team Physician Course
Oct 23-26, 2024	Las Vegas (USA)	The Association for Applied Sport Psychology annual conference
Nov 7-8, 2024	Coventry (UK)	British Association of Sport and Exercise Medicine annual conference
Nov 15-16, 2024	Rochester (United States)	33th Annual Mayo Clinic Symposium on Sports Medicine
Dec 3-4, 2024	Singapore (Singapore)	Asia-Singapore Conference on Sport Scinece (ACSS 2024)
Dec, 2024	San Fransisco (USA)	University of California San Francisco 19th Annual Conference Sports Medicine for Primary Care
Apr 22-27, 2025	Kansas City (USA)	American Medical Society for Sport Medicine annual symposium
May 27-31, 2025	Atlanta (USA)	American College of Sport Medicine Annual symposium
July 2-4, 2025	Melbourne (Australia)	15th International Conference on Sport and Society
May 26-30, 2026	Salt Lake City (USA)	American College of Sport Medicine Annual symposium
Jun 1-4, 2027	Indianapolis (USA)	American College of Sport Medicine Annual symposium