

PREVENTIVE SPORTS MEDICINE

Mark D. Harris, MD, MPH
Family, Sports and
Preventive Medicine

Main Areas of Prevention in Sports Medicine

⦿ In the Clinic

- Preparticipation Screening
- Exercise as Medicine

⦿ In the Training Room and on the Field

- Conditioning and Training Programs for Athletes and Non-athletes
- Disease and Injury Prevention
- Covering Athletic Competitions

Preventive Sports Medicine in the Clinic

- Preparticipation Exams (PPE)
- Exercise as Medicine (EAM)

Why do PPEs?

- ⦿ Athlete – “to keep me off the field.”
- ⦿ Parents – “because my child can’t play without it, and to make sure he doesn’t get hurt or killed during sports”
- ⦿ School administrator – “to shield my school from liability.”
- ⦿ Health care administrator – “to provide a reliable income stream.”
- ⦿ Military health care administrator – “to make my summer miserable trying to get all these kids seen.”

Why do PPEs?

- To screen for any common condition for which the athlete may need medical care.
- To screen for any condition which may be disqualifying for athletic competition.
- To assess for risk of harm from anticipated exercise and decrease the risk if possible.
- To help athletes get required health maintenance services such as paps and cholesterol checks.
- To help provide health promotion interventions tailored to the athlete's individual needs.
 - General health – sex, substances, sleep
 - Sports specific – conditioning, injury prevention

All of that in a 10 minute visit?

- ⦿ No, however...
- ⦿ The PPE is the only interaction many athletes have with the health care system.
- ⦿ Even if we can't get all of that done, we can at least screen for the areas at greatest risk in exercise (MSK, cardiac, psych) and refer the rest.
- ⦿ The PPE does not take the place of a comprehensive physical and health appraisal exam in any age group.
- ⦿ **People are engaging in high intensity sports with conditions that would have disqualified them in the past. We need to help them compete effectively and safely.**

Olympians w/ Chronic Disease

- Jackie Joyner-Kersey (track & field) - asthma
- Mark Spitz (swimming) – asthma
- Kris Freeman (Nordic skiing) – Type 1 DM
- Kevin Hanson (volleyball) – Type 1 DM
- Bob Beamon (long jump) – DM
- Paola Fantato (archery) - polio
- Nicola Coles (rowing) – A Fib
- Garrett Weber-Gale (swimming) – HTN
- Natalia Partyka (table tennis) – born w/o R arm

Target the PPE to the Athlete & Sport

⦿ Athlete age

- 6-10 – good history for missed congenital issues (heart problems, bleeding disorders, epilepsy)
- 11-15 – many non-sport concerns (sex, substances)
- 16-30 – athletic prime, prior injuries/adequate rehab?
- 31-65 – sporadic (acute injury) vs. regularly exercising (overuse injury) athlete
- 66+ - exercise as medicine for chronic disease and exercise to maintain function

⦿ Contemplated exercise program – motivation, frequency, intensity, risk of injury

Florence Griffith Joyner

1959-1998
(Epilepsy, cerebral aneurysm)



To Think About During the PPE – Injury Prediction

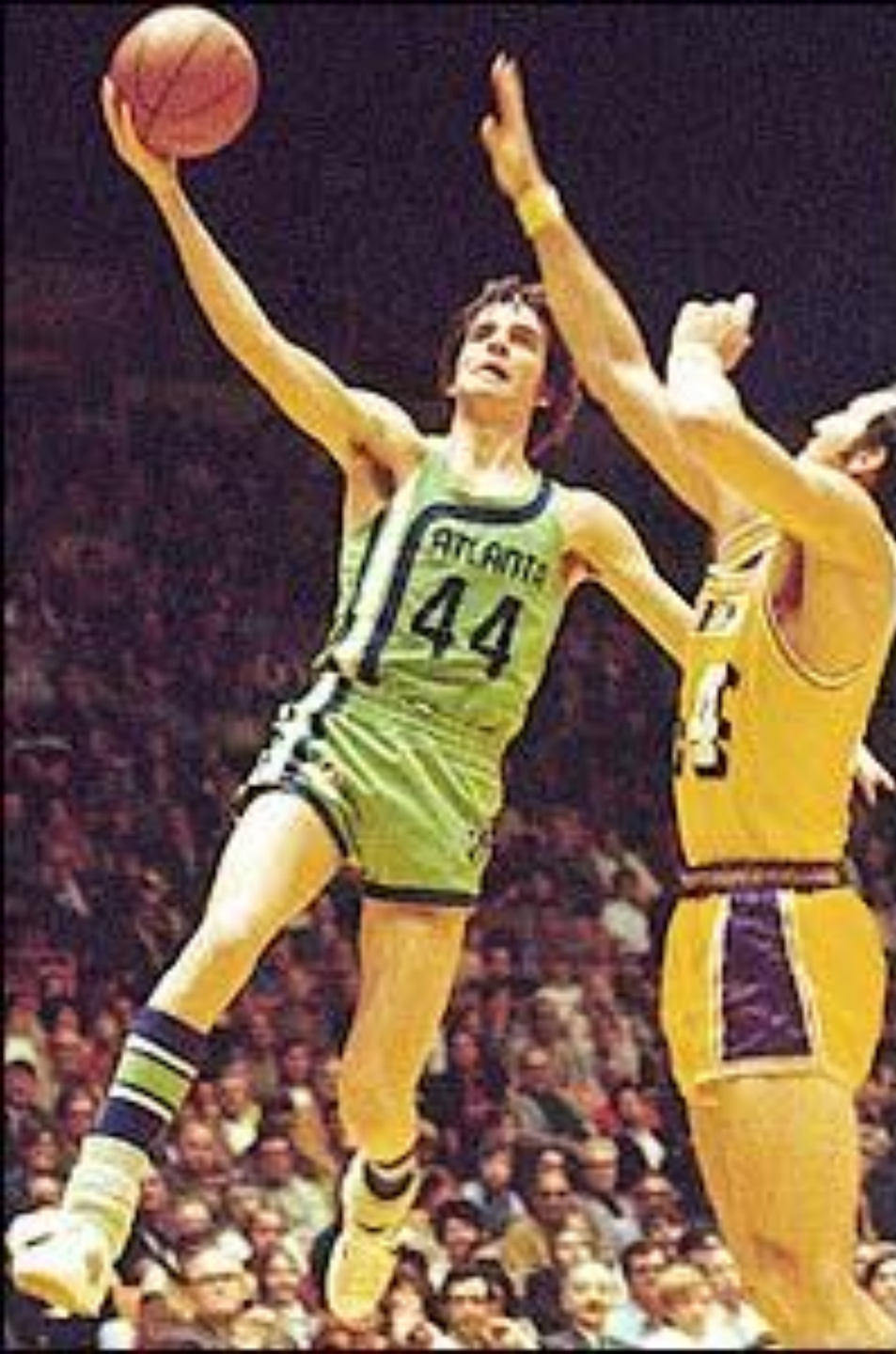
- Maturity – unbalanced competition between early and late maturing adolescents is a strong predictor of injury in contact/collision sports
- Family functioning – increased rate of injuries in athletes w/ poorly functioning families
- Cardiovascular fitness – poor fitness leads to fatigue which results in injuries
- Lean body mass – both obesity and extreme weight loss diminish performance and increase injuries
- Muscular strength – asymmetry in strength is a strong predictor of future injury
- Alcohol use - In one study, athletes who drank alcohol at least once per week had an annual injury rate of 54.8%, while non-drinkers had a rate of 23.5% across all sports.

EAM - Exercise Prescription

- Intensity – usually measured by heart rate every 10-15 min throughout the activity
- Duration – 15-60 mins of continuous aerobic exercise recommended.
- Work done = Frequency x intensity x duration
- Detraining – total loss of conditioning after 10-34 weeks of inactivity
- More injuries in weight bearing than non weight bearing activities
- Energy equivalents:
 - 9 units biking = 4 units running = 1 unit swimming
- Exercise < 3 days/wk, < 50% VO₂ max, and duration < 10 min/day is inadequate to achieve training effect

Pre-exercise GXT

- Evaluate exertional discomfort
- Provoke occult pathology
- Define prognosis in known disease states
- Evaluate rehabilitative therapy
- Exercise prescription



“Pistol” Pete
Maravich
1947-1988
(Anomalous
Coronary Artery,
absent LAD)

EAM - Diabetes

- ⦿ Aerobic exercise 30-60 minutes, 50-80% VO_2 max and 3-4x/wk decreased HgbA1C 10-20%
- ⦿ Exercise elevates muscle GLUT4, improving muscle glucose transport and enhancing whole body glucose tolerance.
- ⦿ Exercise does not lower HgbA1C values in type 1 DM, but does improve all-cause mortality
- ⦿ Regular exercise decreases risk factors for HTN, HLD, CVD, coagulation abnormalities, and improves mental health
- ⦿ Risks – hypoglycemia, myocardial ischemia

EAM - Hypertension

- ⦿ Aerobic exercise decreased BP 3.4-4.7/2.4-3.1, higher in hypertensives.
- ⦿ Decreases in SBP and DBP of 2 mm decreases CVA by 14% and 17% and CVD by 9% and 6% respectively
- ⦿ One small meta-analysis of resistance training showed 3.2 SBP and 3.5 DBP decrease.
- ⦿ Exercise augments effects of antihypertensives
- ⦿ Risks – complications of undiagnosed CAD prior to beginning exercise program, consider GXT

EAM – Dyslipidemia

- Triglycerides – 10-20% reduction in TG concentrations w/ 3-12 mo aerobic exercise, more in pts with hypertriglyceridemia
- TC and LDL – LDL decreases of 5% w/ aerobic exercise
- HDL – increases of 4-43% w/ consistent aerobic conditioning, dose dependent
- No firm evidence yet that resistance exercise improves lipid profile
- Risks – HLD does not affect exercise response, but HMG-CoA reductase inhibitors can cause rhabdomyolysis



James
Fixx 1932
-1984
(CAD/MI)



EAM - Obesity

- ⦿ Some studies suggest that exercise alone is not effective for weight loss.
- ⦿ Studies that include enough exercise to actually provide a significant negative caloric balance show that exercise is effective.
- ⦿ Exercise is also critical to keeping weight off, and in attenuating loss of lean tissue.
- ⦿ Lifestyle changes are as effective as formal exercise programs for losing weight and maintaining it.
- ⦿ Risks – orthopedic injury, heat injury higher in overweight

EAM - Osteoporosis

- Exercise training, both aerobic and anaerobic in both sexes has been shown to increase BMD in the femoral neck and lumbar spine an average of 1-2%, both early and later in life.
- Training should incorporate movements resulting in high loads from multiple directions.
- Reproductive hormone status and nutrient intake also significantly affects BMD
- Risks – CAD, orthopedic limitations (i.e. kyphosis), falls

EAM - Depression

- Both aerobic and anaerobic training significantly improved self reported depression scores in men and women, in and outpatients.
- Symptom improvement in one study was as good as psychotherapy
- Regular exercise helps prevent recurrence

Preventive Sports Medicine in the Training Room and on the Field

- Conditioning and Training Programs
- Disease and Injury Prevention
- Event Coverage



Metabolic Specificity

- The mode of exercise used in training should be the mode used in sport performance
- “SAID Principle” – Specific Adaptations to Imposed Demands
- Overload – exercising above normal levels (frequency, intensity, duration, type of exercise)
- Individual differences – a specific program that works for one athlete may not work for another
- Reversibility (“detraining”) – after only 2 wks of inactivity, significant reductions in work capacity occur

Components of a Good Training Program

- Preconditioning – 10-14 days at levels < normal
- Warm up – 5-10 minutes of low intensity activity such as jogging
- Exercise – include aerobic, anaerobic, str, and cross training on different days
- Cool down – 5 minutes. This is especially important as going immediately from hard exercise to non-exercise can induce arrhythmias. Include flexibility.
- Progression – never increase more than 1 component (FID) of a training program at the same time.
- Prefer relative rest and alternate activity to complete rest

Infections in Athletes - AIS Study

- 98% of college athletes had ≥ 1 illness during winter 2-month period
- 246/588 visits for medical problems (42%)
 - URI most common
 - chest infection
 - viral syndrome
 - Gastroenteritis
 - Asthma/allergy
 - Skin problems
 - Fatigue
 - Otitis externa

Disease Prevention

- ⦿ Don't share stuff – personal care products, water bottles, needles, body fluids
- ⦿ Wash your hands...good personal hygiene
- ⦿ Keep rashes clean, dry and covered
- ⦿ Get your shots
- ⦿ Avoid drugs and alcohol
- ⦿ Protect your skin
- ⦿ Use vector protection – DEET, permethrin, long sleeves

Prevention of Complications from Ergogenic Aids

- Don't use them
- Ephedra – implicated in heat injury deaths of Steve Bechler (Orioles), Kory Stringer (Vikings), Rashidi Wheeler (Northwestern football)
- EPO – possibly implicated in deaths of 18 in Dutch and Belgium cyclists from 1987-1990

Epidemiology – Injuries

- ⊙ Across all sports, injury rates are significantly higher in games than practices
- ⊙ Lower extremity - >50% of all practice/game injuries
 - Ankle sprains – 14%
 - ACL – 3% (men – football, women – basketball, soccer)
- ⊙ Upper extremity – 20% of all practice/game injuries
 - Shoulder – 10% (contact – football, ice hockey, noncontact – baseball, tennis)
- ⊙ Head/neck injuries – 12%
- ⊙ Concussions – 5% but increasing in number
- ⊙ Catastrophic head/neck/spine injuries – rare.
 - Football, gymnastics, ice hockey, wrestling, and cheerleading

Epidemiology – Injuries (2)

- ⦿ Sudden cardiac death – HCM, arrhythmias, coronary artery anomalies, myocarditis, ruptured aortic aneurysm (Marfan's)
- ⦿ Commotio cordis – baseball, lacrosse, ice hockey, softball, esp. boys aged 7-16
- ⦿ Heat illness – 3rd leading cause of death in high school athletes
- ⦿ Skin infections
 - College – 1-2% of all time loss for injuries
 - Wrestling – 16-20% of all time loss for injuries, increased 3x in past year

Injury Prevention Paradigm – the Haddon Matrix

Table 1. The Haddon matrix and pedestrian injury from automobiles.

Phase	Influencing factors			
	Host	Agent/vehicle	Physical environment	Social environment
Preevent	Intoxicated driver Fatigued driver	Speeding automobile Worn tires	Poor street lighting Slick pavement	Unenforced speed limit laws Inadequate investment in crosswalks
	Pedestrian crossing street	Worn brakes	Potholes Inadequate signage Nighttime	
	Intoxicated pedestrian Elderly pedestrian Pedestrian with osteoporosis Pedestrian wearing headphones	Momentum of automobile	Hospitals nearby with specialty in trauma care	
Event	Hearing-impaired pedestrian	Impact of automobile with pedestrian	Part of body impacting ground	Good samaritan laws
	Part of pedestrian's body struck by vehicle	Portion of vehicle impacting pedestrian		
Postevent	Ability of victim to recover Postinjury care received	Severity of physical injuries	Rehabilitation facility	Health insurance
	Psychological coping of victim in aftermath of event	Severity of postevent psychological impact		Access to rehabilitation services Family and social support

Internal Factors - Conditioning

- Being “in condition” means the athlete is equal to the neuromuscular demands and has the necessary strength and stamina, physically and mentally for his/her sport.
- Conditioning should be offseason, preseason, during the season, and post season.
 - Athletes must stay in condition all year

Internal Factors - Warm Up

- ⦿ Jogging/cycling and sports specific warm up, beginning w/ large muscle groups
- ⦿ 15 minute duration, and finish no sooner than 10 minutes prior to activity
- ⦿ Benefits
 - Decreases stiffness
 - Decreases peripheral vascular resistance and increases circulation
 - Increases blood flow and oxygen delivery to muscle
 - Increases mechanical efficiency
 - Increases nerve impulse speed
 - Increases range of motion
 - Increases alertness
 - Increases concentration



Internal Factors - Training

⦿ Flexibility and Mobility

- Static stretching – 15-30 seconds, 3-4x/session
- Dynamic stretching – controlled swinging of the limb gradually increasing distance, speed and intensity
- Ballistic stretching – bounce, don't do it
- PNF stretch – a partner stretches the athlete, who isometrically contracts the muscle against the partner. The partner then stretches the athlete farther

⦿ Strength and Power

- Power is the ability to do maximal work rapidly over time
- 3 types of resistance training
 - Concentric – isotonic (same force), isokinetic (same speed)
 - Eccentric - lengthening
 - Isometric – same distance (static work)

Internal Factors – Training (2)

- ⦿ Coordination and Proprioception
 - Interaction between musculoskeletal, musculotendinous and central nervous systems
 - Exercises – jumping, single leg stand
- ⦿ Sport Specific – can take place within the sport practice, examples are speed and agility drills
- ⦿ Recovery
 - Overtraining causes chronic muscle soreness, fatigue, poor performance and increased risk for future injury
 - Cool down w/ less intense activity 10-15 minutes after training
 - Whirlpool and massage helps recovery process
 - 1-2 recovery days per week
 - Eight hrs sleep/night

Internal Factors – Injury Rehabilitation

- ⦿ Progression of rehabilitation
 - Eliminate pain and swelling
 - Restore full active range of motion
 - Restore full strength
 - Restore normal proprioception
 - Work on psychological rehabilitation throughout
- ⦿ Return to full competitive activity when...
 - No pain with activity
 - Full strength in the injured area
 - Full range of motion
 - Proper mental attitude

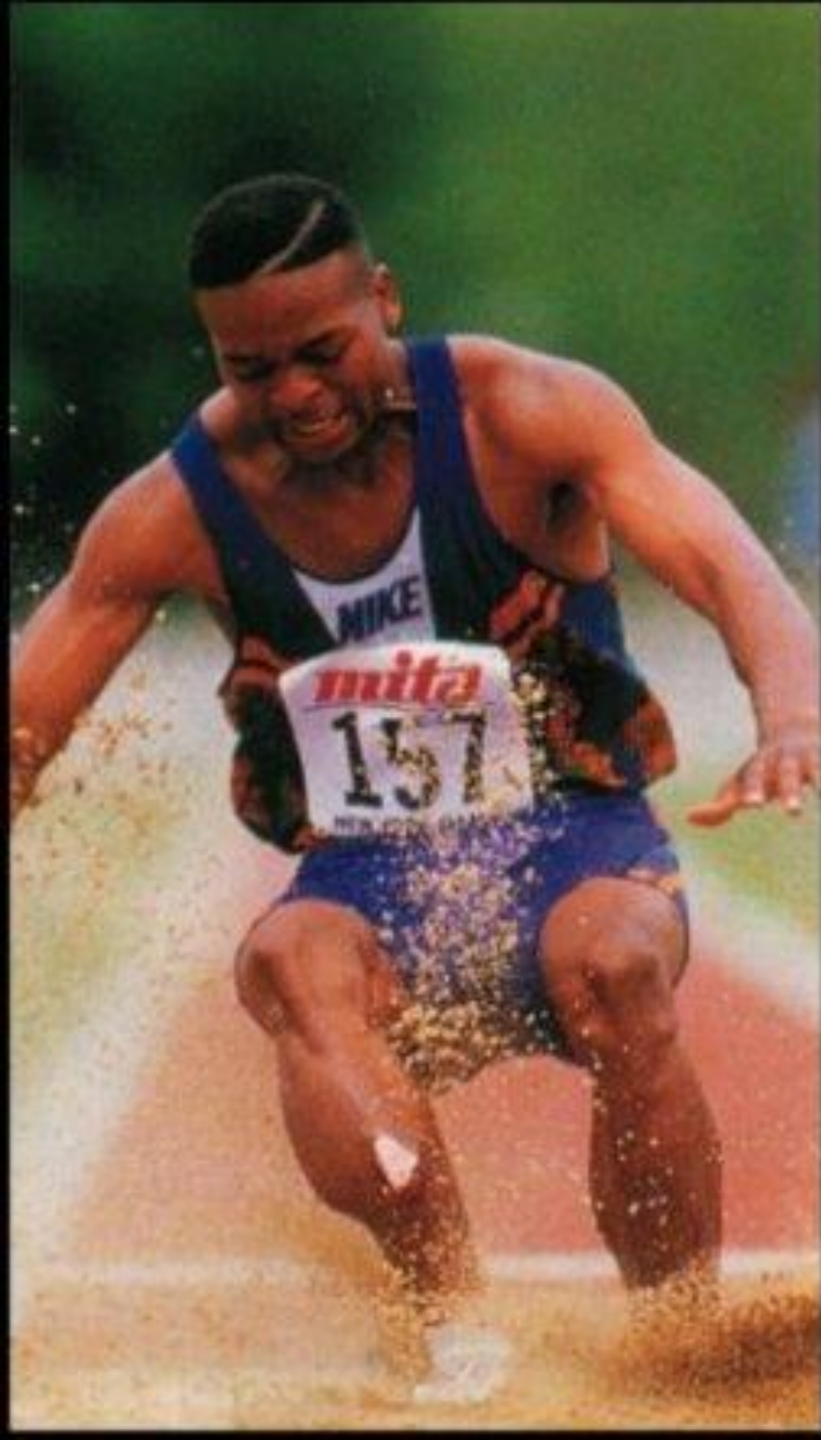
Internal Factors – Nutrition and Education

⦿ Nutrition

- Adequate hydration
- Good diet
- Avoid substances

⦿ Education

- Learn about the athlete's chosen sport, including common injuries and how to prevent them.



Tibial fracture – Long jump

External Factors - Equipment

⦿ Purposes

- Protect the athlete from injury – helmets, mouthguards
- Protect a preexisting injury – joint bracing, splinting
- Alter biomechanics to avoid injuries – taping, arch supports
- Protect the athlete from the environment - clothing

⦿ Common equipment problems

- Overworn running shoes
- Loose fitting helmets – recondition annually
- Improperly fit shoulder pads – recondition annually
- Prophylactic knee bracing – may increase knee injuries

⦿ Baseball – reduced impact balls, face guards, break away safety bases

External Factors – Equipment (2)

- Helmets ↓ skull fx, major head trauma
- Face shields ↓ facial injuries and lacerations
- Mouth guards ↓ dental injury
- Shin guards ↓ tibia fx in soccer
- Breakaway bases ↓ ankle injury (baseball)
- Protective eye wear ↓ eye injury (lacrosse)
- Taping/bracing ↓ ankle injury if prior injury
- MCL bracing no ↓ MCL injury, may ↑ lat knee fx

External Factors - Heat

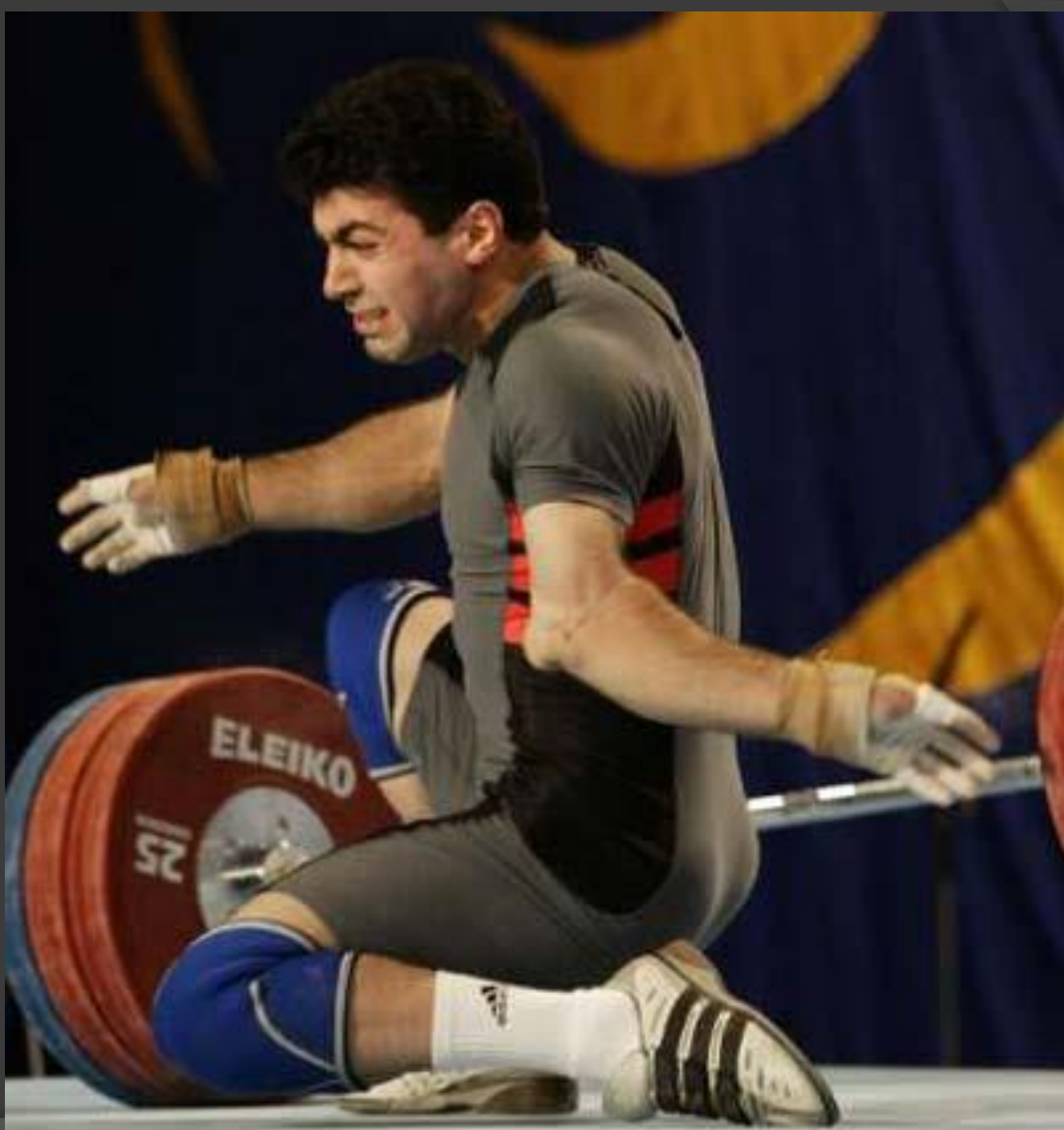
- ◎ Assessing potential for heat injury
 - Heat production w/ exercise 15-20x rest
 - Monitor WBGT on site
 - Monitor pre and post practice weight in athletes
 - Reschedule workouts to avoid extreme heat
 - Shorten workouts and decrease training intensity
 - Screen for sickle cell trait
- ◎ Acclimate in 7-10 days
 - More efficient sweating
 - Lower skin temperatures
 - Maintain lower core body temperature
- ◎ Adequate hydration
 - Maximal skin exposure – loose fitting, breathable clothing, light color
 - Remove headgear and towel face periodically
- ◎ Remain alert for heat related illness

External Factors - Cold

- ⦿ Key factors include optimal conditioning, adequate hydration and good nutrition
- ⦿ Key interventions
 - Never train alone in extremes of weather
 - Avoid substances including caffeine
 - Dress in multiple layers
 - Stay dry
 - Protect your head and neck – 50-75% of heat loss
 - Use goggles for eye protection
 - Use mittens over gloves

External Factors – Area of Play

- Uncovered drains or irregularities in the field – soccer, football, lacrosse, field hockey
- Water on the court – basketball, tennis
- Unbanked tracks – running
- Unlatched doors – hockey
- Appropriate landing areas – track and field jumps
- Ensure that all playing areas have an appropriate buffer zone from spectators and others
- Advantages of artificial surfaces – minimal maintenance, uniform surface, efficient use of available space, uniformity under heavy usage



External Factors - Coaching

- ⦿ Support for preparticipation screening
- ⦿ Teaching correct sport techniques
- ⦿ Develop good off season and preseason conditioning programs
- ⦿ Adjust practices and competitions based on weather and field conditions
- ⦿ Ensure the athletes get good hydration and nutrition
- ⦿ Cooperate with sports medicine team

External Factors - Officiating

- ⦿ Officials should do a pregame evaluation
- ⦿ Meet with fellow officials
- ⦿ Inspect game and player equipment
- ⦿ Inspect area of play
- ⦿ Meet with coaches and trainers to verify rule compliance on specific equipment

External Factors – Balancing Competition

- ⦿ Among children, competitors can differ greatly in size, skill, and maturity
- ⦿ These differences can cause discouragement and physical injury
- ⦿ To balance competition
 - Weight classes in wrestling
 - Little League baseball games pitched by coaches
 - Running clocks or mercy rules when scores are one sided
 - Weight limit in youth football
 - Strict rule enforcement

Prevention Interventions - Ankle

- ⦿ RF – peroneal muscle weakness, decreased dorsiflexion, heel varus, increased BMI
- ⦿ Intervention
 - Exercises to STR local muscles, esp. eccentrics for peroneals and improve dorsiflexion ROM
 - PT for neuromuscular control (balance/core)
 - Pregame taping/bracing for athletes w/ h/o prior ankle sprain

Preventive Interventions - ACL

- ⦿ Athletes in high risk sports (running, cutting) – injury prevention evaluation
 - Personal or FHx of ACL tear
 - Lower extremity alignment
 - Motor eval (core, LE STR, balance, flexibility)
 - Biomechanical analysis of jumping/landing
 - Consider evaluating playing surface and shoes
- ⦿ Target conditioning to meet deficiencies

Prevent Injury and Enhance Performance

(PEP) ACL Injury Prevention

- ⦿ Warm up (sideline to sideline 3x)
 - Slow jog holding hip/knee/ankle in alignment
 - Run side to side, avoiding inward caving of knee
 - Run backward, staying on toes and keeping knees slightly bent
- ⦿ Strengthening
 - Walking lunges
 - Russian hamstring
 - Single toe raises
- ⦿ Plyometrics
 - Hops over cone (lateral, forward/backward, single leg)
 - Jumps (vertical, scissors)
- ⦿ Agility
 - Forward run w/ three step deceleration
 - Lateral diagonal run
 - Bounding run
- ⦿ Stretching (calf, quad, hamstring, inner thigh, hip flexor)

SportsMetrics ACL Injury Prevention

- Dynamic Warm-up: (5 minutes) Prepares the body with functional based activities that use sport specific motions. It raises core body temperature, increases blood flow to the muscles and improves flexibility, balance and coordination.
- Plyometrics/Jump Training: (30 minutes) Plyometrics, the core of the Sportsmetrics™ program, are used to focus on correct jumping technique and are divided into three two week phases. Each phase has a different training focus and the exercises change accordingly. Plyometrics develops muscle control and strength that are critical for reducing the risk of knee injury and increasing jump height.
- High Intensity Strength Training: (30 minutes) With emphasis on body alignment and form. Sportsmetrics™ provides structured (yet adaptable) strength training guidance. This section focuses on development of core strength and improving overall muscular efficiency. This can be done with or without equipment or free weights.
- Flexibility Training: (10 minutes) Stretching is essential to achieve maximum muscle length, allowing muscles to work with power through complete range of motion. This is important for decreasing injury and post-training muscle soreness.

Shaun Livingston

LA Clippers vs. Charlotte Bobcats

Feb 2007



Harry How, Getty Images

Preventive Interventions – Disabled Adolescent Throwing Shoulder

- ⦿ Coaches must teach proper mechanics
- ⦿ Prohibit curve balls and other breaking pitches in athletes 9-14 years old
- ⦿ Little League – no more than 6 innings per week with 3 days of rest between pitching.
- ⦿ AAP recommends no more than 90 pitches per game for skeletally immature athletes.
 - Useful rule of thumb – max 10 pitches x age per 7 days

Glenohumeral Internal Rotation Deficit (GIRD) Treatment and Prevention

- Shoulder rotates approximately 3,000 to 6,000 degrees per second from external to internal rotation with throwing
- Repetitive damage to posterior/inferior capsule causes scarring
- Dx - Internal rotation difference of 25-degrees dominant shoulder to non-dominant
- Treatment
- Sleeper Stretch (90% effective)
 - Keep arm in a 90 deg position.
 - Use other arm and gently push your throwing shoulder down slowly towards the table or bed.
 - Hold each stretch for at least 20 to 30 s.
 - Perform stretch 2-3 times daily.
- If not responsive, arthroscopic release



Preventive Interventions – Comotio Cordis

- Blunt force applied to the chest – usually baseball, hockey, lacrosse – results in life threatening ventricular arrhythmia
- 70 cases of sudden death through July 1998, usually immature athletes w/hypercompliant chest wall
- Prevention with chest protectors has not worked out yet.
- Use softer baseballs?

Preventive Interventions - Concussion

- ① No evidence that mouthguards reduce concussions.
- ① No evidence that strengthening the neck muscles reduces concussions.
- ① Helmets may reduce incidence of concussions.
- ① Rule enforcement (such as no spearing) and proper techniques are still the best way to minimize risk of concussion.



Preventive Interventions – Cervical Spine Injury

- Strict prohibition and enforcement of rules against face masking and spearing in football.
- Neck strengthening may help.

Preventive Interventions – Complications of Sickle Cell Trait (NCAA 2010 Division 1)

- Set own pace
- Slow and gradual pre-season conditioning regimen
- Adequate rest and recovery between repetitions
- No all-out exertion for more than 2-3 minutes at a time
- No performance tests such as serial sprints or timed mile runs.
- Stop activity immediately if muscle pain, abnormal weakness, undue fatigue or breathlessness
- Stay well hydrated
- Optimally manage asthma
- Avoid extreme exercise during acute illness or fever
- Use supplemental O₂ at altitude prn
- Seek prompt medical care if experiencing problems

Preventive Interventions – Skin Disease

- ⦿ Keep skin clean and dry.
- ⦿ Clean and disinfect potentially contaminated surfaces such as wrestling mats.
- ⦿ Keep wounds covered at all times during competition.
- ⦿ Avoid skin microtrauma from chafing clothes

Athletic Competition - Pregame

- ⦿ Players ready – conditioned, trained, equipped
- ⦿ Venue ready – minimize chance of injury
- ⦿ Team support staff ready – coaches and others knowledgeable and supportive
- ⦿ Medical team ready – trained, equipped, emergency response in place
- ⦿ Other stakeholders (security, etc) - ready

Athletic Competition - Game

- ⦿ During athletic competitions, sports medicine personnel need to be aware of potential hazards to athletes, not just injuries to athletes
- ⦿ Sideline providers watch players on the field and on the bench to find signs of unreported injury
 - Vomiting or acting unusual may be a concussion
 - Not using an arm normally may be a stinger
- ⦿ Athletes sometimes do not report injury or illness

Athletic Competition - Postgame

- ⦿ Check w/ AT about injured players and arrange continued care
- ⦿ Monitor all athletes for unreported injury
- ⦿ Discuss RTP and other issues with coaching staff
- ⦿ Brief, usually informal AAR with medical team to improve next competition

Athletic Competition – Event Planning

- ◎ The victorious strategist only seeks battle after the victory has been won, whereas he who is destined to defeat first fights and afterwards looks for victory.

- **Sun Tzu**

- ◎ Many good people and resources available
- ◎ Examples
 - Proposed Ft. Belvoir triathlon
 - Ft. Bliss Kids Breast Cancer Fundraising Walk

PREVENTION IS ALWAYS BETTER
THAN CURE!

Questions?