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Pre-Participation Screenings

Casey Unverzagt, PT, DPT, DSc, OCS, SCS, CSCS
OMPT Fellow in Training

Who Am I?

BS: University of Puget Sound
DPT: Slippery Rock University
Sports Residency: Skyline Hospital, WA
DSc: Andrews University
OMPT Fellowship: EIM

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My Practice

5

Slippery Rock, PA

6

Teaching

Evidence in Motion
South College
Slippery Rock University

7

Who Are You Responsible For?

8

Pre-Participation Screening:
History, Purpose & Mechanics

Cardiac Anomalies & Screening

Injury Prevention Screen

Sports Performance Testing

9

Objectives

As a result of this course, participants will be able to:

1. Identify at least three signs of the stigmata associated with sudden cardiac death.
2. Describe a well-founded opinion on whether or not pre-participation ECG's should be required.
3. Coordinate and execute a mass pre-participation screening.
4. List at least three components of a musculoskeletal screen for the pre-participation screening.
5. Identify at least three various injury-prevention screens used in the pre-participation screening.
6. Identify at least three various sport-performance tests used in the pre-participation screening.

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Pre-Participation Screening: History, Purpose & Mechanics

Cardiac Anomalies & Screening

Injury Prevention Screen

Sports Performance Testing

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Purpose of PPE's

Primary Objectives

Detection of conditions that may limit participation or predispose to injury

Detect conditions that may be life threatening or disabling

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Purpose of PPE's

Secondary Objectives

Meet legal requirements:
state, local, club

Determine general health

Entry point into healthcare system

Opportunity to initiate discussion

13

Historically Speaking

Negative connotation

Looking to disqualify
individuals

"Turn your head and cough"

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Are They Successful?

AAFP
AAP
ACSM
AAOSSM
AOASM
SPTS/APTA
NATA

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Are They Successful?

Preparticipation Evaluation: An Evidence-Based Review

Wingfield, Kristin MD*; Matheson, Gordon O. MD, PhD*; Meeuwisse, Willem H. MD, PhD†

Clin J of Sports Med, 2004

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Are They Successful?

Preparticipation Evaluation: An Evidence-Based Review

Wingfield, Kristin MD*; Matheson, Gordon O. MD, PhD*; Meeuwisse, Willem H. MD, PhD†

The 5 studies that assessed the format or effectiveness of the PPE concluded that it was inadequate. The format of the PPE is not standardized and does not consistently address the American Heart Association recommendations for cardiovascular screening history and physical exams. A variety of health care professionals, some without proper training, administer the PPE.

Clin J of Sports Med, 2004

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Are They Successful?

Preparticipation Evaluation: An Evidence-Based Review

Wingfield, Kristin MD*; Matheson, Gordon O. MD, PhD*; Meeuwisse, Willem H. MD, PhD†

A PPE is required by most sport organizations in America, but research as to its effectiveness is very limited. Very few studies in America or elsewhere have been performed on the PPE process. The research available indicates that the PPE is not implemented adequately or uniformly. An opportunity exists to create a standardized, validated PPE that meets medical standards for quality and provides sensitive, specific screening of potential participants in sport and exercise.

Clin J of Sports Med, 2004

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PPE vs. PPS

Evaluation

- Performed in office
- Cost
- 1-1
- Established rapport

Screen

- Mass participation
- Free or reduced price
- Low anxiety
- Potential for performance testing

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Timing and Frequency

- >6 weeks in advance
- Collegiate
  - Initial, brief annual
- Secondary Education
  - At entry, every 2 years

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PPE/PPS Team

MD/DO
PT
ATC
RN
Support personnel

Optometrist
Dentist
Medical assistant
Dietician

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Format of PPE's

Straight Line
Space Available

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Components

Check in station
Vitals
Medical history
Musculoskeletal screening
General medical evaluation
Athlete fitness testing
Special population testing/exam
Check out station

23

4th Edition PPE

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Check In Station

- Official Forms
  - Consent (for minors as well)
  - Medical history form
  - Insurance information
  - Permission to participate in sport
  - Emergency contact form

PREPARTICIPATION PHYSICAL EVALUATION

HISTORY FORM

(Note: This form is to be filled out by the patient and parent prior to seeing the physician. The physician should keep this form in the chart.)

Date of Exam _____

Name _____ Date of birth _____

Sex _____ Age _____ Grade _____ School _____ Sport(s) _____

Medicines and Allergies: Please list all of the prescription and over-the-counter medicines and supplements (herbal and nutritional) that you are currently taking

_____

_____

_____

Do you have any allergies? ☐ Yes ☐ No If yes, please identify specific allergy below.
☐ Medicines ☐ Pollens ☐ Food ☐ Stinging Insects

Explain "Yes" answers below. Circle questions you don't know the answers to.

GENERAL QUESTIONS	Yes	No
1. Has a doctor ever denied or restricted your participation in sports for any reason?		
2. Do you have any ongoing medical conditions? If so, please identify below: ☐ Asthma ☐ Anemia ☐ Diabetes ☐ Infections Other:		
3. Have you ever spent the night in the hospital?		
4. Have you ever had surgery?		
HEART HEALTH QUESTIONS ABOUT YOU	**Yes**	**No**
5. Have you ever passed out or nearly passed out DURING or AFTER exercise?		
6. Have you ever had discomfort, pain, tightness, or pressure in your chest during exercise?		
7. Does your heart ever race or skip beats (irregular beats) during exercise?		
8. Has a doctor ever told you that you have any heart problems? If so, check all that apply: ☐ High blood pressure ☐ A heart murmur ☐ High cholesterol ☐ A heart infection ☐ Kawasaki disease Other:		
9. Has a doctor ever ordered a test for your heart? (For example, ECG/EKG, echocardiogram)		
10. Do you get lightheaded or feel more short of breath than expected during exercise?		
11. Have you ever had an unexplained seizure?		
12. Do you get more tired or short of breath more quickly than your friends during exercise?		
HEART HEALTH QUESTIONS ABOUT YOUR FAMILY	**Yes**	**No**
13. Has any family member or relative died of heart problems or had an unexpected or unexplained sudden death before age 50 (including drowning, unexplained car accident, or sudden infant death syndrome)?		
14. Does anyone in your family have hypertrophic cardiomyopathy, Marfan syndrome, arrhythmogenic right ventricular cardiomyopathy, long QT syndrome, short QT syndrome, Brugada syndrome, or catecholaminergic polymorphic ventricular tachycardia?		
15. Does anyone in your family have a heart problem, pacemaker, or implanted defibrillator?		
16. Has anyone in your family had unexplained fainting, unexplained seizures, or near drowning?		
BONE AND JOINT QUESTIONS	**Yes**	**No**
17. Have you ever had an injury to a bone, muscle, ligament, or tendon that caused you to miss a practice or a game?		
18. Have you ever had any broken or fractured bones or dislocated joints?		
19. Have you ever had an injury that required x-rays, MRI, CT scan, injections, therapy, a brace, a cast, or crutches?		
20. Have you ever had a stress fracture?		
21. Have you ever been told that you have or have you had an x-ray for neck instability or atlantoaxial instability? (Down syndrome or dwarfism)		
22. Do you regularly use a brace, orthotics, or other assistive device?		
23. Do you have a bone, muscle, or joint injury that bothers you?		
24. Do any of your joints become painful, swollen, feel warm, or look red?		
25. Do you have any history of juvenile arthritis or connective tissue disease?		

MEDICAL QUESTIONS	Yes	No
26. Do you cough, wheeze, or have difficulty breathing during or after exercise?		
27. Have you ever used an inhaler or taken asthma medicine?		
28. Is there anyone in your family who has asthma?		
29. Were you born without or are you missing a kidney, an eye, a testicle (males), your spleen, or any other organ?		
30. Do you have groin pain or a painful bulge or hernia in the groin area?		
31. Have you had infectious mononucleosis (mono) within the last month?		
32. Do you have any rashes, pressure sores, or other skin problems?		
33. Have you had a herpes or MRSA skin infection?		
34. Have you ever had a head injury or concussion?		
35. Have you ever had a hit or blow to this head that caused confusion, prolonged headache, or memory problems?		
36. Do you have a history of seizure disorder?		
37. Do you have headaches with exercise?		
38. Have you ever had numbness, tingling, or weakness in your arms or legs after being hit or falling?		
39. Have you ever been unable to move your arms or legs after being hit or falling?		
40. Have you ever became ill while exercising in the heat?		
41. Do you get frequent muscle cramps when exercising?		
42. Do you or someone in your family have sickle cell trait or disease?		
43. Have you had any problems with your eyes or vision?		
44. Have you had any eye injuries?		
45. Do you wear glasses or contact lenses?		
46. Do you wear protective eyewear, such as goggles or a face shield?		
47. Do you worry about your weight?		
48. Are you trying to or has anyone recommended that you gain or lose weight?		
49. Are you on a special diet or do you avoid certain types of foods?		
50. Have you ever had an eating disorder?		
51. Do you have any concerns that you would like to discuss with a doctor?		
FEMALES ONLY		
52. Have you ever had a menstrual period?		
53. How old were you when you had your first menstrual period?		
54. How many periods have you had in the last 12 months?		

Explain "yes" answers here

_____

_____

_____

_____

_____

_____

_____

I hereby state that, to the best of my knowledge, my answers to the above questions are complete and correct.

Signature of athlete _____ Signature of parent/guardian _____ Date _____

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Vitals

Blood pressure
Pulse
Respiration rate
Body weight
Height
Temperature
SpO2

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Medical History

- General history
  - Previous hospitalization
  - Previous surgery
  - Previous injury status
  - Current injury status
  - OTC and rx medications

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Medical History: Cardiovascular

- History of:
  - Congenital or acquired heart disease
  - Exertional chest pain or SOB
  - Exertional syncope or near-syncope
  - Unexplained fatigue
  - HTN, dysrhythmia, murmur
  - Sudden cardiac death in family <50 y/o

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Medical History: Cardiovascular

- History of
  - Congenital or acquired heart disease
  - Exertional chest pain or SOB
  - Exertional syncope or near syncope
  - Unexplained fatigue
  - HTN, dysrhythmia, murmur
  - Sudden cardiac death in family <50 y/o

More to come

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Medical History: Neurologic

Head or neck injuries
Concussions
Second impact syndrome
Seizures
Burners/stingers

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Medical History: Environmental

Historical Red Flags

Cramping

Syncope

Exhaustion

Heat stroke

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Musculoskeletal Screening

Posture

Scoliosis screening

Flexibility

AROM

Muscle performance

Function

MUSCULOSKELETAL	Normal	Abnormal Findings
Neck		
Back		
Shoulder/arm		
Elbow/forearm		
Wrist/hand/fingers		
Hip/thigh		
Knee		
Leg/ankle		
Foot/toes		
Functional • Duck-walk, single leg hop		

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NATA 90-Second MSK Screen

Instruction	Observation
Stand facing examiner	Acromioclavicular joints: general habitus
Look at ceiling, floor, over both shoulders, touch ears to shoulder	Cervical spine motion
Shrug shoulders (resistance)	Trapezius strength
Abduct shoulders to 90° (resistance at 90°)	Deltoid strength
Full external rotation of arms	Shoulder motion
Flex and extend elbows	Elbow motion
Arms at sides, elbows at 90° flexed; pronate and supinate wrists	Elbow and wrist motion
Spread fingers; make fist	Hand and finger motion, strength, and deformities
Tighten (contract) quadriceps; relax quadriceps	Symmetry and knee effusions, ankle effusion
"Duck walk" away and toward examiner	Hip, knee, and ankle motions
Back to examiner	Shoulder symmetry; scoliosis
Knees straight, touch toes	Scoliosis, hip motion, hamstrings tightness
Raise upon toes, heels	Calf symmetry, leg strength

Conley et al., 2014

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Musculoskeletal Screening

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Consider a More Thorough Examination

Joint laxity
Special testing
Gait
Vestibular evaluation

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General Medical Evaluation

Visual evaluation
Hearing evaluation
Dental evaluation
Heart, lungs, chest
Hernia exam
Testicular exam

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Check Out Station

- Ensure completion of stations
- Summarize data
- Disposition of the athlete
  - By health care decision maker
  - Given to responsible person
  - Subject to HIPPA guidelines

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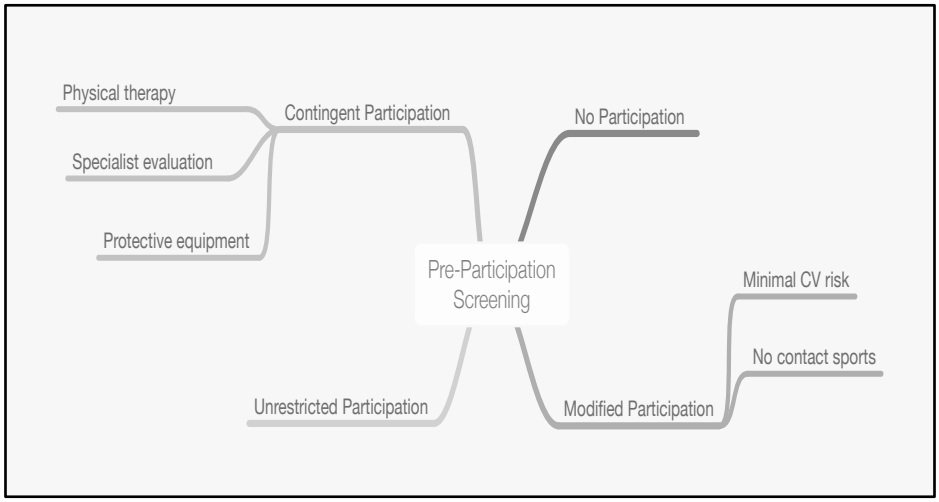
Final Verdict



Only 4 Options

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Contact Classifications

Increasing Static Component	A. Low (<40% Max O_2)	B. Moderate (40-70% Max O_2)	C. High (>70% Max O_2)
III. High (>50% MVC)	Bobsledding/Luge*†, Field events (throwing), Gymnastics*†, Martial arts*, Sailing, Sport climbing, Water skiing*†, Weight lifting*†, Windsurfing*†	Body building*†, Downhill skiing*†, Skateboarding*†, Snowboarding*†, Wrestling*	Boxing*, Canoeing/Kayaking, Cycling*†, Decathlon, Rowing, Speed-skating*†, Triathlon*†
II. Moderate (20-50% MVC)	Archery, Auto racing*†, Diving*†, Equestrian*†, Motorcycling*†	American football*, Field events (jumping), Figure skating*, Rodeoing*†, Rugby*, Running (sprint), Surfing*†, Synchronized swimming†	Basketball*, Ice hockey*, Cross-country skiing (skating technique), Lacrosse*, Running (middle distance), Swimming, Team handball
I. Low (<20% MVC)	Billiards, Bowling, Cricket, Curling, Golf, Riflery	Baseball/Softball*, Fencing, Table tennis, Volleyball	Badminton, Cross-country skiing (classic technique), Field hockey*, Orienteering, Race walking, Racquetball/Squash, Running (long distance), Soccer*, Tennis

Increasing Dynamic Component →

Mitchell & Haskell, 2005 39

Legal Considerations

Athlete's Right to Participate

Liability

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Logistics

Pick location and date
Assemble team
Advertise
Confirmation of participants
Completion of process: Setup, PPE, teardown
Follow-up: Stats, paperwork, gratitude

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Special Populations

The disabled athlete
The female athlete
Sickle cell trait
Solitary organs
The diabetic athlete
The Olympic athlete

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The Disabled Athlete

PREPARTICIPATION PHYSICAL EVALUATION
THE ATHLETE WITH SPECIAL NEEDS: SUPPLEMENTAL HISTORY FORM

Date of Exam _____

Name _____ Date of birth _____

Sex _____ Age _____ Grade _____ School _____ Sport(s) _____

1. Type of disability		
2. Date of disability		
3. Classification (if available)		
4. Cause of disability (birth, disease, accident/trauma, other)		
5. List the sports you are interested in playing		
	Yes	No
6. Do you regularly use a brace, assistive device, or prosthetic?		
7. Do you use any special brace or assistive device for sports?		
8. Do you have any rashes, pressure sores, or any other skin problems?		
9. Do you have a hearing loss? Do you use a hearing aid?		
10. Do you have a visual impairment?		
11. Do you use any special devices for bowel or bladder function?		
12. Do you have burning or discomfort when urinating?		
13. Have you had autonomic dysreflexia?		
14. Have you ever been diagnosed with a heat-related (hyperthermia) or cold-related (hypothermia) illness?		
15. Do you have muscle spasticity?		
16. Do you have frequent seizures that cannot be controlled by medication?		

Explain "yes" answers here

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The Disabled Athlete

PREPARTICIPATION PHYSICAL EVALUATION
THE ATHLETE WITH SPECIAL NEEDS: SUPPLEMENTAL HISTORY FORM

	Yes	No
Atlantoaxial instability		
X-ray evaluation for atlantoaxial instability		
Dislocated joints (more than one)		
Easy bleeding		
Enlarged spleen		
Hepatitis		
Osteopenia or osteoporosis		
Difficulty controlling bowel		
Difficulty controlling bladder		
Numbness or tingling in arms or hands		
Numbness or tingling in legs or feet		
Weakness in arms or hands		
Weakness in legs or feet		
Recent change in coordination		
Recent change in ability to walk		
Spina bifida		
Latex allergy		

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The Disabled Athlete

IJSPT

ORIGINAL RESEARCH

THE PREPARTICIPATION EVALUATION FOR ATHLETES WITH DISABILITY

Jonathan P. Hawkeswood, FRCPC[1]
O'Connor, R. FRCPC[1]
H. Anton, FRCPC[1]
H. Finlayson, FRCPC[1]

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The Female Athlete

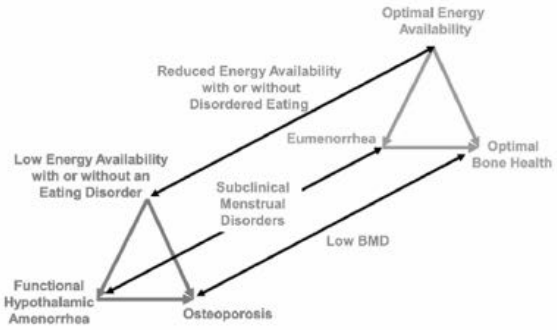
CLINICAL COMMENTARY

THE FEMALE ATHLETE TRIAD-WHAT EVERY PHYSICAL THERAPIST SHOULD KNOW

Laurie Stickler, PT, DHS, OCS[1]
Barbara J. Hoogenboom, PT, EdD, SCS, ATC[1]
Lauren Smith, BS, ATC[1]

Prevalence in high school, collegiate & elite athletes

1 component: 16-70%
2 components: 3-27%
3 components: 0-16%



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The Female Athlete

CLINICAL COMMENTARY

THE FEMALE ATHLETE TRIAD-WHAT EVERY PHYSICAL THERAPIST SHOULD KNOW

Laurie Stickler, PT, DHS, OCS[1]
Barbara J. Hoogenboom, PT, EdD, SCS, ATC[1]
Lauren Smith, BS, ATC[1]

1. Have you ever had a menstrual period?
2. How old were you when you had your first menstrual period?
3. When was your most recent menstrual period"
4. How many periods have you had in the last 12 months?
5. Are you presently taking any female hormones (estrogen, progesterone, birth control pills)
6. Do you worry about your weight?
7. Are you trying or has anyone recommended that you gain or lose weight?
8. Are you on a special diet or do you avoid certain types of foods or food groups?
9. Have you ever had an eating disorder?
10. Have you ever had a stress fracture?
11. Have you ever been told you have low bone density (osteopenia or osteoporosis)?

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Sickle Cell Trait

Prevent and manage heat exposure
Support adequate nutrition and hydration
Understand the impact of exercise intensity
Provide adequate rest
Develop and implement site-specific action plans

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Solitary Organs

Single kidney
Single eye
Single testicle

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Diabetic Athlete

Type I vs. II
Regular exercise key to glycemic control
Insulin management requires special attention
Pre and post exercise hypoglycemia
Delayed-onset hypoglycemia
Hyperglycemia and ketosis

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Diabetes in Sports

Insulin Guidelines

Measure glucose prior to activity
<120 mg/dL: 30g CHO & 14g protein
120-180 mg/dL: 15g CHO & 7-8g protein
180-240 mg/dL: 15g CHO only

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Must Have

Diabetes in Sports
Christine Shugart, Jonathan Jackson and Karl B. Fields
Sports Health: A Multidisciplinary Approach 2010 2: 29
DOI: 10.1177/1941738109347974

[Primary Care]

Diabetes in Sports

Christine Shugart, MD, Jonathan Jackson, MD, and Karl B. Fields, MD*

Context: Exercise is recommended for individuals with diabetes mellitus, and several facets of the disease must be considered when managing the diabetic athlete. The purpose of this article is to review diabetes care in the context of sports participation.

Evidence Acquisition: Relevant studies were identified through a literature search of MEDLINE and the Cochrane database, as well as manual review of reference lists of identified sources.

Results: Diabetics should be evaluated for complications of long-standing disease before beginning an exercise program, and exercise should be modified appropriately if complications are present. Athletes who use insulin or oral insulin secretogogues are at risk for exercise-induced immediate or delayed hypoglycemia. Diabetics are advised to engage in a combination of regular aerobic and resistance exercise. Insulin-dependent diabetics should supplement carbohydrate before and after exercise, as well as during exercise for events lasting longer than 1 hour. Adjustment of insulin dosing based on planned exercise intensity is another strategy to prevent hypoglycemia. Insulin-dependent athletes should monitor blood sugar closely before, during, and after exercise. Significant hyperglycemia before exercise should preclude exercise because the stress of exercise can paradoxically exacerbate hyperglycemia and lead to ketoacidosis. Athletes should be aware of hypoglycemia symptoms and have rapidly absorbable glucose available in case of hypoglycemia.

Conclusion: Exercise is an important component of diabetes treatment, and most people with diabetes can safely participate in sports at recreational and elite levels with attention to appropriate precautions.

Keywords: diabetic athlete; medication adjustment; insulin pump; benefits and risks of sport

Diabetes mellitus (DM) affects 7% of Americans, according to 2005 data from the Centers for Disease Control and Prevention.[1] The prevalence of DM is increasing owing to the national epidemic of obesity.[2] Exercise can delay the onset of diabetes in individuals with impaired glucose tolerance.[10,11,17,18] Exercise aids in diabetes treatment by improving glucose metabolism[4,13] and insulin sensitivity,[8] and it can reduce the use of oral medications and insulin. Participation in team sports early in life has been associated with decreased macrovascular complications and mortality for type 1 diabetics.[19] To avoid harmful effects, exercise may require modifications for individuals with complications of diabetes.[3] Physicians must carefully adjust treatment and monitor care of diabetic athletes to maximize their safe participation in sport.

There are separate but related considerations for athletes with type 1 and type 2 DM (respectively, DM1 and DM2). Individuals with DM1 are typically thin and experience onset of the illness at a young age. Their disease is caused by an autoimmune process that destroys the insulin-producing beta cells in the pancreas, rendering them completely dependent on exogenous insulin.[14] Management of insulin dosing and glycemic control is an important component of their athletic participation. Type 1 diabetics with long-standing disease often have end-organ complications. Athletes with DM1 may participate in sports at many levels, ranging from recreational to elite, with appropriate care.

DM2 most commonly affects overweight adults, although it is on the rise in younger age groups, secondary to childhood obesity. DM2 is caused by insulin resistance and relative insulin deficiency and can sometimes be controlled through lifestyle changes such as diet and exercise. Type 2 diabetics often require oral medications and in the later stages of the disease may require insulin injection. Just as for DM1, management of exercise includes consideration of diabetes complications. Most athletes with DM2 participate in recreational-level sports.

PHYSIOLOGY OVERVIEW

An increase in plasma glucose concentration after a meal stimulates insulin secretion by the beta cells of the pancreas.[11]

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Must Have

National Athletic Trainers' Association Position Statement: Management of the Athlete With Type 1 Diabetes Mellitus

Carolyn C. Jimenez, PhD, ATC*; Matthew H. Corcoran, MD, CDE†; James T. Crawley, MEd, PT, ATC‡; W. Guyton Hornsby, Jr, PhD, CDE‖; Kimberly S. Peer, EdD, LATC¶; Rick D. Philbin, MBA, MEd, ATC#; Michael C. Riddell, PhD**

National Athletic Trainers' Association®
Health Care for Life & Sport

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The Elite Athlete

The International Olympic Committee (IOC) Consensus Statement on Periodic Health Evaluation of Elite Athletes
March 2009

INTERNATIONAL
OLYMPIC
COMMITTEE

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Pre-Participation Screening: History, Purpose & Mechanics

Cardiac Anomalies & Screening

Injury Prevention Screen

Sports Performance Testing

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Cardiac Anomalies & Screening

Background

Sudden Cardiac Death

Cardiac Anomalies

Cardiac Screening

ECG Controversy

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Piermario Morosini: 2012

Age: 25

Soccer

Italy

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Miklos Fehrer: 2004

Age: 24

Soccer

Portugal

59

Claire Crawford: 2016

Age: 16

Volleyball

Georgia

60

Fabrice Muamba: 2012

Age: 23

Soccer

England

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Scope of Problem

10-12 million young athletes

Protect their safety

Honesty

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SCD in the News

- Darryl Kyle – St Louis Cardinals
  - 2002
- Hank Gathers– Loyola Marymount
  - 1990
- Flo Hyman – US Olympic Volleyball
  - 1986
- Jim Fixx – Runner and Fitness guru
  - 1984
- "Pistol" Pete Maravich – NBA Star
  - 1988

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Consider Watching

ESPN 30 for 30
Guro of Go

https://www.youtube.com/watch?v=vcD5XUXfr1Y

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Incidence

Four cases per one million athletes
~25x/year in athletes <30
Significant cause of sports-related deaths in US across all ages

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Incidence

High school athletes:
1 in 150,000

Collegiate athletes:
1 in 65,000

Masters athletes:
1 in 25,000

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Epidemiology

90% SCD in males

More common with dynamic aerobic exercise:

Hockey, football, basketball, squash, triathlons, running

AA>Caucasians

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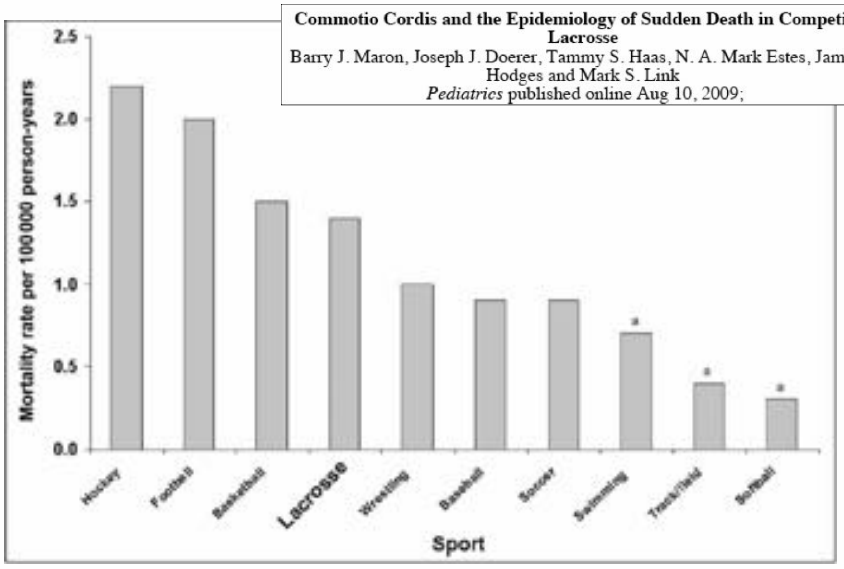
PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Commotio Cordis and the Epidemiology of Sudden Death in Competitive Lacrosse
Barry J. Maron, Joseph J. Doerer, Tammy S. Haas, N. A. Mark Estes, James S. Hodges and Mark S. Link
Pediatrics published online Aug 10, 2009;



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Exercise & the Heart

Increased cardiac output

Raises HR and stroke volume

High systolic BP

Decreased peripheral vascular resistance

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Sudden Cardiac Death

Electrical disturbances in the heart causes arrest or arrhythmia

With or without external trauma

Typically without warning

Can have prodromal signs

Death <1 hour

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Sudden Cardiac Death, <35 years old

Usually structural CVD

Most likely:

1) Hypertrophic cardiomyopathy
2) Coronary artery anomaly
3) Commotio cordis

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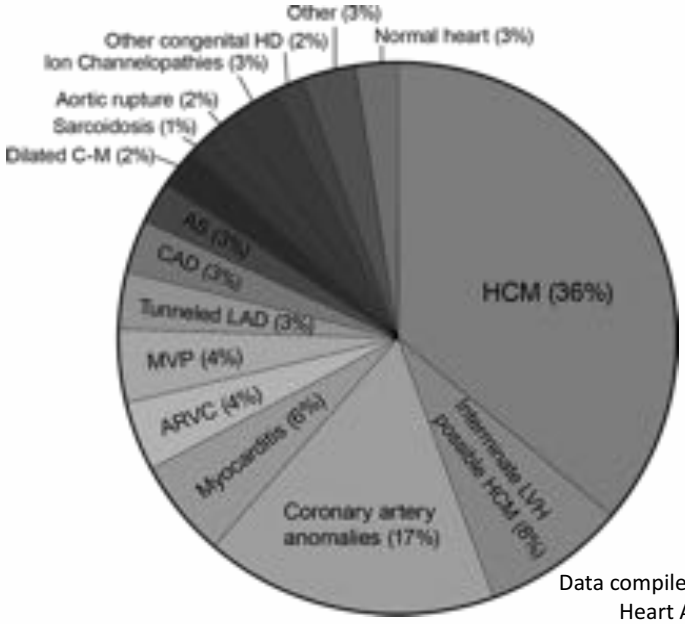
Causes of SCD



Data compiled from American Heart Association

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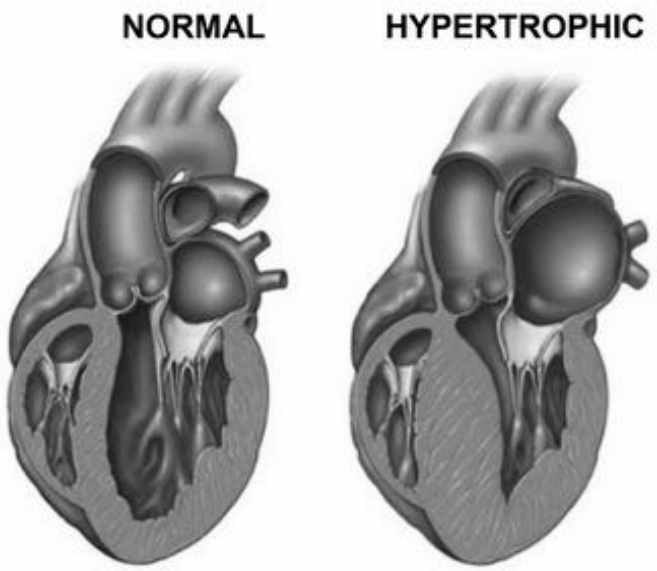
Hypertrophic Cardiomyopathy (HCM)
Coronary Artery Anomalies
Commotio Cordis
Myocarditis
ARVC

HCM



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HCM

Typically inherited as autosomal dominant gene

Over 100 individual genetic defects can result in the condition

60% of people have affected first-degree relative

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Marfan's Syndrome

Fibrillin gene defect

Alters connective tissues throughout body

Leads to ruptured aortic aneurysm

Skeletal, ocular, cardiovascular changes

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Marfan's: Skeletal

Tall stature

Thin

Arm span exceeding height

Pectus excavatum

Joint hypermobility

Scoliosis

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Skeletal Hypermobility

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Marfan's: Ocular

Myopia

Chromic myopia

Ectopia lentis (upward)

Retinal detachment

Hypoplasia of dilator muscle

Flat cornea

79

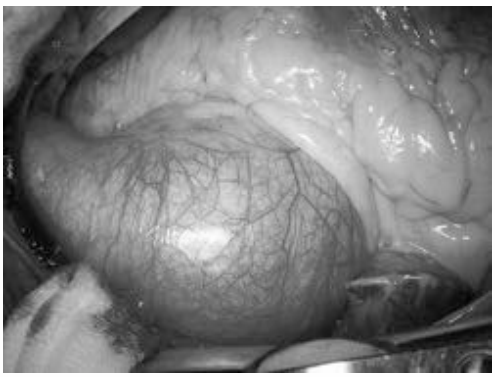
Marfan's: Cardiovascular Changes

Aortic distension

Mitral valve prolapse

Aortic or mitral regurgitation

Dysrhythmias



80

Marfan's: Abraham Lincoln

81

2010 Revised Ghent Nosology

In the Absence of Family History

1. Aortic Root Dilatation Z score ≥ 2 AND Ectopia Lentis
2. Aortic Root Dilatation Z score ≥ 2 AND FBN1
3. Aortic Root Dilatation Z score ≥ 2 AND Systemic Score ≥ 7pts
4. Ectopia lentis AND FBN1 with known Aortic Root Dilatation

In the Presence of Family History

1. Ectopia lentis AND Family History of Marfan syndrome (as defined above)
2. A systemic score ≥ 7 points AND Family History of Marfan syndrome (as defined above)
3. Aortic Root Dilatation Z score ≥ 2 above 20 yrs. old, ≥ 3 below 20 yrs. old) + Family History of Marfan syndrome (as defined above)

82

Myocarditis

Inflammatory process of the myocardium

Typically from echovirus, adenovirus, influenza

Dyspnea, orthopnea

Exercise intolerance

Tachycardia

Diarrhea, malaise, myalgia

Persistent and productive cough

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Myocarditis

Diagnosed with percutaneous endomyocardial biopsy

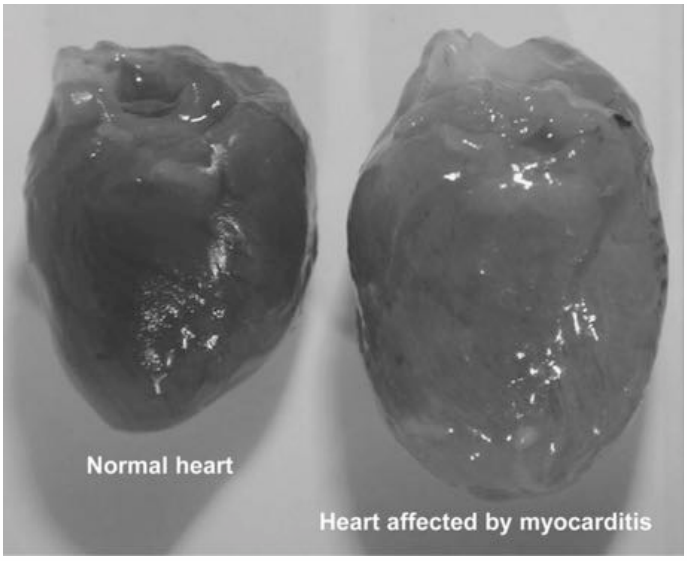
Chest x-ray

Treatment: rest, steroids, NSAID's

Heart transplant in severe cases

Death from ventricular arrhythmia

84



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Myocarditis: Make it Real

86

Commotio Cordis

13-year-old Little Leaguer Hayden Walton dies after being hit in the chest with ball

87

Commotio Cordis

Anatomically normal heart

Males>females

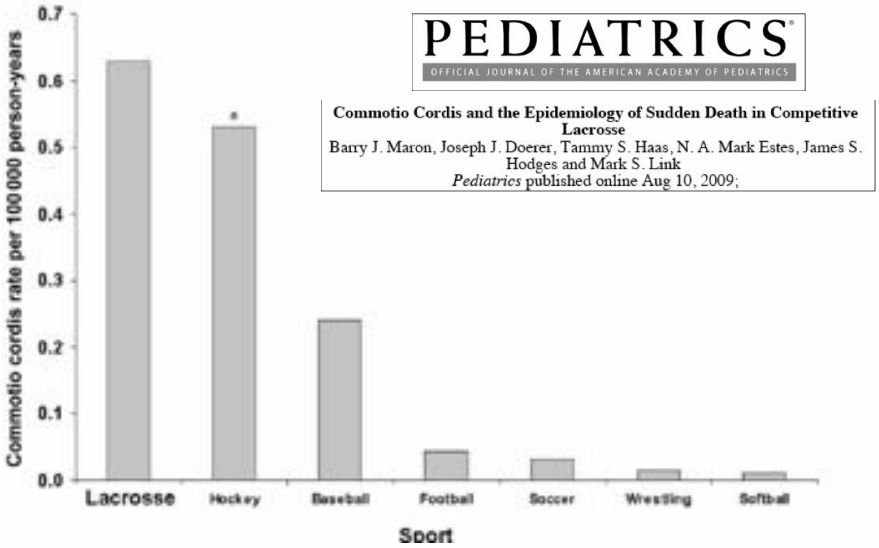
Mean age 13.6 years

80% blow from projective

20% hit from another player

Timing, not force

88

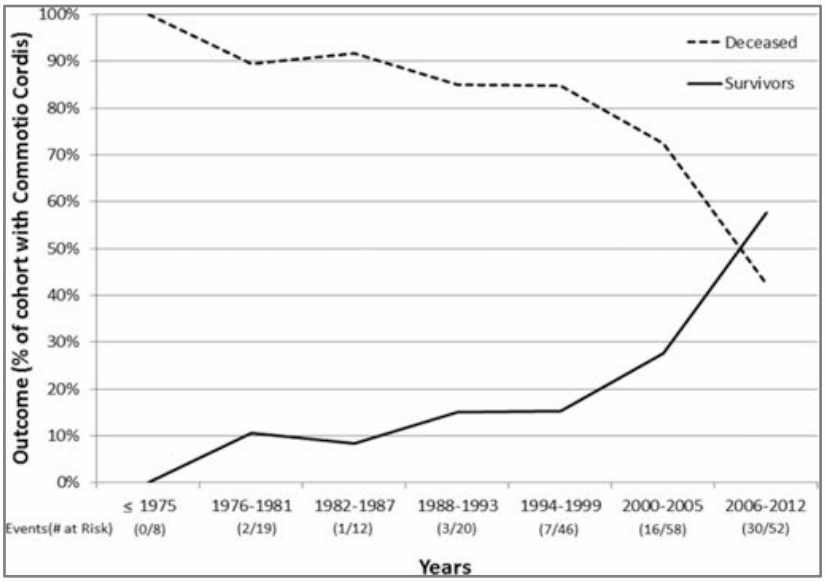


PEDIATRICS
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Commotio Cordis and the Epidemiology of Sudden Death in Competitive Lacrosse
Barry J. Maron, Joseph J. Doerer, Tammy S. Haas, N. A. Mark Estes, James S. Hodges and Mark S. Link
Pediatrics published online Aug 10, 2009;

89

Commotio Cordis: Survival Rates



90

Prevention

Consider chest protection
Age appropriate baseballs
Train EMR's
Have AED accessible

91

Potential Cause?

92

Congenital Coronary Artery Anomalies

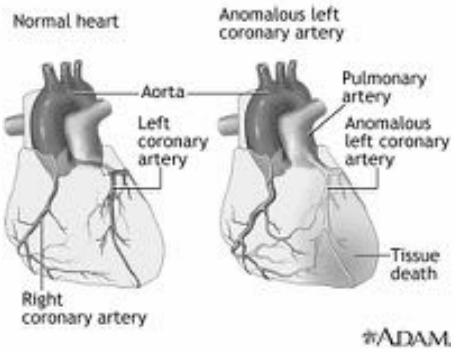
Abnormal artery is compressed as the ascending aorta dilates with exercise

Blood flow to the heart is limited

Hypoperfusion of myocardium occurs and is primary cause of death

Early symptoms include fatigue, exercise-induced syncope, chest pain

Pistol Pete



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SCD in >35 years old

Coronary heart disease: >75% of the time

Factors: smoking, HTN, obesity, high cholesterol, inactivity, DM

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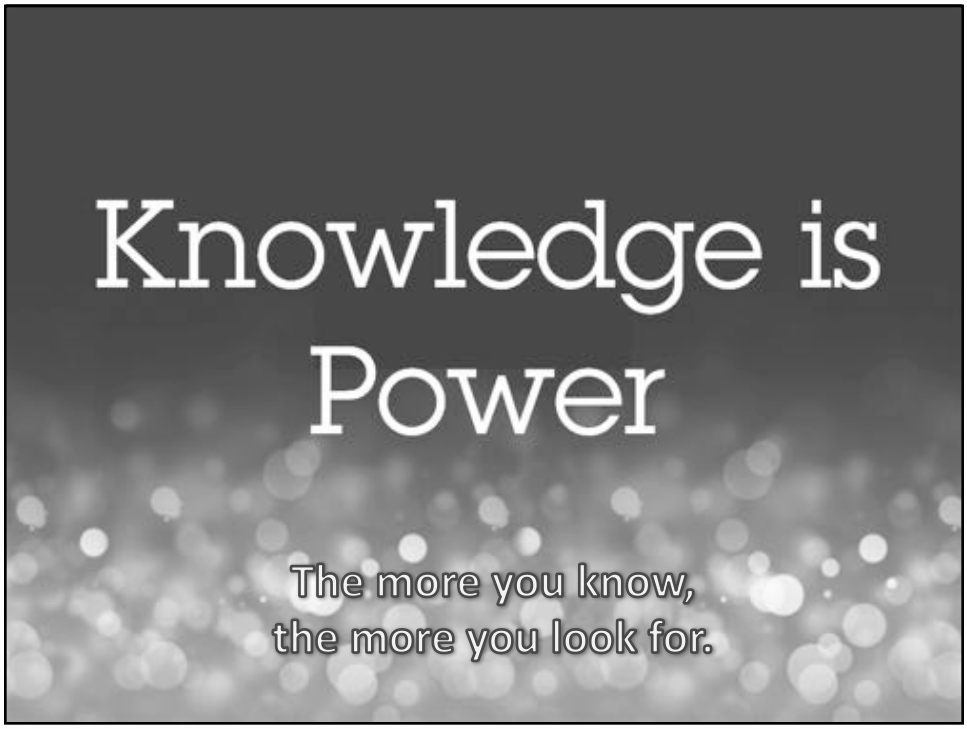
What can We Do?

95



AHA 12 Point Screen

Family history
- Premature death (sudden or otherwise) or significant disability from cardiovascular disease in a close relative younger than 50 years
- Specific knowledge of close relatives with certain cardiovascular conditions (eg, hypertrophic cardiomyopathy, dilated cardiomyopathy, long QT syndrome, Marfan syndrome, or clinically important arrhythmias)

Personal history
- Excessive, unexpected, and unexplained fatigue associated with exercise
- Excessive, unexpected, and unexplained shortness of breath associated with exercise
- Exertional chest pain or discomfort
- Exertional syncope or near syncope
- Heart murmur
- Systemic hypertension

Physical examination
- Auscultation of heart in both supine and standing positions
- Palpation of femoral pulses
- Recognition of physical stigmata of Marfan syndrome
- Brachial artery blood pressure measurement

Parental verification of personal and family history for high school athletes

97

9 Vital Questions

1. Have you ever passed out or nearly passed out *during* exercise?
2. Have you ever passed out or nearly passed out *after* exercise?
3. Have you ever had discomfort, pain, or pressure in your chest during exercise?
4. Does your heart race or skip beats during exercise?
5. Has a doctor ever told you that you have a heart murmur?
6. Has a doctor ever ordered a test for your heart (for example, EKG, ECG)?
7. Has anyone in your family died for no apparent reason?
8. Does anyone in your family have a heart problem?
9. Has any family member or relative died of heart problems or of sudden death before age 50?

98

Physical Exam: Stigmata

Tall, thin build
Long arms, leg, fingers
Flexible joints (Beighton signs)
Scoliosis
Pectus excavatum or carinatum
High palate, small jaw
Crowded teeth
Flat feet
Stretch marks
Ocular lens dislocation
Nearsightedness, blurred vision
Corneal flatness, strabismus, exo or endotropia

99

Return to Play Options

No participation in any sport

Modified participation

Participation after further testing or treatment

Full, unlimited participation

100

Anthony VanLoo

101

Energy Drinks???

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Energy Drinks

Viewpoint

Energy Drink Overconsumption in Adolescents: Implications for Arrhythmias and Other Cardiovascular Events

Fabian Sanchis-Gomar, PhD, MD,[a] Helios Pareja-Galeano, PhD,[a,b] Gianfranco Cervellin, MD,[c] Giuseppe Lippi, MD,[d] and Conrad P. Earnest, PhD[e]

Table 1. Possible manifestations of energy drink abuse in adolescents

Tachycardia
Atrial fibrillation or flutter
Ventricular arrhythmias
QT prolongation
ST-segment elevation
Increased anxiety and depression
Dizziness
Sleeplessness
Shortness of breath
Loss of control and a feeling of imminent death
Development of uncontrollable phobias and fears
Increased platelet aggregation
Decreased endothelial function
Myocardial infarction
Hemodynamic failure
Syncope
Sudden cardiac death
Cumulative cardiovascular load
Cerebral blood flow reduction

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Preventative ECG Testing: Should We Do It?

104

What We Know

The natural history and absolute risk of conditions associated with SCA/D in athletes identified with a cardiac disorder during screening is largely unknown with limited outcomes-based evidence.

Exercise is a known trigger and can unmask occult cardiac disease to precipitate SCA/D.

Athletes display a differential risk for SCA/D based on age, sex, race, sport, and level of play.

The ECG increases early detection of some cardiac disorders associated with SCA/D.

Drezner et al, 2016

105

What We Know

The current PPE history and physical examination, although pragmatic and widely practiced, is limited in its ability to identify athletes with conditions at risk for SCA/D.

Drezner et al, 2016

106

The Problem

Electrocardiogram interpretation accuracy and reliability are challenges with the principal concern of adding false-positive results to the PPE screening process.

Results from centers with considerable experience in athlete ECG screening have demonstrated improved detection of cardiac conditions with potential risk for SCA/D and decreased false-positive rates.

Associated costs of performing prophylactic ECG's is insurmountable

Drezner et al, 2016

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Arguments For & Against ECG's

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Arguments For & Against ECG's

Italian ECG's during PPE for competitive athletes…

- is mandated by law
- includes a 12-lead ECG both at rest and after a submaximal, 3-minute exercise step test
- is only performed by fully certified Sports Medicine Physicians

Roberts et al., 2014

109

Arguments For & Against ECG's

Pre-participation screening of student athletes for cardiovascular disease using a single, appropriately interpreted ECG and cardiovascular focused history and physical examination reduces sudden cardiac death and has an acceptable cost-effectiveness ratio of $76,000 per life year saved as compared with a strategy of no screening.

Wheeler et al., 2010

110

Arguments For & Against ECG's

- In contrast to the Italian experience, Israel implemented a similar mandatory ECG screening program, but has not reported any reduction in SCD
- ECG screening was instituted by legislative action possibly as a response to a cluster of athlete deaths and not by data-driven decision making.

Roberts et al., 2014

111

Arguments For & Against ECG's

"A mathematical modeling of population risk and benefit using the Italian data applied to the UK athlete population concluded that a required ECG would be of more harm than benefit from a public health perspective, with a small impact on population health and a potentially great cost to athletes with unnecessary restriction of activity due to false positive findings. The end result of the analysis demonstrated that preventing 1 SCD each year would exclude nearly 800 athletes from competition."

Roberts et al., 2014

112

Consensus Verdict

We have insufficient evidence on whether to perform ECG screening in all athletes. Cost, iatrogenic complications, and unnecessary activity restrictions due to false positive findings must be considered when deciding on mandated ECG screening.

The ECG may be important in specific populations that have an evidence base to show increased risk and should be a part of the exam for anyone with truly positive responses and supporting history to the risk-based cardiac screening questions.

Roberts et al., 2014

113

Key Resources

AMSSM Position Statement on Cardiovascular Preparticipation Screening in Athletes: Current Evidence, Knowledge Gaps, Recommendations, and Future Directions

The absence of definitive outcomes-based evidence at this time precludes AMSSM from endorsing any single or universal CV screening strategy for all athletes including legislative mandates. This statement presents a new paradigm to assist the individual physician in assessing the most appropriate CV screening strategy unique to their athlete population, community needs, and resources.

Drezner et al, 2016

114

Future Resources

Inter-Association Task Force Recommendations on Emergency Preparedness and Management of Sudden Cardiac Arrest in High School and College Athletic Programs: A Consensus Statement

Jonathan A. Drezner, MD, Ron W. Courson, ATC, PT,† William O. Roberts, MD,‡ Vincent N. Mosesso, Jr, MD,§ Mark S. Link, MD,¶ and Barry J. Maron, MD‖*

115

Pre-Participation Screening: History, Purpose & Mechanics

Cardiac Anomalies & Screening

Injury Prevention Screen

Sports Performance Testing

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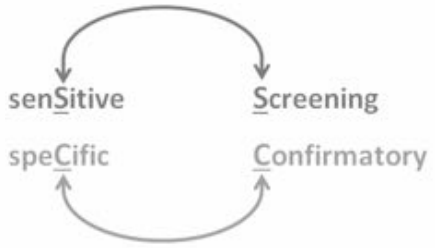
The Crux of It

Remember the Purpose?

Detection of conditions that may limit participation or predispose to injury

Detect conditions that may be life threatening or disabling



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When Would I Do This?

Sports teams
Extra fee for service
Sufficient staff, space, equipment

118

What Are My Options?

Y Balance Test

Functional Movement Screen (FMS)

Closed Kinetic Chain Dorsiflexion Test

Tuck Jump Assessment

Landing Error Scoring System (LESS)

Move2Perform

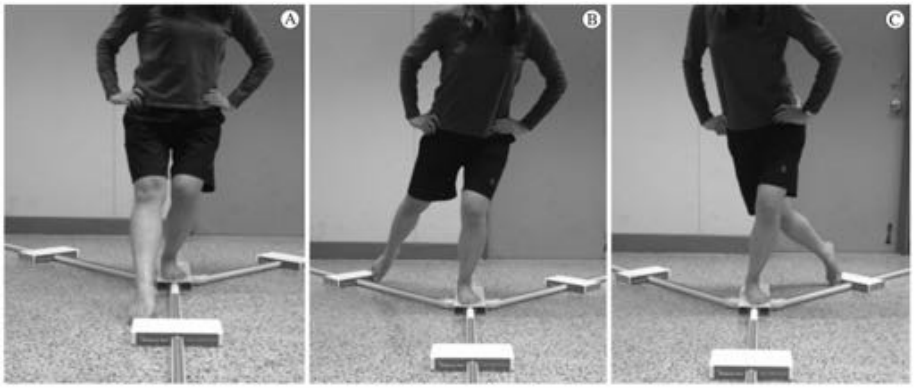
119

Y Balance Test

Star Excursion Balance Test

120

Y Balance Test



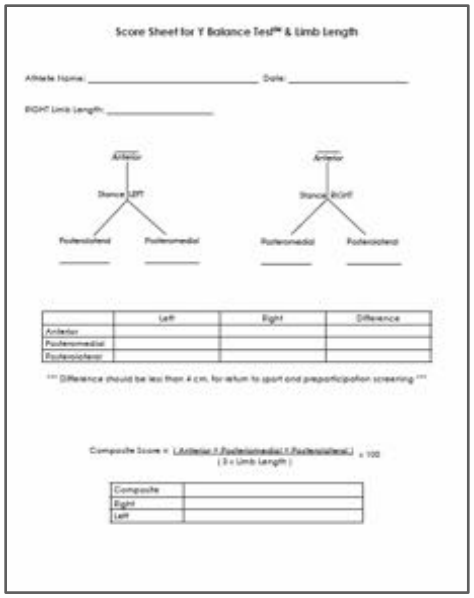
Anterior
Posteromedial
Posterolateral

121

Y Balance Test

122

Y Balance Test



Score Sheet for Y Balance Test™ & Limb Length

Athlete Name: _____ Date: _____

RIGHT Limb Length: _____

Anterior — Stance LEFT — Posterolateral _____ Posteromedial _____

Anterior — Stance RIGHT — Posteromedial _____ Posterolateral _____

	Left	Right	Difference
Anterior			
Posteromedial			
Posterolateral			

*** Difference should be less than 4 cm. for return to sport and preparticipation screening ***

Composite Score = [Anterior + Posteromedial + Posterolateral] / (3 x Limb Length) x 100

Composite	
Right	
Left	

123

Functional Movement Screen

Screen

7 Different Movements

Scored 0-3

Top score of 21

3 "clearing movements"

Gray Cook & Lee Burton

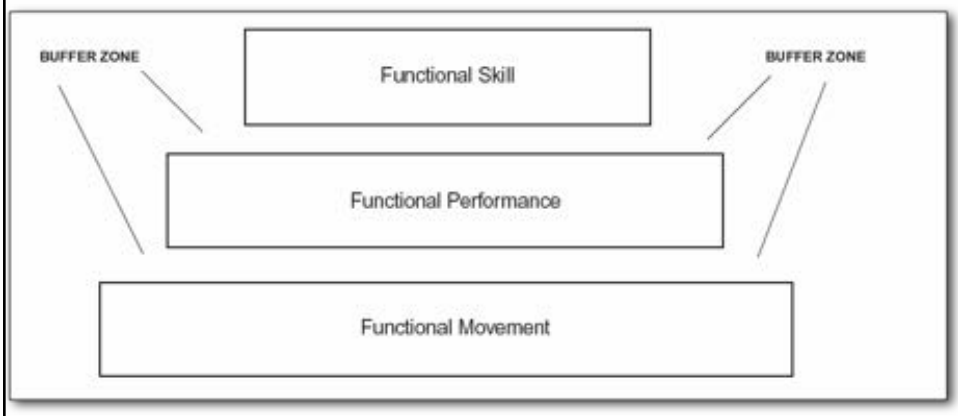
124

Functional Movement Screen

Underlying assumptions
Concept
Target population

125

Functional Movement Screen: Optimal Performance Pyramid



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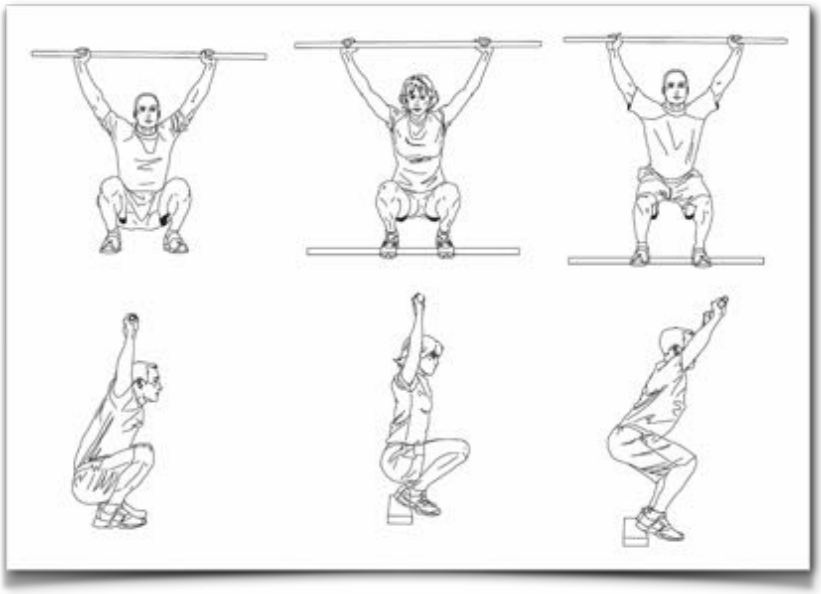
1: Deep Squat

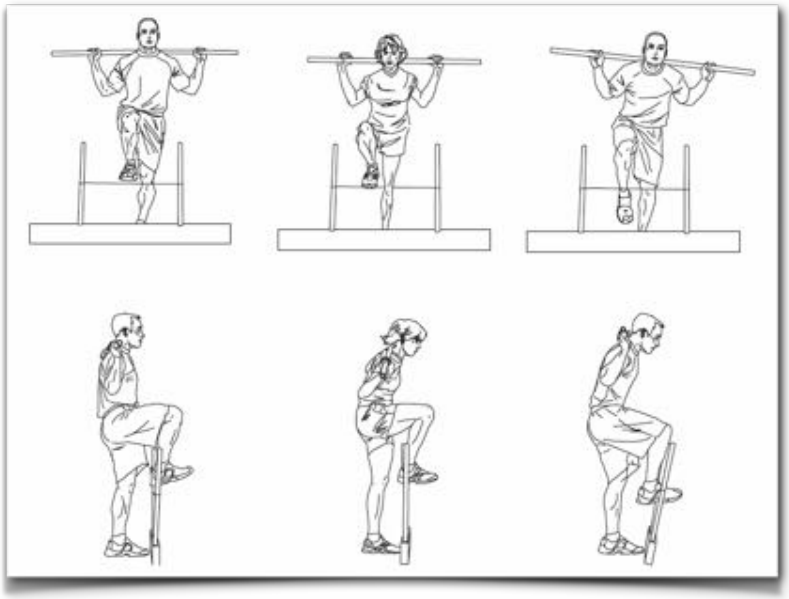


127

1: Deep Squat

128

2: Hurdle Step

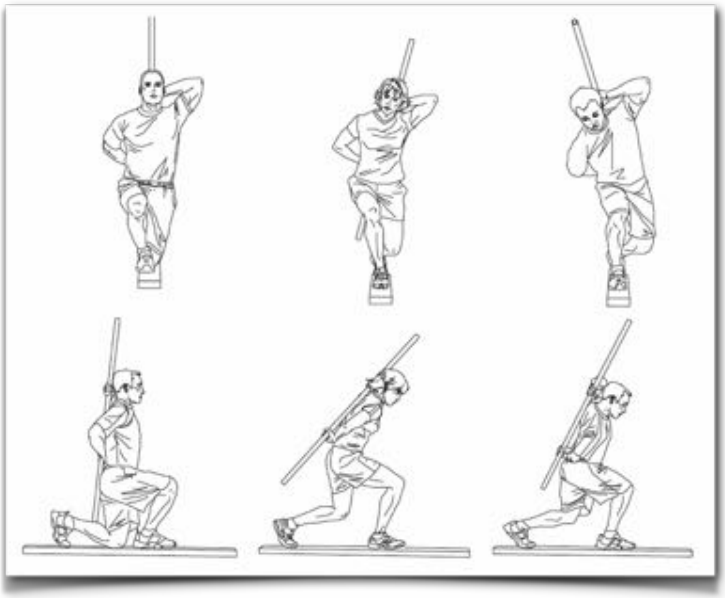


129

2: Hurdle Step

130

3: In Line Lunge



131

3: In Line Lunge

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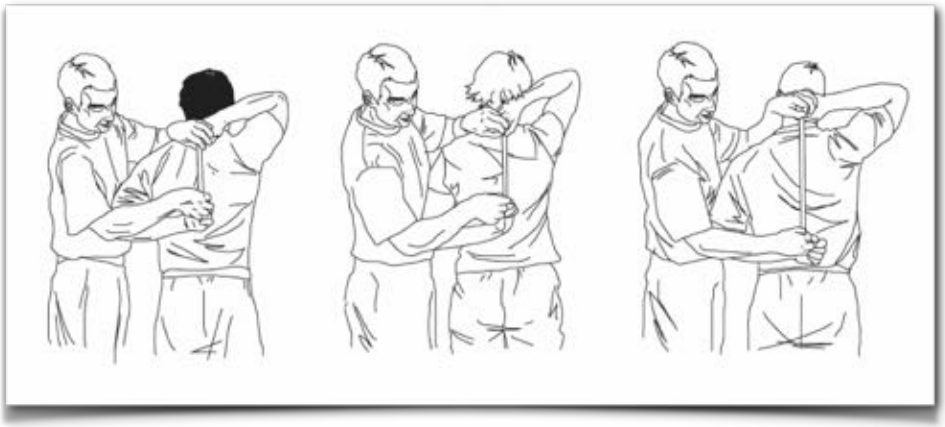
4: Shoulder Mobility



133

4: Shoulder Mobility

134

4: Shoulder Mobility Clearing Test

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5: Active Straight Leg Raise

136

5: Active Straight Leg Raise

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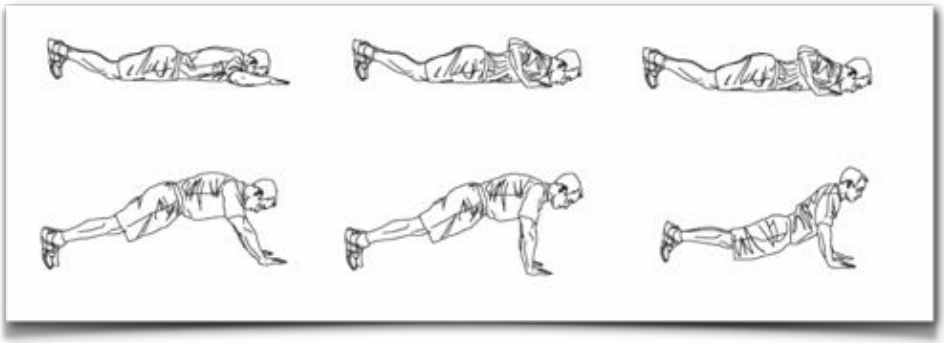
6: Trunk Stability Pushup



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6: Trunk Stability Pushup

139

6: Trunk Stability Pushup Clearing Test

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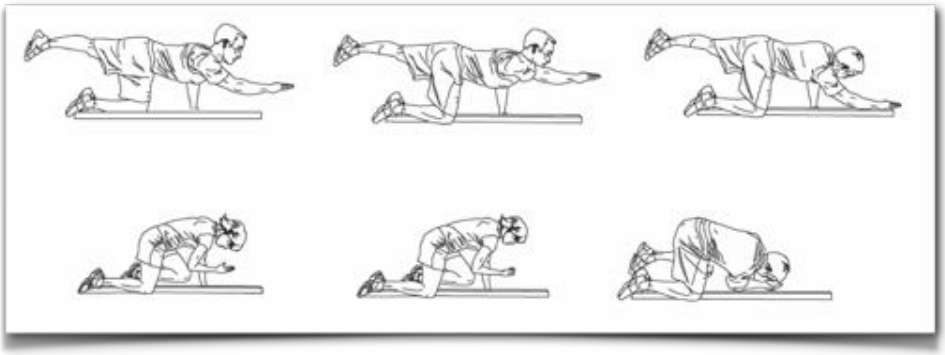
7: Rotary Stability



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7: Rotary Stability

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7: Rotary Stability Clearing Test

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Client One

TEST	RAW SC	FINAL	COMMENTS
DEEP SQUAT	2	2	
HURDLE ST. L	2	2	
HURDLE ST. R	2		
IN-LINE LUN. L	2		
IN-LINE LUN. R	3		
SHO. MOB. L	1		
SHO. MOB. R	3	1	
ACTIVE IMP. L	-		
ACTIVE IMP. R	-		
ASLR L	2	2	
ASLR R	3		
TSPU	2	2	
EXT	-		
ROT. STAB. L	2	2	
ROT. STAB. R	2		
FLX	-		
TOTAL		13	

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Client Two

TEST	RAW SC	FINAL	COMMENTS
HURDLE ST. L	2	2	
HURDLE ST. R	3		
IN-LINE LUN. L	2	2	
IN-LINE LUN. R	2		
SHO. MOB. L	3	3	
SHO. MOB. R	3		
ACTIVE IMP. L	-		
ACTIVE IMP. R	-		
ASLR L	2	2	
ASLR R	2		
TSPU	3	3	
EXT	-		
ROT. STAB. L	2	2	
ROT. STAB. R	2		
FLX	-		
TOTAL		17	

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Client Three

TEST	RAW SC	FINAL	COMMENTS
DEEP SQUAT	2	2	
HURDLE ST. L	2	2	
HURDLE ST. R	2		
IN-LINE LUN. L	2	2	
IN-LINE LUN. R	2		
SHO. MOB. L	2	2	
SHO. MOB. R	3		
ACTIVE IMP. L	-		
ACTIVE IMP. R	-		
ASLR L	3	2	
ASLR R	2		
TSPU	3	0	
EXT	+		
ROT. STAB. L	2	2	
ROT. STAB. R	3		
FLX	-		
TOTAL		12	

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Does it Really Work to Predict Injuries?

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ORIGINAL RESEARCH

CAN SERIOUS INJURY IN PROFESSIONAL FOOTBALL BE PREDICTED BY A PRESEASON FUNCTIONAL MOVEMENT SCREEN?

Kyle Kiesel, PT, PhD, ATC, CSCS[a]
Phillip J. Plisky, PT, DSc, OCS, ATC[a]
Michael L. Voight, PT, DHSc, OCS, SCS, ATC[b]

Purpose: to determine the relationship between professional football players' score on the FMS and the likelihood of serious injury

IJSPT INTERNATIONAL JOURNAL OF SPORTS PHYSICAL THERAPY

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The Magic Number

≤14

Specificity: 0.91
Sensitivity: 0.54
Odds ratio 11.67
Positive Likelihood Ratio:5.92
Negative Likelihood Ratio: 0.51

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Is There An Application Besides Football?

NAJSPT

ORIGINAL RESEARCH

USE OF A FUNCTIONAL MOVEMENT SCREENING TOOL TO DETERMINE INJURY RISK IN FEMALE COLLEGIATE ATHLETES

Rita S. Chorba, PT, MSPT, MAT, ATC, CSCS[a]
David J. Chorba, MSEd, MAT, ATC, CSCS[b]
Lucinda E. Bouillon, PhD, PT[c]
Corey A. Overmyer PT, MPT, OCS[d]
James A. Landis, MD, PhD, CSCS[e]

Purpose: determine if compensatory movement patterns predispose female college athletes to injury, and if a FMS tool can be used to predict injuries in this population

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38 NCAA Division II Athletes

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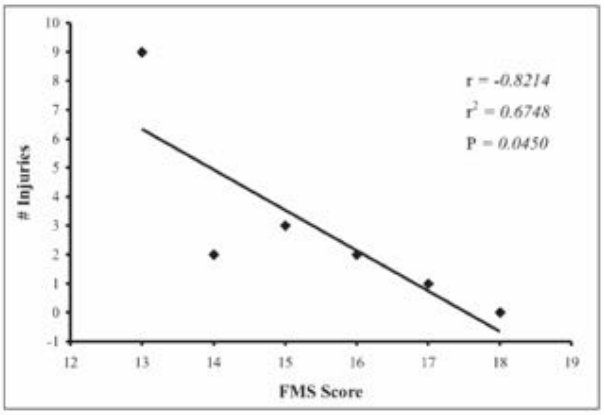
Results



A lower score on the FMS™ was significantly associated with injury, with 69% of those scoring 14 or less sustaining an injury, and experiencing a 4-fold increase in injury risk.

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More Than Meets the Eye

153

Evaluation of the Functional Movement Screen as an Injury Prediction Tool Among Active Adult Populations: A Systematic Review and Meta-analysis

Study	True Positives, n	False Negatives, n	False Positives, n	True Negatives, n	Sensitivity, %	Specificity, %	Positive Predictive Value, %	Negative Predictive Value, %
Kiesel et al[15]	7	6	3	30	53.8	90.9	70.0	83.3
Chorba et al[9]	11	8	5	14	57.9	73.7	68.8	63.6
O'Connor et al[25]	42	228	51	553	15.6	91.6	45.2	70.8
Peate et al[28]	43	75	90	225	36.4	71.4	32.3	75.0
Shojaedin et al[32]	22	20	24	34	52.4	58.6	47.8	63.0
Kiesel et al[16]	16	44	24	154	26.7	86.5	40.0	77.8
Total					24.7	85.7	42.8	72.5

[a]Six studies included 1729 cases.

Dorrel et al., 2015: *Sports Health* 154

Closed Kinetic Chain Dorsiflexion Test (CKC-DF)

<9-10cm abnormal

Tibial shaft angle <35-38 degrees abnormal

Predictive of injury in cricket and soccer

Common compensatory strategies?

155

Closed Kinetic Chain Dorsiflexion Test (CKC-DF)

156

Tuck Jump Assessment

10 seconds
10 errors (Yes/No)
Maximum effort
Reliability (inter/intra)

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Tuck Jump Assessment

Tuck Jump Assessment	Pre	Mid	Post	Comments
Knee and Thigh Motion				
1 Lower extremity valgus at landing	❑	❑	❑	
2 Thighs do not reach parallel (peak of jump)	❑	❑	❑	
3 Thighs not equal side-to-side (during flight)	❑	❑	❑	
Foot Position During Landing				
4 Foot placement not shoulder width apart	❑	❑	❑	
5 Foot placement not parallel (front to back)	❑	❑	❑	
6 Foot contact timing not equal	❑	❑	❑	
7. Excessive landing contact noise	❑	❑	❑	
Plyometric Technique				
8. Pause between jumps	❑	❑	❑	
9. Technique declines prior to 10 seconds	❑	❑	❑	
10. Does not land in same footprint (excessive in-flight motion)	❑	❑	❑	
	Total _____	Total _____	Total _____	

Figure reproduced from: Myer GD, et al. Tuck jump assessment for reducing anterior cruciate ligament injury risk. Athletic Therapy Today. 2008;13(5):39-44. Used with permission, Athletic Therapy Today.

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Tuck Jump Assessment

159

Landing Error Scoring System (LESS)

Drop height: 30 cm
Horizontal distance: 50% body height
Jump for maximum vertical height after landing
Focus on initial landing and max knee flexion
Quantify the number of movement errors

160

Landing Error Scoring System

The Landing Error Scoring System as a Screening Tool for an Anterior Cruciate Ligament Injury–Prevention Program in Elite-Youth Soccer Athletes

Pauda et al., 2015

161

Landing Error Scoring System

1. **Knee Flexion @ Initial Contact: > 30 degrees**
   ____ Yes (0)
   ____ No (+1)
2. **Knee Valgus @ Initial Contact: Knees over midfoot**
   ____ Yes (0)
   ____ No (+1)
3. **Hip Flexion @ Initial Contact: Hips are flexed**
   ____ Yes (0)
   ____ No (+1)
4. **Trunk Flexion @ Initial Contact: Trunk is flexed**
   ____ Yes (0)
   ____ No (+1)
5. **Lateral Trunk Flexion @ Initial Contact: Trunk is vertical**
   ____ Sternum centered over hips (0)
   ____ Lateral deviation of sternum over hips (+1)
6. **Ankle Plantar Flexion @ Initial Contact: Toe to heel**
   ____ Yes (0)
   ____ No (+1)
7. **Foot Position @ Initial Contact: Toes > 30 of ER**
   ____ Yes (+1)
   ____ No (0)
8. **Foot Position @ Initial Contact: Toes > 30 of IR**
   ____ Yes (+1)
   ____ No (0)
9. **Stance Width @ Initial Contact:< Shoulder width**
   ____ Yes (+1)
   ____ No (0)
10. **Stance Width @ Initial Contact:> Shoulder width**
    ____ Yes (+1)
    ____ No (0)
11. **Initial Foot Contact: Symmetric**
    ____ Yes (+0)
    ____ No (+1)
12. **Knee Flexion Displacement: > 45 degrees**
    ____ Yes (0)
    ____ No (+1)
13. **Knee Valgus Displacement: ≥ great toe**
    ____ Yes (+1)
    ____ No (0)
14. **Hip Flexion Displacement: Hips flex more than at initial contact**
    ____ Yes (0)
    ____ No (1)
15. **Trunk Flexion Displacement: Trunk flexes more than at initial contact**
    ____ Yes (0)
    ____ No (1)
16. **Joint Displacement (Sagittal Plane)**
    ____ Soft (0)
    ____ Average (+1)
    ____ Stiff (+2)
17. **Overall Impression**
    ____ Excellent (0)
    ____ Average (+1)
    ____ Poor (+2)

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Landing Error Scoring System Item	Operational Definition of Error	Scoring
Knee flexion: initial contact	The knee is flexed less than 30° at initial contact.	0 = Absent 1 = Present
Hip flexion: initial contact	The thigh is in line with the trunk at initial contact.	0 = Absent 1 = Present
Trunk flexion: initial contact	The trunk is vertical or extended on the hips at initial contact.	0 = Absent 1 = Present
Ankle plantar flexion: initial contact	The foot lands heel to toe or with a flat foot at initial contact.	0 = Absent 1 = Present
Medial knee position: initial contact	The center of the patella is medial to the midfoot at initial contact.	0 = Absent 1 = Present
Lateral trunk flexion: initial contact	The midline of the trunk is flexed to the left or the right side of the body at initial contact.	0 = Absent 1 = Present
Stance width: wide	The feet are positioned greater than shoulder width apart (acromion processes) at initial contact.	0 = Absent 1 = Present
Stance width: narrow	The feet are positioned less than shoulder width apart (acromion processes) at initial contact.	0 = Absent 1 = Present
Foot position: external rotation	The foot is externally rotated more than 30° between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Foot position: internal rotation	The foot is internally rotated more than 30° between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Symmetric initial foot contact: initial contact	One foot lands before the other foot or 1 foot lands heel to toe and the other foot lands toe to heel.	0 = Absent 1 = Present
Knee-flexion displacement	The knee flexes less than 45° between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Hip-flexion displacement	The thigh does not flex more on the trunk between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Trunk-flexion displacement	The trunk does not flex more between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Medial-knee displacement	At the point of maximum medial knee position, the center of the patella is medial to the midfoot.	0 = Absent 1 = Present
Joint displacement	Soft: the participant demonstrates a large amount of trunk, hip, and knee displacement.	0 = Soft
	Average: the participant has some, but not a large amount of, trunk, hip, and knee displacement.	1 = Average
	Stiff: the participant goes through very little, if any, trunk, hip, and knee displacement.	2 = Stiff
Overall impression	Excellent: the participant displays a soft landing with no frontal-plane or transverse-plane motion.	0 = Excellent
	Average: all other landings.	1 = Average
	Poor: the participant displays large frontal-plane or transverse-plane motion, or the participant displays a stiff landing with some frontal-plane or transverse-plane motion.	2 = Poor

Landing Error Scoring System (LESS)

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Move2Perform

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Move2Perform

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Pre-Participation Screening: History, Purpose & Mechanics

Cardiac Anomalies & Screening

Injury Prevention Screen

Sports Performance Testing

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Sports Performance Testing

Agility

T Test

Pro Agility Test

Lower Extremity Functional Test

Power

1-RM

Broad Jump

Vertical Jump

Medicine Ball Throw

Max Aerobic Test

Bruce Treadmill

Balk Treadmill

PACER Test

1.5 mile run

Submax Aerobic Test

Harvard Step Test

12-Minute Run

Modified Bruce Treadmill

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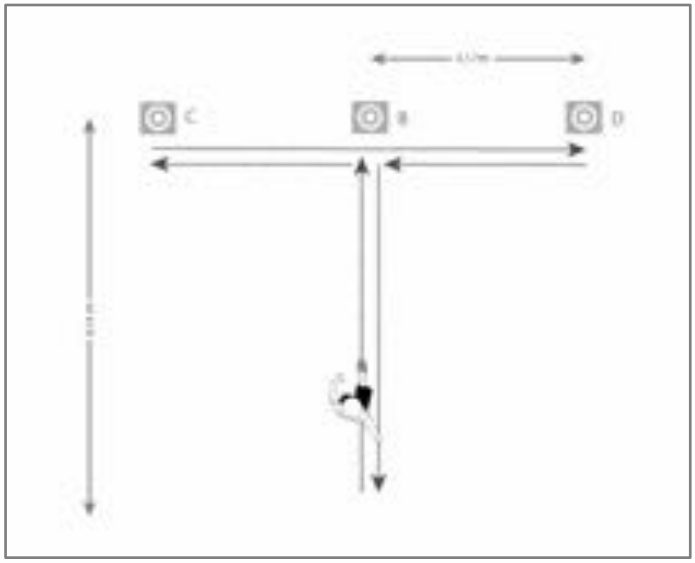
T Test



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T Test

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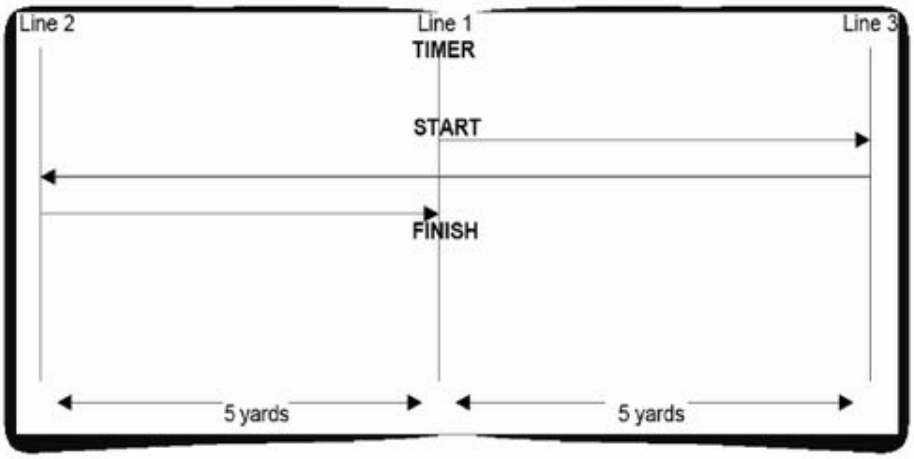
Pro-Agility Test



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Pro-Agility Test

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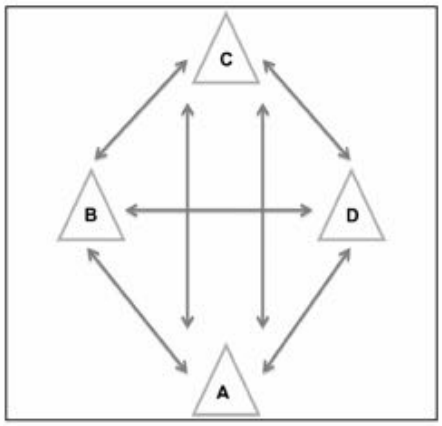
Lower Extremity Functional Test (LEFT)

9.14m "North to South"
3.03m "East to West"



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Lower Extremity Functional Test (LEFT)

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Thank You!

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