Physical Fitness and Writing an Exercise Prescription: A Primer for the Family Physician (2020)

…and Other Stuff a Family Doc should Know!

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Background: Physical Inactivity

- One in five adults is physically inactive; approximately **50% of adults** meet the 2008 aerobic physical guidelines.

- In 2016, **21.7% of U.S. adults** aged 18 met the 2008 federal physical active guidelines for **aerobic and strength activities**.

- **Sedentary behavior** is associated with a variety of poor health outcomes including an increase in mortality.

- One study estimates **physical inactivity accounts for 9% of premature mortality**.

Background: The Benefits

- Numerous observational studies demonstrate that regular exercise **reduces risk of all-cause, cardiovascular and cancer related mortality.**
- Exercise may provide modest protection against **breast, intestinal, prostate, endometrial and pancreatic cancer.**
- Exercise is associated with **improved cognition,** however, unclear if exercise mitigates dementia and cognitive decline.
- The effect appears to be dose dependent; however appears to be **no mortality benefit over 100 minutes/day** of moderate activity.

Background: The Impact of the Medical Provider

- The Most Powerful Intervention a Physician can Prescribe is not a Drug…
- … it’s Exercise!

Prevalence of aerobic physical activity level among adults aged 18–64 years with a disability (N = 1,090), by whether or not a doctor or health professional recommended exercise or physical activity in the past 12 months — National Health Interview Survey, United States, 2010
“Our growing softness, our increasing lack of physical fitness, is a menace to our security.”
We’ve Got an Additional Problem!

Source: Defense Department

Military Times December 2016
A Frightening Trend!

- World War I: 1/3 unfit for Service.
- World War II: 1/2 unfit for Service.
“The obesity issue is the most troubling because the trend is going in the wrong direction,” he said. “We think by 2020 it could be as high as 50%, which means only 2 in 10 would qualify to join the Army.” He paused. “It’s a sad testament to who we are as a society right now.”

Wall Street Journal, June 2014
“Nations have passed away and left no trace, and history gives the naked cause of it—one single simple reason in all cases; they fell because their people were not fit”

Rudyard Kipling
Objectives

At the Conclusion of this lecture the participant will be able to:

- **Discuss** the **Terminology and Components** of Physical Fitness
- **Describe** the **Tools** for the Measurement and Assessment of Physical Fitness
- **Describe** the **Principles and Recommendations** of Training to achieve Physical Fitness
- **Write and Progress** a Patient through a Basic Exercise Prescription
- **Discuss and Manage** Common Exercise Questions that Confront the Family Physician
Terminology of Physical Fitness
Physical Activity

- Any bodily movement produced by skeletal muscles that results in energy expenditure above resting levels.
- Physical activity broadly encompasses exercise, sports, and physical fitness activities done as part of daily living, occupation, leisure, and active transportation.

Exercise

- Physical activity that is **planned**, **structured** and repetitive and has a final or intermediate objective the **improvement or maintenance** of physical fitness.

- **Conditioning** is regular exercise conducted over an **extended period of time**.

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Physical Fitness

- The ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy pursuits and to meet unforeseen emergencies.

- Physical fitness is operationalized as measurable health and skill related attributes that include cardiorespiratory fitness, muscular strength and endurance, body composition and flexibility, balance, agility, reaction time and power.

Key Physiologic Terminology and Concepts of Physical Fitness
Maximal Aerobic Power (VO₂ max)

- Also known as oxygen consumption, oxygen uptake, and cardiorespiratory fitness.
- Greatest amount of O₂ a person can use during physical exercise.
- Ability to take in, transport and deliver O₂ to skeletal muscle for use by tissue.
- Commonly expressed as liters (L) /min or ml/kg/min.
The Standard Metabolic Equivalent (MET)

- An index of energy expenditure.
- One MET is the amount of energy expended sitting quietly at rest adjusted to body weight (1 MET = 3.5 ml oxygen consumed/kg of body weight/minute). Also equal to 1 kcal/kg/hour.
- Physical activity intensity is often expressed in MET units.
- Walking at a 14 minute per mile pace is expressed as an intensity of 6 METs (21 ml/kg/min) or 6 times resting energy expenditure (Defines Vigorous versus Moderate).
Calculating METs

\[ \text{METs} = (6 \times \text{Heart Rate Index}) - 5 \]

Where the Heart Rate Index equals the activity heart rate divided by the resting heart rate.

- **Example**: A tennis player’s resting heart rate of 60 beats per minute (bpm) is increased to 120 bpm during a tennis match. His MET level is estimated as follows:

  - \( \frac{120 \text{ bpm}}{60 \text{ bpm}} = 2.0 \) Heart Rate Index which is multiplied by 6, yielding 12, from which we subtract 5, yielding an estimated 7 METs. \((120/60 \times 6) - 5 = (2 \times 6) - 5 = 7 \text{ METs}\).

### Rating of Perceived Exertion: RPE/Borg Scale

<table>
<thead>
<tr>
<th>Rating (1-20)</th>
<th>Description</th>
<th>Lactate Threshold</th>
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</thead>
<tbody>
<tr>
<td>6-7</td>
<td>Very, very light</td>
<td></td>
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<tr>
<td>8-10</td>
<td>Very light</td>
<td></td>
</tr>
<tr>
<td>11-12</td>
<td>Fairly light</td>
<td>Lactate Threshold</td>
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<tr>
<td>13-14</td>
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<tr>
<td>15-16</td>
<td>Hard</td>
<td>2.5 mM Lactate</td>
</tr>
<tr>
<td>17-18</td>
<td>Very hard</td>
<td>4.0 mM Lactate</td>
</tr>
<tr>
<td>19-20</td>
<td>Very, very hard</td>
<td>Maximal exercise</td>
</tr>
</tbody>
</table>
Force and Types of Muscle Contractions

Concentric

Eccentric

Isometric
Force-Velocity Relationship

- **Eccentric: ECC**
  - Greater force with increasing velocity/acceleration, due to lower metabolic cost, greater mechanical efficiency and greater contribution from series elastic components.

**Conclusion:** high speed eccentric exercise is associated with high force loads and can be a problem!
Process of Strength Gains

- **Early** strength gains influenced by neural factors.

- **Long-term** strength gains due to muscle hypertrophy.
Muscle Fiber Hypertrophy

- Increase in numbers of myofibrils and actin and myosin filaments
  - Allows more cross-bridges.
- Increases in muscle protein synthesis during post-exercise period.
- **Testosterone** plays a role in promoting muscle growth.
- **High intensity training** may promote greater fiber hypertrophy than low intensity training.
Components of Physical Fitness
American College of Sports Medicine Exercise Position Stand 2011

Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise.

Cardiorespiratory Fitness

- **Cardiorespiratory fitness** is a health-related component of physical fitness that relates to the ability of the **circulatory and respiratory systems** to supply fuel during **sustained physical activity** and to eliminate metabolic by-products after supplying fuel.
- Frequently measured by **$V\text{O}_2\text{ max}$**
Muscular Strength and Endurance

- **Muscular strength** is the ability of a muscle to *exert force*.
- **Strength** is a health-related fitness component that is assessed by the maximal amount of resistance or force that can be *sustained in a single effort*. 
Muscular endurance is a health-related fitness component that relates to the amount of external force that a muscle can exert over an extended period of time.
Body Composition

- **Body composition** is a health-related physical fitness component that relates to the relative amounts of muscle, fat, bone, and other vital parts of the body.
Flexibility

- **Flexibility** is a health-related component of physical fitness that relates to the *range of motion* available at a joint.
Neuromotor Fitness

- A new component of fitness recently recognized by the ACSM.
- **Integrated fitness** composed of balance, agility, coordination and proprioception.
- Frequently described as **functional fitness**.
Measurement and Assessment of Physical Fitness
Assessing \( (\text{VO}_2\text{ max}) \)

- Indirect Measure: gas exchange at mouth:
  \[
  \text{VO}_2 = V_E \times (F_{\text{IO2}} - F_{\text{EO2}})
  \]
  
  - Rest: 0.20 to 0.35 L/min
  - Maximal Exercise: 2 to 6 L/min
Common Criteria Used to Document VO$_2$ max

- **Primary Criteria**
  - $< 2.1$ ml/kg/min increase with 2.5% grade increase often seen as a plateau in VO$_2$

- **Secondary Criteria**
  - Blood lactate $\geq 8$ mmol/L
  - RER $\geq 1.10$
  - ↑ in HR to 90% of age predicted
  - RPE $\geq 17$
### VO$_{2\text{max}}$ Classification for Men (ml/kg/min)

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Low</th>
<th>Fair</th>
<th>Average</th>
<th>Good</th>
<th>High</th>
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<td>20 - 29</td>
<td>&lt;25</td>
<td>25 - 33</td>
<td>34 - 42</td>
<td>43 - 52</td>
<td>53+</td>
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<tr>
<td>30 - 39</td>
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<td>31 - 38</td>
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<td>43+</td>
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<tr>
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<td>&lt;16</td>
<td>16 - 22</td>
<td>23 - 30</td>
<td>31 - 40</td>
<td>41+</td>
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</table>
**VO₂max Classification for Women (ml/kg/min)**

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Low</th>
<th>Fair</th>
<th>Average</th>
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<td>20 - 29</td>
<td>&lt;24</td>
<td>24 - 30</td>
<td>31 - 37</td>
<td>38 - 48</td>
<td>49+</td>
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<tr>
<td>30 - 39</td>
<td>&lt;20</td>
<td>20 - 27</td>
<td>28 - 33</td>
<td>34 - 44</td>
<td>45+</td>
</tr>
<tr>
<td>40 - 49</td>
<td>&lt;17</td>
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<td>31 - 41</td>
<td>42+</td>
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<tr>
<td>50 - 59</td>
<td>&lt;15</td>
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<td>13 - 17</td>
<td>18 - 23</td>
<td>24 - 34</td>
<td>35+</td>
</tr>
</tbody>
</table>
Anaerobic Power

- Depends on ATP-PC energy reserves and **maximal rate** at which energy can be produced by ATP-PCR system.
- Maximal effort
- Calculate **peak power output**, anaerobic fatigue, and anaerobic capacity.
Wingate Test for Anaerobic Power

- 30 sec cycle ergometer test
- Count pedal revolutions
- Calculate peak power output, anaerobic fatigue, and anaerobic capacity
Training for Physical Fitness: Principles and Recommendations
Training and Overload

- Progressive overload to displace homeostasis and create stimulus for adaptation (improved performance).
- Overload Principle: gains can only come about with progressively greater demands.
Adaptation

- Physiologic response to stress (training load) to better respond to similar stress in the future.
- Adaptation is the type of change in physiologic functions that occur with training, REST, and recovery.
SAID Principle

Specific Adaptations to Imposed Demands

- Specific exercise elicits specific adaptations to elicit specific training effects.
- E.g. swimmers who swam 1 hr/day, 3x/wk for 10 weeks showed almost no improvement in running VO2 max.
  - Swimming VO2 increase – 11%
  - Running VO2 increase – 1.5%
Principle of Reversibility

- Training effects gained through aerobic training are reversible through detraining.

Data from VA Convertino MSSE 1997

% Decline in VO$_{2\text{max}}$

1.4 - 0.85 X Days;

$r = -0.73$

Days of Bedrest

Data from VA Convertino MSSE 1997
Periodization Principle

- Periodization
  - Technique that involves altering training variables to achieve well-defined gains in muscular strength, endurance and performance.
  - Activation phase (4 weeks)
  - Strength development (4 - 7 weeks)
  - Muscular endurance (8 - 12 weeks)
  - Rest
The Concept of Load

Load, Overload, and Recovery in the Athlete: Select Issues for the Team Physician—A Consensus Statement

DEFINITION

Load, overload, and recovery are key issues for team physicians treating and caring for athletes. Load is an inevitable result of athletic conditioning, training, and competition. Load in activity may be defined as a stimulus experienced and responded to by an individual before, during, or after participation. Load creates a demand or stress (both physiological and psychological) and has internal and external components. Load that is safely managed may result in improved athletic capacity and performance, and injury and illness risk reduction.

Overload, as defined in this document, is load that is excessive or not well managed. It will result in anatomical, physiological, and/or psychological conditions that will manifest as altered performance and injury and illness. Identification and modification of load and minimizing overload have been advocated as central parts of optimal performance and injury and illness prevention strategies.

Recovery is the period and process during which the body responds to load. Adequate recovery may result in positive adaptations for athletic capacity, performance, and injury and illness risk, whereas inadequate recovery may result in maladaptations for athletic capacity, performance, and injury and illness.

GOAL

The goal of this document is to help the team physician improve the care of the athlete by understanding load, overload, and recovery issues in athletes. To accomplish this goal, the team physician should have knowledge of and be involved with the following:

• Current concepts in load, overload, and recovery
• Medical issues related to load, overload, and recovery
• Musculoskeletal issues related to load, overload, and recovery
• Psychological and mental health issues
• The role of measurement and monitoring in load, overload, and recovery
• Intervention strategies to reduce overload, injury, and illness risk
• The role of modalities in recovery

SUMMARY

This document provides an overview of the concepts of load, overload, and recovery, as well as the musculoskeletal and psychological issues related to overload injuries and illnesses that are important for the team physician to understand. In addition, understanding the role of wearable devices, technology, and other tools used to measure load, overload, and recovery is important. Interventions to manage load may improve performance and reduce the risk of overload injuries and illnesses. This document is not intended as a standard of care and should not be interpreted as such. It is only a guide and, as such, is of a general nature, consistent with the reasonable, objective practice of the health care professional. Individual treatment will turn on the specific facts and circumstances presented to the physician. Adequate insurance should be in place to help protect the physician, the athlete, and the sponsoring organization.

This statement was developed by a collaboration of six major professional associations concerned about clinical sports medicine issues; they have committed to forming an ongoing project-based alliance to bring together sports medicine organizations to best serve active people and athletes. The organizations are the American Academy of Family Physicians, the American Academy of Orthopaedic Surgeons, the American College of Sports Medicine, the American Medical Society for Sports Medicine, the American Orthopaedic Academy for Sports Medicine, and the American Osteopathic Academy of Sports Medicine.

EXPERT PANEL

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DOI: 10.1249/MSM.0000000000000180

MEDICINE & SCIENCE IN SPORTS & EXERCISE
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Case 1: The Need for a Pre-Exercise GXT

- Pete, 52, is a longtime patient of yours who has struggled with obesity and hypertension.
- He has decided that this year he is going to join a local gym and get fit.
- He seeks your guidance for clearance and wants to know if he needs a GXT?

What Do You Advise?
Risks for MI and SCA
Go Up for Fit and Unfit with Exercise!

RIEBE, DEBORAH; FRANKLIN, BARRY A.; THOMPSON, PAUL D.; GARBER, CAROL EWING; WHITFIELD, GEOFFREY P.; MAGAL, MEIR; PESCATELLO, LINDA S. Medicine & Science in Sports & Exercise 47(11):2473-2479, November 2015
ACS National Committee on Physical Activity

Recommendations for Exercise Testing Prior to Exercise Participation

- **Initial ACSM Risk Stratification**
  - **Low Risk**: younger individuals who are asymptomatic and have no more than one risk factor.
  - **Moderate Risk**: older or those who meet the threshold for two or more risk factors.
  - **High Risk**: individual with signs or symptoms of CAD, or known cardiovascular, pulmonary, or metabolic disease

- **Old versus Young**
  - Men < 45 years of age; Women < 55.

- **Moderate versus Vigorous Exercise**
  - **Moderate**: 3-6 METs, 40 to 60% maximal oxygen uptake.
  - **Vigorous**: >6 METs, or 60% maximal uptake.

The Decision used to be Pretty Straightforward!
## ACSM Recommendations for Exercise Testing Prior to Exercise Participation

<table>
<thead>
<tr>
<th></th>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moderate Exercise</strong></td>
<td>Not Necessary</td>
<td>Not Necessary</td>
<td>Recommended</td>
</tr>
<tr>
<td><strong>Vigorous Exercise</strong></td>
<td>Not Necessary</td>
<td>Recommended</td>
<td>Recommended</td>
</tr>
</tbody>
</table>
The Decision is now with the Provider!

Case 2: Prescribing Intensity

- Pete passed the GXT you administered and now would like to discuss an exercise prescription.
- He’s committed to a jogging program, has the time and location.
- He seeks your guidance on recommendations for choosing the right exercise intensity.

What Do You Advise?
2011 Recommendations

Cardiorespiratory Fitness

- **Frequency:** > 5d/week *moderate*; >3d/week *vigorous*
- **Intensity:** moderate and/or vigorous
- **Time:** 30-60 min/day mod (*150min/wk*); 20-60min vigorous (*75min/wk*)
- **Type:** regular, continuous and rhythmic in nature
- **Volume:** 500 to 1000 MET/wk; step ct of *7000/day*
- **Pattern:** one session or *multiple 10 min sessions*
- **Progression:** gradual adjusting duration, frequency, and intensity

Moderate vs. Vigorous

- Moderate activities typically are performed at 40 to 60% of the HRR, while vigorous activities are 60 to 90%.
- The “Talk Test”
- Heavy breathing versus panting
- 6 METs
Monitoring Exercise Intensity

- **Heart rate**
  - Straight heart rate percentage method
    - 60-90% of HR max
  - Heart rate reserve method (HRR) (Method of Karvonen)
    - HRR = (HR max – Resting HR)
    - Target HR = Resting HR + %desired (HRR)

- **Pace**

- **Perceived exertion**

- **Blood lactate**
Estimating Maximal Heart Rate

- Standard Formula: $220 - \text{Age in years}$
- Other Formulas
  - $210 - 0.65 \times \text{Age in years}$
  - New: $208 - 0.7 \times \text{Age in years}$
  - New formula may be more accurate for older persons and is independent of gender and habitual physical activity
- Estimated maximal heart rate may be 5 - 10% (10 to 20 bpm) ± actual value.
- Maximal heart rate differs for various activities: influenced by body position and amount of muscle mass involved.
Approaches to Determining Training Heart Rate

- 60 to 90% of Maximal HR
  - Max HR = 180
  - 60% = 108 and 90% = 162

- 50 to 85% of Heart Rate Reserve
  - Target HR = RHR + %(HRR)
  - Where:
    - Max HR = 180 and Resting HR = 70
    - HRR = 180 - 70 = 110
    - 50% = 70 + 55 \{.50 \times 110\} = 125;
      85% = 70 + 94 \{.85 \times 110\} = 164

- Plot HR vs. O\textsubscript{2} Uptake or Exercise Intensity
The Rate of Progression

- **The Initial Conditioning Stage** - lasts for about 4 or 5 weeks with an exercise intensity beginning at about 40% of HRmax progressing to 70% with sessions lasting from about 12 minutes up to 20 minutes with a frequency of 3 times/wk.

- **The Improvement Stage** - lasts for 4 to 5 months; intensity progresses within the upper half of the target range of 60 to 85% of HRmax; duration from about 20 minutes increasing to 30 minutes per session with 3 to 5 sessions/week.

- **The Maintenance Stage** - Typically involves frequency of about 3 times a week, working within a target range of 70 to 85% of HRmax and lasting from about 30 to 45 minutes per bout; enables individuals to maintain their fitness levels.

Adjust variables as follows:

1. Frequency
2. Duration
3. Intensity
Case 3: Injury Prevention

- Pete is now regularly running and decides to pursue the NYC marathon next year.
- He seeks your guidance on recommendations for training and trying to avoid getting injured as his goal is to finish.

What Do You Advise?
Epidemiology of Overuse Injuries in Runners

- Yearly incidence rates for injuries approach 90% in runners training for marathons.
- More experienced runners appear to be less prone to injury.
- A threshold for increased risk for injury appears to be 40 miles/week.
- Patellofemoral pain appears to be the most common injury followed by illiotibial band, tibial stress syndrome, plantar fasciitis and Achilles tendinopathy.

Etiology of Running Injuries

- **Intrinsic Abnormalities**
  - Malalignment
  - Flexibility deficits
  - Muscle imbalance
  - Instability
  - Personality

- **Extrinsic Abnormalities**
  - Training errors
  - Equipment
  - Technique
  - Environment

Most of the time...

**too much, too soon, too fast!**
Etiology of Overuse Injuries in Runners

- Multiple variables have been studied, to include anthropometric measurements, static alignment, dynamic kinematic variables, and training variables.
- Study methodology, injury definition, and populations have varied greatly making assessments challenging.
- Most studies consistently implicate training volume and prior injury as consistent risk factors.

The Galloway Method
The Galloway Method

<table>
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<tr>
<th>Walk Break Ratios</th>
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<tr>
<td>8 min/mi</td>
<td>run 4 min / walk 35 seconds</td>
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<tr>
<td>9 min/mi</td>
<td>run 4 min / walk 1 min</td>
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<tr>
<td>10 min/mi</td>
<td>run 3 min / walk 1 min</td>
</tr>
<tr>
<td>11 min/mi</td>
<td>run 2 min 30 sec / walk 1 min</td>
</tr>
<tr>
<td>12 min/mi</td>
<td>run 2 min / walk 1 min</td>
</tr>
<tr>
<td>13 min/mi</td>
<td>run 1 min / walk 1 min</td>
</tr>
<tr>
<td>14 min/mi</td>
<td>run 30 sec / walk 30 sec</td>
</tr>
<tr>
<td>15 min/mi</td>
<td>run 30 sec / walk 45 sec</td>
</tr>
<tr>
<td>16 min/mi</td>
<td>run 30 sec / walk 60 sec</td>
</tr>
</tbody>
</table>
Case 4: Exercise and Hydration

- Pete is off to New York City this weekend to run his first marathon.
- He has read all sorts of conflicting information about hydration strategies as he is concerned about both over and under-hydration.

What Do You Advise?
Most individuals can avoid fluid-balance problems by drinking when thirsty during and after exercise and eating a healthy diet. In healthy individuals, the thirst mechanism is

Key to this document is the Individualization of the Hydration Plan

If athletes do not know their individual sweat rates, drinking to thirst during activity most likely represents a safe strategy to prevent overdrinking. Drinking to thirst...
Case 5: Cardiac Protection

- Pete is down at the marathon EXPO in NYC and gives you an urgent call.
- He forgot to ask you if he should hold his statin prior to the race, and also wants to know if he should take an aspirin?

What Do You Advise?
Cardiac Protection

- **Statins:**
  - Patients on statins need not eliminate exercise;
  - Physical exertion may increase CK during exercise in patients on statins more than those not on statins.
  - Trained individuals **need not discontinue** statins prior to a race.

- **Aspirin:**
  - **Prerace low-dose aspirin usage is prudent** to protect **susceptible runners** from a high, if transient, risk for cardiac arrest during races as evidence-based to prevent first myocardial infarctions in same-aged healthy men.

Statin Myopathy; UpToDate 2018.
Siegel AJ: Prerace aspirin to protect susceptible runners from cardiac arrest during marathons: is opportunity knocking? Open Heart. 2015 Jul 2;2(1).
Researchers at the Cooper Institute examined the relations among cardiorespiratory fitness, expressed as METs, physical activity, and coronary artery calcification (CAC), in middle-aged and older men.

Over an extended follow up, the risk for adverse cardiovascular events was lower in fit/highly active men as compared with their unfit/inactive counterparts with comparable coronary artery calcium scores.

The investigators concluded that fit, highly active men can safely continue their exercise programs, even in the setting of prevalent CAC, provided they remain asymptomatic.

Case 6: Strength Training

- Pete’s wife Sarah, 49, is encouraged by Pete’s progress, and recently encouraged by friends, wants to begin strength training.
- She was a prior track athlete, but has little experience with weight training.
- She brings in some fitness bands, but has no idea how to get started?

What Do You Advise?
2011 Recommendations

- Resistance Exercise
  - **Frequency**: each muscle group 2 to 3 days/wk
  - **Intensity**: 60 to 70% of 1RM for strength; <50% for endurance
  - **Time**: TBD
  - **Type**: a variety may be performed.
  - **Repetitions**: 8-12 strength; 15 to 20 endurance
  - **Sets**: 2-4 strength; <2 for endurance
  - **Pattern**: rest 2-3 min for sets; 48h for sessions
  - **Progression**: resistance, repetitions, frequency are altered for effect.

Approaches to Strength Training

- Static (isometric) actions
- Dynamic actions
  - Free weights
  - Gravity dependent
  - Variable resistance
  - Isokineti actions
  - Plyometrics
- Other
  - Neuromuscular electrical stimulation
# Thera-Band Color Progression

<table>
<thead>
<tr>
<th>Thera-Band® Band/Tubing Color</th>
<th>Increase from Preceding Color at 100% Elongation</th>
<th>Resistance in Pounds at: 100% Elongation</th>
<th>Resistance in Pounds at: 200% Elongation</th>
<th>Resistance in Kilograms at: 100% Elongation</th>
<th>Resistance in Kilograms at: 200% Elongation</th>
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<tr>
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<td>3.4</td>
<td>1.1</td>
<td>1.5</td>
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<tr>
<td>Thera-Band Yellow</td>
<td>25%</td>
<td>3.0</td>
<td>4.3</td>
<td>1.3</td>
<td>2.0</td>
</tr>
<tr>
<td>Thera-Band Red</td>
<td>25%</td>
<td>3.7</td>
<td>5.5</td>
<td>1.7</td>
<td>2.5</td>
</tr>
<tr>
<td>Thera-Band Green</td>
<td>25%</td>
<td>4.6</td>
<td>6.7</td>
<td>2.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Thera-Band Blue</td>
<td>25%</td>
<td>5.8</td>
<td>8.6</td>
<td>2.6</td>
<td>3.9</td>
</tr>
<tr>
<td>Thera-Band Black</td>
<td>25%</td>
<td>7.3</td>
<td>10.2</td>
<td>3.3</td>
<td>4.6</td>
</tr>
<tr>
<td>Thera-Band Silver</td>
<td>40%</td>
<td>10.2</td>
<td>15.3</td>
<td>4.6</td>
<td>6.9</td>
</tr>
<tr>
<td>Thera-Band Gold</td>
<td>40%</td>
<td>14.2</td>
<td>21.3</td>
<td>6.5</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Represents typical values. All products not available in all colors.
ACSM GENERAL EXERCISE PRESCRIPTION FOR WEIGHT RESISTANCE TRAINING

- Perform a minimum of **8 to 10 separate exercises** that train the major muscle groups. Programs lasting **longer than 1 hour per session** are associated with a higher drop out rate.
- Perform one set of **8 to 12 repetitions** of each of these exercises to the point of **volitional fatigue**.
- Perform these exercises **at least 2 days** per week.
- Adhere as closely as possible to the specific techniques for performing a given exercise.
- Perform every exercise throughout a **full range of motion**.
- Perform both the lifting (concentric phases) and lowering (eccentric phases) portion of the resistance exercises in a controlled manner.
- Hold weights firmly but not too tightly in the hand.
- **Maintain a normal breathing pattern.**
Case 7: High Intensity Training

- Sarah is really starting to get into strength training.
- She has been reading about “High Intensity Training” and wondering if she can be more productive with higher intensities and less time in the gym.

What Do You Advise?
High Intensity Interval Training

- High-intensity interval training (HIT) describes physical exercise that is characterized by brief, intermittent bursts of vigorous activity, interspersed by periods of rest or low-intensity exercise.

- Considerable evidence currently exists to support a role for low-volume HIT as a potent and time-efficient training method for inducing both central (cardiovascular) and peripheral (skeletal muscle) adaptations that are linked to improved health outcomes.

Some studies suggest that HIIT elicits slightly greater increases in cardiorespiratory fitness (~0.5 MET) than MICT, while simultaneously providing a more time-efficient training alternative, concerns regarding the safety of repeated near-maximum exercise bouts in patients with known or occult coronary disease suggest that additional long-term studies assessing the safety of HIIT are needed before it can be widely adopted, especially in unsupervised nonmedical settings.

Case 8: Extreme Exercise

- Pete’s wife Sarah is now board with the surgical tubing.
- She recently is encouraged by friends, wants to join a local Cross Fit box.
- She wants some engagement with friends as Pete is always running.

What Do You Advise?
A Cluster of Exertional Rhabdomyolysis Cases in an ROTC Unit Engaged in an Extreme Exercise Program

Francis G. O’Connor, MD, Anthony I. Beutler, MD, Meghan Raleigh, MD, John Barrett, MD, Patricia A. Deuster, PhD
Uniformed Services University of the Health Sciences
Brockport ROTC Unit

- 44 Cadets participated in ECP event
  - 29 as individuals (IND)
  - 15 in teams (T) of 3 members
- 9/29 IND (31%) and 2/15 T (13%) were admitted to hospital for management of ER
- Longest hospitalization was 11 days.
- No association of ER with “Murph” finish time or APFT score
  - (The FIT were not protected)

CHAMP Workshop: High Intensity Exercise

- **Problem:**
  - Anecdotal reports of injury from warfighter participation in High Intensity Training (HIT) programs

- **Solution:**
  - Held Joint Conference with DoD and American College of Sports Medicine on 13-14 September 2010 at USU to address issues involving HIT

- **Outcome:**
  - Publication with Recommendations
  - Adoption of term Extreme Conditioning Programs (ECP)
Common Themes

- Eccentric Exercise Predominance
- Unaccustomed Exercise
- Sudden Increase in Volume or Intensity
- Vulnerable Population
- Timed!
Results

- Positive Aspects
  - Multifaceted
  - Functional fitness orientation
  - Core emphasis
  - Group orientation
  - Exciting, fun and motivating
  - Translation to Warrior Ethos
Results

- Negative Aspects
  - Inadequate rest and recovery
  - Demand for excellent technique
  - Lack of safe entry guidelines
  - Lack of all components of well balanced fitness program
  - Propensity for overreaching
Recommendation 1

- Improve efficacy/safety of ECP:
  - Conduct regular careful **inspections** of designated exercise equipment and areas;
  - **Introduce** ECPs to new participants gradually;
  - **Individualize** supplemental conditioning programs based on fitness, training goals, and job-specific functional needs and demands;
  - **Protect** anyone with a clinical condition or health status that would contraindicate participating in ECPs or other high-intensity physical activities.
“Accordingly, the evidence-based, peer-reviewed literature does not yet support the efficacy for or clarify any notable injury risk potential with ECPs to validate or dismiss the claims, clinical observations, or media reports.”
Extreme Exercise

• In the End, the Critical Variable is…. Leadership
Leadership Followership Model

Case 9: Statin Myopathy

- Sarah is now all in with her new fitness program at the box.
- She comes into to see you because she is having some muscle soreness and is concerned she has a statin myopathy.

What Do You Advise?
Statin Myopathy

- **Terminology:**
  - **Myalgia**: a symptom of muscle discomfort e.g. aches, soreness, stiffness.
  - **Myopathy**: weakness not due to pain, with or without a CK elevation.

- **Pathogenesis**: mechanism by which statins contribute to muscle toxicity is not understood.

- **Prevalence** of 2 to 11%; Lowest risk with Pravastatin and Fluvastatin.

- **Exercise and Statins:**
  - Unaccustomed vigorous exercise may increase the risk for muscle injury.
  - No effect on exercise tolerance.
Statin Myopathy: Management

- Not all symptomatic patients have elevated CKs

- History or Rhabdomyolysis:
  - Discontinue the statin.

- Myalgias/Myopathy:
  - Discontinue the medication;
  - Consider drug interactions and vitamin D deficiency and hypothyroidism;
  - Restart low risk statin when asymptomatic;
  - Consider alternate day dosing.
  - No evidence supporting CoQ10 supplementation.
Case 10: Cardiac Overtraining

- Pete is now regularly engaging in ultramarathons.
- He recently read that too much exercise may be counterproductive and could lead to an increased risk of atrial fibrillation.

What Do You Advise?
Is there a Cardiac Overtraining Syndrome?

- Just as runners can develop stress fractures, it may also be that **endurance athletes may develop sports-related cardiac injuries**.
- Despite exercise being our oldest and most efficacious therapy, there is an **incomplete understanding of the entire dose–response relationship**.
- Faced with the modern inactivity pandemic there has been an **appropriate focus on the harm associated with too little exercise**.
- Extreme training can result in profound cardiac remodeling, termed the “athlete’s heart,” and the **prognostic significance of the resulting structural, functional, and electric changes remains uncertain**.

The “U” Shaped Hypothesis

The U Shaped Hypothesis

What is Extreme Endurance Exercise?

“Therefore, although cardiac alterations can be discerned in those performing ≥3 hours of sports per week, this discussion is most relevant to endurance athletes who typically perform 15 to 40 hours of training per week.”

A hypothesis explaining how multiple bouts of exercise ("overtraining") may lead to adverse cardiac remodeling.

Myocardial Fibrosis

- Studies have taught us that elite athletes enjoy excellent health, and athletic animal models consistently show up-regulation of molecular pathways, which are free of fibrosis and entirely different from those induced through pathological cardiac loading.

- On the other hand, extreme exercise has been associated with biochemical and functional evidence of acute damage, and some recent imaging techniques raise the possibility of small areas of myocardial scar.

Atrial Fibrillation (AF) Risk

- A total of 655 athletes and 895 controls were compared.
- Mean age was 51 ± 9 years; 93% were men. There were 147 (23%) vs. 116 (12.5%) cases of AF among athletes compared with controls.
- The overall risk of AF was significantly higher in athletes than in controls with odds ratio (95% confidence interval) = 5.29 (3.57–7.85), P = 0.0001.

Right Ventricular Dysfunction

- Forty athletes were studied at baseline, immediately following an endurance race (3–11 h duration) and 1-week post-race.
- Relative to baseline, RV volumes increased and all functional measures decreased post-race, whereas LV volumes reduced and function was preserved.
- Intense endurance exercise causes acute dysfunction of the RV, but not the LV.

Case 11: Pediatric Strength Training

- Sarah brings in her son Patrick to see you.
- He is a 14 y/o being seen to discuss beginning a weight training program.
- He wants to get bigger to try to compete for the varsity wrestling team this season.
- He is 5 feet nothing; being observed for constitutional delay.

What Do You Advise?
Can Children Gain Strength?

Strength Training by Children and Adolescents

Pediatrics April 2008; 121:4 835; 10.1542/peds.2007-3790
Can Children Gain Strength?

- **Yes**…studies consistently demonstrate that supervised instruction can result in increases in muscular strength.
- **There have not** been consistent studies to demonstrate that strength training programs in this age group result in injury prevention.
How do Children Gain Strength?

- Children gain strength through **neuromuscular adaptation**.
- Training increases the number of motor units that are recruited.
- There is **no significant muscular hypertrophy** until puberty.
Benefits and Risks of Strength Training

**Benefits:**
- Improve cardiovascular fitness;
- Increase bone mineral density;
- Improve body composition;
- Enhance mental health.

**Risks:**
- Appropriate strength training programs have no apparent adverse effect on linear growth, growth plates of cardiovascular system.
AAP Recommendations for Strength Training

- Proper resistance techniques and safety precautions should be followed so that strength-training programs for preadolescents and adolescents are safe and effective.
- Preadolescents and adolescents should avoid power lifting, body building, and maximal lifts until they reach physical and skeletal maturity.
- As the AAP has stated previously, athletes should not use performance-enhancing substances or anabolic steroids.
When pediatricians are asked to recommend or evaluate strength-training programs for children and adolescents, the following issues should be considered:

- Before beginning a formal strength-training program, a medical evaluation should be performed by a pediatrician or family physician. Youth with uncontrolled hypertension, seizure disorders, or a history of childhood cancer and chemotherapy should be withheld from participation until additional treatment or evaluation.

- Children with complex congenital cardiac disease (cardiomyopathy, pulmonary artery hypertension, or Marfan syndrome) should have a consultation with a pediatric cardiologist before beginning a strength-training program.

- Aerobic conditioning should be coupled with resistance training if general health benefits are the goal.

- Strength-training programs should include a 10- to 15-minute warm-up and cool-down.
AAP Recommendations for Strength Training

- Athletes **should have adequate intake of fluids** and proper nutrition, because both are vital in maintenance of muscle energy stores, recovery, and performance.

- Specific strength-training exercises should be **learned initially with no load (no resistance)**. Once the exercise technique has been mastered, incremental loads can be added using either body weight or other forms of resistance. Strength training should involve 2 to 3 sets of higher repetitions (8 to 15) 2 to 3 times per week and be at least 8 weeks in duration.

- A general strengthening program should **address all major muscle groups**, including the core, and exercise through the complete range of motion. More sports-specific areas may be addressed subsequently.

- Any sign of illness or injury from strength training should be evaluated fully before allowing resumption of the exercise program.

- **Instructors or personal trainers should have certification** reflecting specific qualifications in pediatric strength training.

- **Proper technique and strict supervision** by a qualified instructor are critical safety components in any strength-training program involving preadolescents and adolescents.
Case 12: Pediatric Overtraining

- Pete and Sarah’s daughter, Heather is a 16 y/o patient of yours being seen today for follow up of recurrent shin splints.
- She is a soccer player currently participating on a school team, as well as a club team.
- Pete and Sarah, who are now divorced as Pete runs Ultras every weekend and Sarah now owns a Cross Fit box, are arguing over the value of playing on two teams.

What Do You Advise?
Preventing Injuries in Children and Adolescents
Preventing Injury

- Children should always participate in athletics at a level that is *commensurate with their skill and ability*.
- Organized sporting activities should always have *adequate supervision*.
- Organized sporting activities should always provide participants with the *proper protective equipment*.
- Training programs for young athletes should always proceed at the *proper intensity to avoid overuse injuries*.
- Funding and priority should be increased for research into equipment modifications and training program enhancements that will decrease sports injuries in young athletes.

Preventing Burnout

- Encourage athletes to strive to have at least 1 to 2 days off per week from competitive athletics, sport-specific training, and competitive practice (scrimmage) to allow them to recover both physically and psychologically.

- Advise athletes that the weekly training time, number of repetitions, or total distance should not increase by more than 10% each week (e.g., increase total running mileage by 2 miles if currently running a total of 20 miles per week).

- Encourage the athlete to take at least 2 to 3 months away from a specific sport during the year.

- Emphasize that the focus of sports participation should be on fun, skill acquisition, safety, and sportsmanship.

- Encourage the athlete to participate on only 1 team during a season. If the also a member of a traveling or select team, then that participation time should be incorporated into the aforementioned guidelines.

Preventing Burnout

- If the athlete complains of nonspecific muscle or joint problems, fatigue, or poor academic performance, be alert for possible burnout. Questions pertaining to sport motivation may be appropriate.

- Advocate for the development of a medical advisory board for weekend athletic tournaments to educate athletes about heat or cold illness, over participation, associated overuse injuries, and/or burnout.

- Encourage the development of educational opportunities for athletes, parents, and coaches to provide information about appropriate nutrition and fluids, sport safety, and the avoidance of overtraining to achieve optimal performance and good health.

- Convey a special caution to parents with younger athletes who participate in multigame tournaments in short periods of time.

The American College of Sports Medicine

- Exercise is Medicine
  - http://www.acsm.org/
  - http://exerciseismedicine.org/
Questions?