SHOULD I CHECK MY PATIENT’S FITNESS LEVEL?

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Ability respiratory and circulatory systems to deliver oxygen to working muscles during sustained exercise
Oxygen Consumption Relative to Exercise Intensity

- Maximal Intensity
- $\nu VO2$ max
- Low intensity
<table>
<thead>
<tr>
<th>Age Group</th>
<th>Men</th>
<th>Women</th>
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</thead>
<tbody>
<tr>
<td>20-39</td>
<td>&gt;50</td>
<td>&gt;41</td>
</tr>
<tr>
<td>40-49</td>
<td>&gt;47</td>
<td>&gt;38</td>
</tr>
<tr>
<td>50-59</td>
<td>&gt;42</td>
<td>&gt;34</td>
</tr>
<tr>
<td>60+</td>
<td>&gt;37</td>
<td>&gt;31</td>
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</tbody>
</table>

20% of men and women should have VO2 max values above these thresholds.
# VO2 max normative values: Male

<table>
<thead>
<tr>
<th>rating</th>
<th>18–25</th>
<th>26–35</th>
<th>36–45</th>
<th>46–55</th>
<th>56–65</th>
<th>65+</th>
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<tbody>
<tr>
<td>excellent</td>
<td>&gt; 60</td>
<td>&gt; 56</td>
<td>&gt; 51</td>
<td>&gt; 45</td>
<td>&gt; 41</td>
<td>&gt; 37</td>
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<tr>
<td>good</td>
<td>52–60</td>
<td>49–56</td>
<td>43–51</td>
<td>39–45</td>
<td>36–41</td>
<td>33–37</td>
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<tr>
<td>very poor</td>
<td>&lt; 30</td>
<td>&lt; 30</td>
<td>&lt; 26</td>
<td>&lt; 25</td>
<td>&lt; 22</td>
<td>&lt; 20</td>
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</tbody>
</table>

Schwartz W, Reibold RC. Aviat Space Environ Med 1990
### VO2 max normative values: Female

<table>
<thead>
<tr>
<th>rating</th>
<th>18–25</th>
<th>26–35</th>
<th>36–45</th>
<th>46–55</th>
<th>56–65</th>
<th>65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>excellent</td>
<td>&gt; 56</td>
<td>&gt; 52</td>
<td>&gt; 45</td>
<td>&gt; 40</td>
<td>&gt; 37</td>
<td>&gt; 32</td>
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<tr>
<td>good</td>
<td>47–56</td>
<td>45–52</td>
<td>38–45</td>
<td>34–40</td>
<td>32–37</td>
<td>28–32</td>
</tr>
<tr>
<td>poor</td>
<td>28–32</td>
<td>26–30</td>
<td>22–26</td>
<td>20–24</td>
<td>18–21</td>
<td>17–18</td>
</tr>
<tr>
<td>very poor</td>
<td>&lt; 28</td>
<td>&lt; 26</td>
<td>&lt; 22</td>
<td>&lt; 20</td>
<td>&lt; 18</td>
<td>&lt; 17</td>
</tr>
</tbody>
</table>

Schwartz W, Reibold RC. Aviat Space Environ Med 1990
Fitness ≠ Exercise
CRF

NON-MODIFIABLE
- Age
- Gender
- Genotype

MODIFIABLE
- Physical Activity
- Smoking
- Obesity
- Cardiopulmonary disease
VO2 Max: maximum amount of O2 that can be utilized during intense sustained exercise
CARDIORESPIRATORY 
FITNESS MEASURES

METS 
Metabolic Equivalent Tasks
1 MET =
energy produced 
average person seated at rest
METS AVERAGE WALKING SPEED

Walking 3.1 mph

3.4 METS
METS x 3.5 = VO2 Max
Implications for Health Care Professionals: Moving Patients Out of the Least Fit, “High-Risk” Cohort

Relative Risk

Quintile

Aerobic capacity

Blair SN et al. JAMA 1996;276:205
Williams PT Med Sci Sports Exerc 2001;33:754
AVOIDING SCA

Low vs High CRF  ↓  48% SCA

1 MET  ↑  14%  ↓

Cardiorespiratory Fitness and Risk of Sudden Cardiac Death in Men and Women in the United States

*Mayo Clinic Proceedings*, 2016-07-01, Volume 91, Issue 7, Pages 849-857
Low aerobic capacity in middle-aged men associated with increased mortality rates during 45 years of follow-up.

European Journal Preventive Cardiology, July 2016
1913 TRIAL: 792 $\text{♂}$ $\times$ 45 YEARS

Smoking $>$ VO$_{2\text{max}}$ $>$ HTN $>$ Lipids

European Journal Preventive Cardiology, July 2016
Association of Leisure-Time Physical Activity With Risk of 26 Types of Cancer in 1.44 Million Adults.

HIGHEST IMPACT:
ALL CAUSE MORTALITY

- Smoking
- Cardiorespiratory fitness
Smoke/Exercise

Lipids

Hypertension
lipids
hypertension
cardiorespiratory fitness
smoking

Measure me!
AHA SCIENTIFIC STATEMENT

ALL HEALTHY ADULTS SHOULD HAVE CRF MEASURED
• MORE RISK FACTORS: START EARLIER
• FOR CRF ASSESSMENT, NOT DIAGNOSIS CAD
CHRONIC DISEASE

- KNOWN CORONARY DISEASE
- CONGESTIVE HEART FAILURE
- COPD
- PERIPHERAL ARTERY DISEASE
VO2 Max Testing

All Healthy Adults

Gas Exchange
Gold standard

Max Exercise
#2

Submax
#3

Calculator
#4: easy/fast
CRF TESTING STEP 1:
DECONDITIONED OR UNSURE

Duke Activity Status
Index
“DASI”
DASI

Maximum: 9.89 METS
(VO2\approx34)

Low to low-moderate fitness
STEP 2: CRF VO2 CALCULATOR

DASI >9 or younger, higher level of functioning

Cardiac Exercise Research Group “CERG”
CRF: STEP 2
CERG VO2 CALCULATOR

• Need resting and maximum heart rate
• Vital statistics
• Exercise volume and frequency
MAX HEART RATE then VO2 MAX

- Age
- Height (cm)
- Weight (kg)
- No B-blockers
- Max heart rate
- Exercise frequency
- Resting HR
- Waist (cm)

HTTPS://WWW.NTNU.EDU/CERG
Not a substitute for maximal exercise testing
Calculators

Limits:
- Underestimate fit
- Reliant upon subjective input

Pros:
- Fast/easy
- Correctly classify most
- Starting point
Max heart rate

More stats

- Resting heart rate
- Waist circumference

VO2 Max

- Exercise frequency
- Exercise intensity
CRF ASSESSMENT: ACTIVE

**Submaximal**
- 6 minute walk test
- Rockport One Mile walk Test

**Maximal**
- Ramp protocols: Treadmill or Bike
VO2 Max Testing

Athletes only?

Gas Exchange

Gold standard

Max Exercise #2

Submax #3

Calculator #4: easy/fast
ATS 6MWT

- No definitive parameters
- Better for treatment assessment
- <500 meters ? poor prognosis
1 MILE WALK TEST (ROCKPORT)

**PROS**
- Minimal resources
- Done independently

**LIMITATIONS**
- Cohort limitations (30-69 yoa)
- Need accurate measurements
- Time
VO2 MAX TESTING

**CALCULATOR**

**CERG**
- Underestimates fit
- Requires subjective data
- Not substitute for exercise test

**SUBMAXIMAL**

**6MWT**
- For advanced deconditioning
  - 1 mile walk test
- Cohort dependent
- Multiple measurements
- Time=GXT
VO2 Max Testing

Athletes only?

Gas Exchange

Gold standard

Max Exercise #2

Submax #3

Calculator #4: easy/fast
MAXIMAL EXERCISE TESTING

• Not for diagnosis of CAD!
• Exercise capacity evaluation
MAXIMAL EXERCISE TESTING
  =LAB, NOT OFFICE

- Known Coronary disease
- Congestive Heart Failure
- Peripheral Arterial Disease
- Chronic Obstructive Pulmonary Disease
CRF: ACTIVE
MAXIMAL EXERCISE TESTING
STEP 1

• Administer pre test questionnaire
• Par-Q+ validated
MAXIMAL EXERCISE TESTING

• Easy
• Inexpensive
• Most are walking
VALIDATED TREADMILL PROTOCOLS

• Bruce protocol
• Balke
• Modified Balke
<table>
<thead>
<tr>
<th>Stage</th>
<th>Minutes</th>
<th>% grade</th>
<th>km/h</th>
<th>MPH</th>
<th>METS</th>
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<tr>
<td>1</td>
<td>3</td>
<td>10</td>
<td>2.7</td>
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<td>3</td>
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<td>21</td>
<td>22</td>
<td>9.6</td>
<td>6.0</td>
<td>20</td>
</tr>
</tbody>
</table>
Estimating VO2 peak from a nonexercise prediction model: the HUNT Study, Norway.

Nes, BM et al

Importance of Assessing Cardiorespiratory Fitness in Clinical Practice: A Case for Fitness as a Clinical Vital Sign: A Scientific Statement From the American Heart Association

Robert Ross, Steven N. Blair, Ross Arena, Timothy S. Church, Jean-Pierre Després, Barry A. Franklin, William L. Haskell, Leonard A. Kaminsky, Benjamin D. Levine, Carl J. Lavie, Jonathan Myers, Josef Niebauer, Robert Sallis, Susumu S. Sawada, Xuemei Sui, Ulrik Wisløff,
On behalf of the American Heart Association Physical Activity Committee of the Council on Lifestyle and Cardiometabolic Health; Council on Clinical Cardiology; Council on Sport, Exercise, and Cardiovascular Health; Council on Cardiovascular Disease in the Young; Council on Arteriosclerotic Cardiovascular Disease and Stroke; and Council on Cardiovascular and Stroke Nursing