CSEP-Certified Personal Trainer (CSEP-CPT)

Aerobic Theory
Graded Exercise Testing Guidelines

Key Concepts: 3.8-3.17
Selecting an Aerobic Fitness Test

- What are the reasons for the test?
  » occupational? physical activity/sport?, health?

- Who is the client being tested?
  » goal?, activity preference?

- What equipment and personnel are available?

- Also consider validity, reliability, norms, and economy of test
• Considered to be most **valid** measure of the functional capacity of the cardiorespiratory system

• \( \text{VO}_2\text{max} = \text{maximal cardiac output} \times \text{maximal a-vO}_2\text{diff} \)

**CENTRAL**

\[
HR \times SV
\]

capacity of heart, lungs, and blood to transport oxygen to working muscles

**PERIPHERAL**

\[
a-vO_2\text{diff}
\]

ability of muscles to utilize oxygen during exercise
Absolute vs Relative VO$_2$

- **Absolute VO$_2$** - TOTAL volume of oxygen taken up by the body (L·min$^{-1}$)
  - Useful for physical activities where body weight is not carried (i.e., rowing, cycling)

- **Relative VO$_2$** - volume of oxygen taken up by the body RELATIVE to body weight (mL·kg$^{-1}$·min$^{-1}$)
  - Allows individuals of different sizes to be compared
  - May underestimate the VO$_2$max of obese individuals
# Absolute vs. Relative VO₂

## Table of Comparisons

<table>
<thead>
<tr>
<th></th>
<th>Client A</th>
<th>Client B</th>
<th>Client B Loses 10 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute VO₂ max</td>
<td>3.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>(L·min⁻¹)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Weight (kg)</td>
<td>60</td>
<td>100</td>
<td>90</td>
</tr>
<tr>
<td>Relative VO₂ max</td>
<td>50</td>
<td>40</td>
<td>44</td>
</tr>
<tr>
<td>(mL·kg⁻¹·min⁻¹)</td>
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</table>
Assessing Aerobic Fitness

**Direct tests**
- Max: VO\(_2\)max test using metabolic cart

**Indirect tests** - may use HR or time to predict VO\(_2\)max
- Submax: mCAFT, YMCA*, Ebbeling*
- Field: Rockport 1 mile walk*
  * new tests for CFCs and CPTs.
Submaximal Aerobic Tests

• Theory:
  » For a given exercise bout, person with higher VO$_2$ max can perform the exercise with less effort (↓ HR)
  
  » OR more exercise completed at a given HR
Assumptions

1. Linear relationship exists between HR, VO₂, and workload
2. HRmax at a given age is uniform
3. Mechanical efficiency of the activity is uniform

- error is ~ ± 10-20%
Limitations

The diagram illustrates the relationship between 

- VO₂ (mL·kg⁻¹·min⁻¹)
- HR
- HRmax

The graph shows a linear increase in HR with increasing VO₂, indicating the limits of aerobic capacity.
Submaximal Exercise Protocols

- mCAFT
- Ebbeling treadmill test
- YMCA cycle ergometer test
- Rockport 1 mile walk test
General Procedures

• Client position

• Warm-up (5 min at low intensity)
  » Equivalent to approximately 20-30% of Heart Rate Reserve or 35-45% of age-predicted Maximum Heart Rate

• Monitor HR, RPE, client symptoms prior to, during & after exercise (1, 3 and 5 min).
  » Most protocols do not include the post-exercise monitoring recommendation in their description.
  » Critical competency is the ability to measure resting and post-exercise blood pressure.
  » Critical competency is the ability to measure resting, steady state exercise, and post-exercise heart rate via palpation.
  » Important addition for the CSEP-CPT.

• Warm/Cool-down!
  » Active recovery for 5-10 minutes after exercise session helps to remove metabolic wastes & enhance recovery

• Know when to terminate test
Stopping an Aerobic Test/Session

- Client asks to stop
- Physical or verbal manifestations of severe fatigue
- Onset of angina or angina-like symptoms (e.g., clients complains of chest pain)
- Theory only;
  - Significant drop in systolic BP (≥10 mmHg from baseline) or a failure of the systolic BP to rise with an increase in exercise intensity
  - Excessive rise in BP (systolic blood pressure > 260 mmHg and/or diastolic blood pressure > 115 mmHg).
- Signs of poor perfusion (light-headed, confusion, ataxia, pallor, cyanosis, nausea, cold/clammy skin)
- Failure of HR to rise with increasing exercise intensity
- Equipment failure
Heart Rate

• Resting HR limits:
  » >100 bpm after 2 measurements separated by 5 min

• Exercise HR
  » Know expected changes with exercise
  » Must be able to determine HR via palpation during rest, exercise and post-exercise.
  » Best to use HR monitor (easy to use, accurate, stable, functional)
  » Stop test if HR does not increase with workload
**Blood Pressure**

- **Resting BP limits:**
  - Systolic >144 mmHg OR diastolic >94 mmHg after 2 measurements, 5 min apart
  - *Do NOT diagnose someone as hypertensive!*
    - Refer individual to physician

- **Aerobic Exercise BP:**
  - Taken in last 45 seconds of stage
  - Know expected changes in BP with exercise
  - Stop test if BP is >260 (systolic) or >115 (diastolic) OR systolic BP drops >10 from baseline with increasing workload
  - CSEP-CPT candidate must demonstrate this knowledge
Ebbeling Treadmill Test

- Single stage protocol designed for healthy adults b/w 20-59 yrs

- 4 min warm-up at 2.0-4.5 mph & 0% grade
  » HR should be b/w 50-70% HRmax

- Client exercises for an additional 4 min at a 5% grade (same speed as warm-up)
YMCA Cycle Ergometer Test

- Three to four 3 min stages of continuous exercise
- Goal is to increase HR between 110 bpm and 85% of age-predicted HRmax for 2 consecutive stages
- Record HR during final 15-30 sec of 2nd & 3rd min
  » measure HR using HR monitor
    - if a HR monitor is not available, then use 10 second radial pulse or 10 second carotid pulse
    - The ability to measure steady-state exercise HR via palpation is a critical competency for CSEP-CPT candidates.
  » If HR differs by 6 bpm, extend stage for 1 min
**YMCA Cycle Ergometer Test**

<table>
<thead>
<tr>
<th>1st stage</th>
<th>150 kgm·min(^{-1}) (0.5 kg @ 50 rpm) or 25 W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR &lt; 80 bpm</td>
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<tr>
<td></td>
<td>HR 80-89 bpm</td>
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<tr>
<td></td>
<td>HR 90-100 bpm</td>
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<tr>
<td>2nd stage</td>
<td>HR &gt; 100</td>
</tr>
<tr>
<td>3rd stage*</td>
<td>750 kgm·min(^{-1}) (2.5 kg)</td>
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<tr>
<td>3rd stage*</td>
<td>600 kgm·min(^{-1}) (2.0 kg)</td>
</tr>
<tr>
<td>3rd stage*</td>
<td>450 kgm·min(^{-1}) (1.5 kg)</td>
</tr>
<tr>
<td>3rd stage*</td>
<td>300 kgm·min(^{-1}) (1.0 kg)</td>
</tr>
<tr>
<td>4th stage*</td>
<td>900 kgm·min(^{-1}) (3.0 kg)</td>
</tr>
<tr>
<td>4th stage*</td>
<td>750 kgm·min(^{-1}) (2.5 kg)</td>
</tr>
<tr>
<td>4th stage*</td>
<td>600 kgm·min(^{-1}) (2.0 kg)</td>
</tr>
<tr>
<td>4th stage*</td>
<td>450 kgm·min(^{-1}) (1.5 kg)</td>
</tr>
<tr>
<td></td>
<td>1050 kgm·min(^{-1}) (3.5 kg)</td>
</tr>
<tr>
<td></td>
<td>900 kgm·min(^{-1}) (3.0 kg)</td>
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<tr>
<td></td>
<td>750 kgm·min(^{-1}) (2.5 kg)</td>
</tr>
<tr>
<td></td>
<td>600 kgm·min(^{-1}) (2.0 kg)</td>
</tr>
<tr>
<td>* if required</td>
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</table>

2006 Version 2.0

CSEP - CPT Aerobic Theory
Rockport 1-Mile Walk Test

- Created for males & females from 20-69 yrs.

- May be more appropriate for older & sedentary populations.

- One mile, level course, preferable to use a 400 m track.

- “Time to purposefully walk one mile continuously.”
PRACTICE!

- Groups of 3-4

- 1 person client; 1 acts as appraiser; 1 observes

- Use protocols to calculate results

- Ensure that all group members can derive the same predicted VO$_2$max