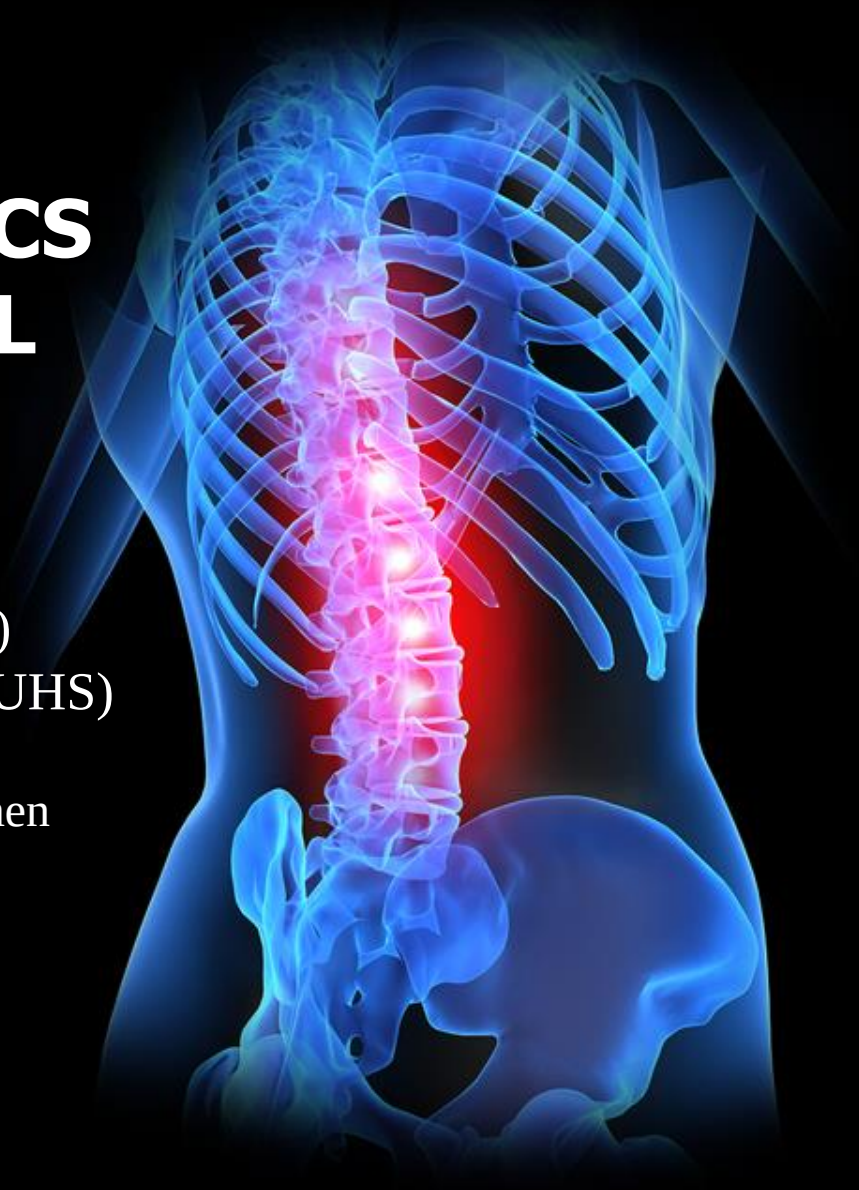
BIOMECHANICS OF CERVICAL SPINE



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FILE CONVERTOR WEBSITE

1. Introduction

This document outlines the complete requirements for developing a modern, fast, and user-friendly one-page website. The website will provide online document and image tools that allow users to convert, optimize, and manage files easily.

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2. Project Objective

The main objective of this project is to build a single-page web application that offers multiple document and image utilities in one place. The platform should be simple, attractive, and optimized for smooth user interaction.

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3. Target Users

- Students
- Freelancers
- Office and corporate users
- Designers and content creators

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4. Website Features

4.1 Document Converters

- PDF to Word and Word to PDF
- PDF to Excel and Excel to PDF
- PDF to PowerPoint and PowerPoint to PDF

4.2 Image Format Conversion

- PNG to JPG and JPG to PNG
- WEBP to JPG / PNG and vice versa

4.3 Image Resizing & Optimization Tools

Work Tests to Evaluate Cardiorespiratory Fitness

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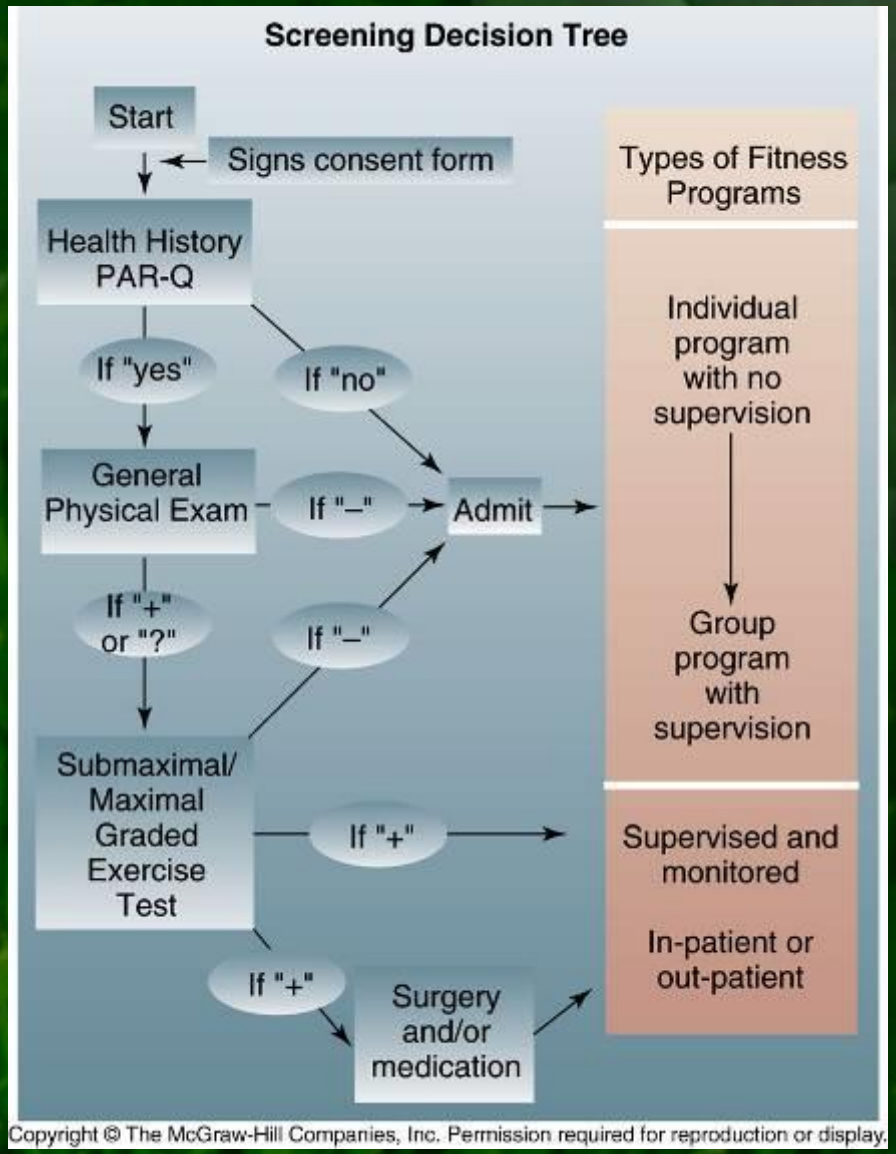
Objectives

- Cardio respiratory fitness
- Testing procedures
- FIELD Tests for estimating CRF
- Graded exercise tests: measurements
- VO2 max
- Graded exercise tests: protocols

Testing Procedures

- Sign consent form
- Screening
  - PAR-Q and PAR_{med}-X
  - Classify individuals as low, moderate, or high risk
- Resting and exercise measures
  - HR and BP
  - Cholesterol
  - ECG
  - GXT or field test

Decision Tree in the Evaluation of Cardiorespiratory Fitness



Field Tests for Estimating Cardiorespiratory Fitness

- Use natural activities
  - Walking, running, or stepping
- Can test large numbers of people at low cost
- Physiological responses may be difficult to measure
- Motivation plays an important role in test results

Maximal Run Tests

- Measure how far a person can run in a set time or how fast they can run a set distance
  - Cooper's 12-minute run and 1.5 mile run
    - For adults
  - AAPHERD's 1-mile run/walk and PACER test
    - For children
- VO_{2max} estimates based on the linear relationship between running speed and oxygen cost of running
  - Duration of 10–20 minutes
    - Running at speed demanding 90–95% VO_{2max}
    - Minimize contribution of anaerobic energy sources

$VO_2 = 0.2\ ml \cdot kg^{-1} \cdot min^{-1}$ per $m \cdot min^{-1} + 3.5\ ml \cdot kg^{-1} \cdot min^{-1}$

Categories of VO_{2max} Values

TABLE 15.1 Men's and Women's Aerobics Fitness Classifications

Men's

	AGE (YEARS)					
Category	**13–19**	**20–29**	**30–39**	**40–49**	**50–59**	**60+**
1. Very Poor	<35.0*	<33.0	<31.5	<30.2	<26.1	<20.5
2. Poor	35.0–38.3	33.0–36.4	31.5–35.4	30.2–33.5	26.1–30.9	20.5–26.0
3. Fair	38.4–45.1	36.5–42.4	35.5–40.9	33.6–38.9	31.0–35.7	26.1–32.2
4. Good	45.2–50.9	42.5–46.4	41.0–44.9	39.0–43.7	35.8–40.9	32.3–36.4
5. Excellent	51.0–55.9	46.5–52.4	45.0–49.4	43.8–48.0	41.0–45.3	36.5–44.2
6. Superior	>56.0	>52.5	>49.5	>48.1	>45.4	>44.3

Women's

	AGE (YEARS)					
Category	**13–19**	**20–29**	**30–39**	**40–49**	**50–59**	**60+**
1. Very Poor	<25.0*	<23.6	<22.8	<21.0	<20.2	<17.5
2. Poor	25.0–30.9	23.6–28.9	22.8–26.9	21.0–24.4	20.2–22.7	17.5–20.1
3. Fair	31.0–34.9	29.0–32.9	27.0–31.4	24.5–28.9	22.8–26.9	20.2–24.4
4. Good	35.0–38.9	33.0–36.9	31.5–35.6	29.0–32.8	27.0–31.4	24.5–30.2
5. Excellent	39.0–41.9	37.0–40.9	35.7–40.0	32.9–36.9	31.5–35.7	30.3–31.4
6. Superior	>42.0	>41.0	>40.1	>37.0	>35.8	>31.5

*Values for oxygen uptake in $ml \cdot kg^{-1} \cdot min^{-1}$

Data from Kenneth H. Cooper, 1977, The Aerobics Way, New York: Bantam Books, Inc.

Walk Tests

- One-mile walk test requires simple measurements
- VO_{2max} is based on:
  - Age (years), weight (pounds), sex (0 for female, 1 for male), time (min), and HR (beats/min)

VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$) = 132.853 - 0.0769 (wt) - 0.3877 (age) + 6.315 (sex) - 3.2649 (time) - 0.1565 (HR)

- As fitness improves, HR and/or time will be lower
  - Results in higher estimated VO_{2max}

Canadian Home Fitness Test

- Uses 8-inch steps to evaluate cardiorespiratory fitness
- Measure HR after 3 minutes of stepping
  - Stop if it exceeds maximum allowable HR based on age
  - Continue for another 3 minutes if it is below maximum allowable HR
  - Fitness level is based on post-exercise HR

Fitness Evaluation from the Canadian Home Fitness Test

TABLE 15.2 Physical fitness Evaluation Chart for the Canadian Home Fitness Test

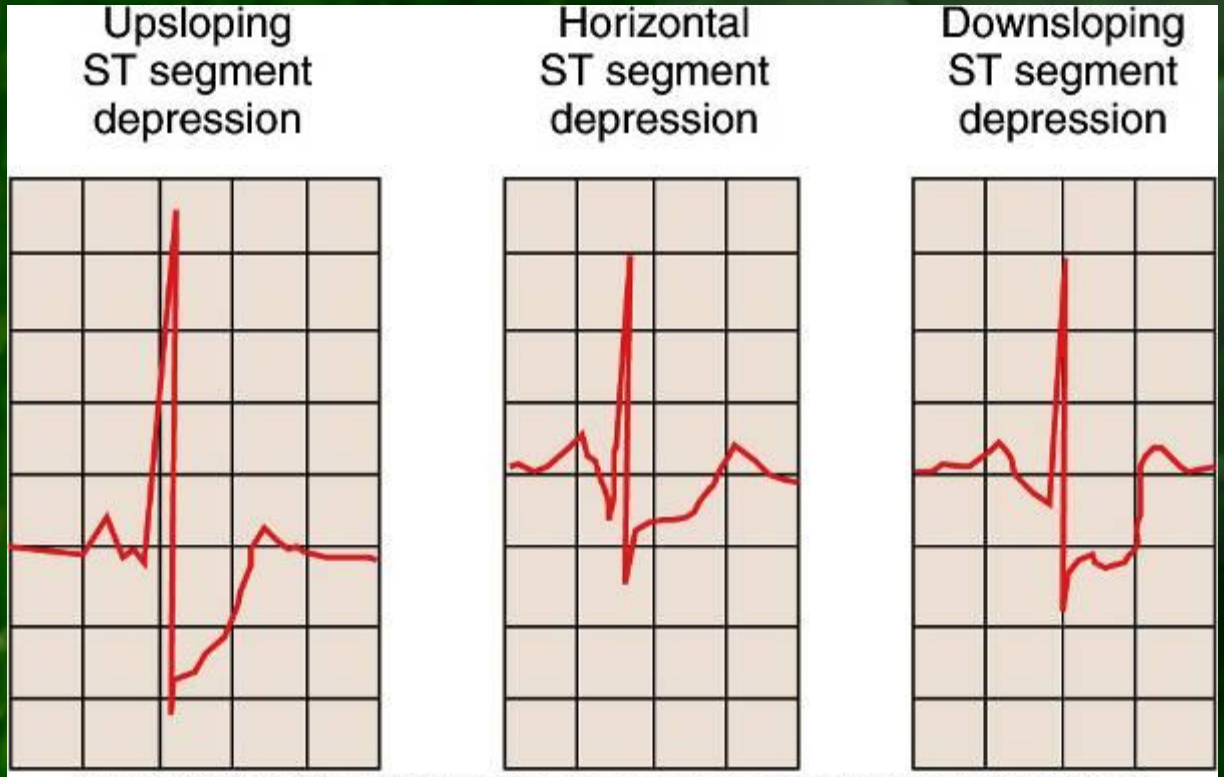
Age (yr)	TEN-SECOND PULSE RATE: After First Three Minutes of Exercise	After Second Three Minutes of Exercise
15–19	If 30 or more, stop. You have an undesirable personal fitness level.	If 27 or more, you have a minimum personal fitness level. If 26 or less, you have the recommended personal fitness level.
20–29	If 29 or more, stop. You have an undesirable personal fitness level.	If 26 or more, you have a minimum personal fitness level. If 25 or less, you have the recommended personal fitness level.
30–39	If 28 or more, stop. You have an undesirable personal fitness level.	If 25 or more, you have a minimum personal fitness level. If 24 or less, you have the recommended personal fitness level.
40–49	If 26 or more, stop. You have an undesirable personal fitness level.	If 24 or more, you have a minimum personal fitness level. If 23 or less, you have the recommended personal fitness level.
50–59	If 25 or more, stop. You have an undesirable personal fitness level.	If 23 or more, you have a minimum personal fitness level. If 22 or less, you have the recommended personal fitness level.
60–69	If 24 or more, stop. You have an undesirable personal fitness level.	If 23 or more, you have a minimum personal fitness level. If 22 or less, you have the recommended personal fitness level.

From R.J. Shephard et al., "Development of the Canadian Home fitness Test," originally published in *Canadian Medical Association Journal*, 114:675–79, 1976. Copyright © 1976 Canadian Medical Association, Ottawa, Canada. Reprinted by permission.

Graded Exercise Tests: Measurements

- Heart rate
  - By palpation, stethoscope, ECG, or monitor
- Blood pressure
  - By auscultation
- ECG
  - Can diagnose arrhythmias or ischemia
    - ST segment depression
- Rating of perceived exertion (RPE)
  - Subjective measure of fatigue
- Termination criteria
  - From ACSM's *Guidelines for Exercise Testing and Prescription*

Three Types of ST Segment Depression



Original and Revised RPE Scales

TABLE 15.3 Rating of Perceived Exertion Scales

Original Rating Scale		Revised Rating Scale	
6		0	Nothing at all
7	Very, very light	0.5	Very, very light (just noticeable)
8		1	Very light
9	Very light	2	Light (weak)
10		3	Moderate
11	Fairly light	4	Somewhat hard
12		5	Heavy (strong)
13	Somewhat hard	6	
14		7	Very heavy
15	Hard	8	
16		9	
17	Very hard	10	Very, very heavy (almost max)
18		•	Maximal
19	Very, very hard		
20			

From G. A. U. Borg "Psychological Bases of Physical Exertion" in *Medicine and Science in Sports and Exercise*, 14:377–81, 1982. Copyright ©1982 American College of Sports Medicine, Indianapolis, IN. Reprinted by permission.

GXT Termination Criteria

- Onset of angina or angina-like symptoms
- Drop in systolic blood pressure of >10mm Hg from baseline blood pressure despite an increase in workload
- Excessive rise in blood pressure: systolic pressure>250mm HG or diastolic pressure >115mm HG
- Shortness of breath, wheezing, leg cramps, or claudication
- Signs of poor perfusion: light-headedness, confusion, ataxia, pallor, cyanosis, or cold and clammy skin
- Failure of heart rate to increase with increased exercise intensity
- Noticeable change in heart rhythm
- Subject requests to stop
- Physical or verbal manifestations of severe fatigue
- Failure of the testing equipment

VO_2 Max

- The gold standard measure of cardiorespiratory fitness
- Estimation from last work rate
  - Use equations to calculate estimated VO_{2max}
- Estimation from submaximal heart rate
  - Extrapolate measured submaximal HR to age-predicted maximal HR to estimate VO_{2max}
  - Careful measurement of HR is required

Estimation of VO_2 Max From Last Work Rate

- Used in many fitness and clinical settings
- Subject should achieve steady-state in each stage
  - Duration and rate of progression depends on fitness level
- Running:

  $VO_2 = 0.2\ ml \cdot kg^{-1} \cdot min^{-1}$ per $m \cdot min^{-1} + 3.5\ ml \cdot kg^{-1} \cdot min^{-1}$

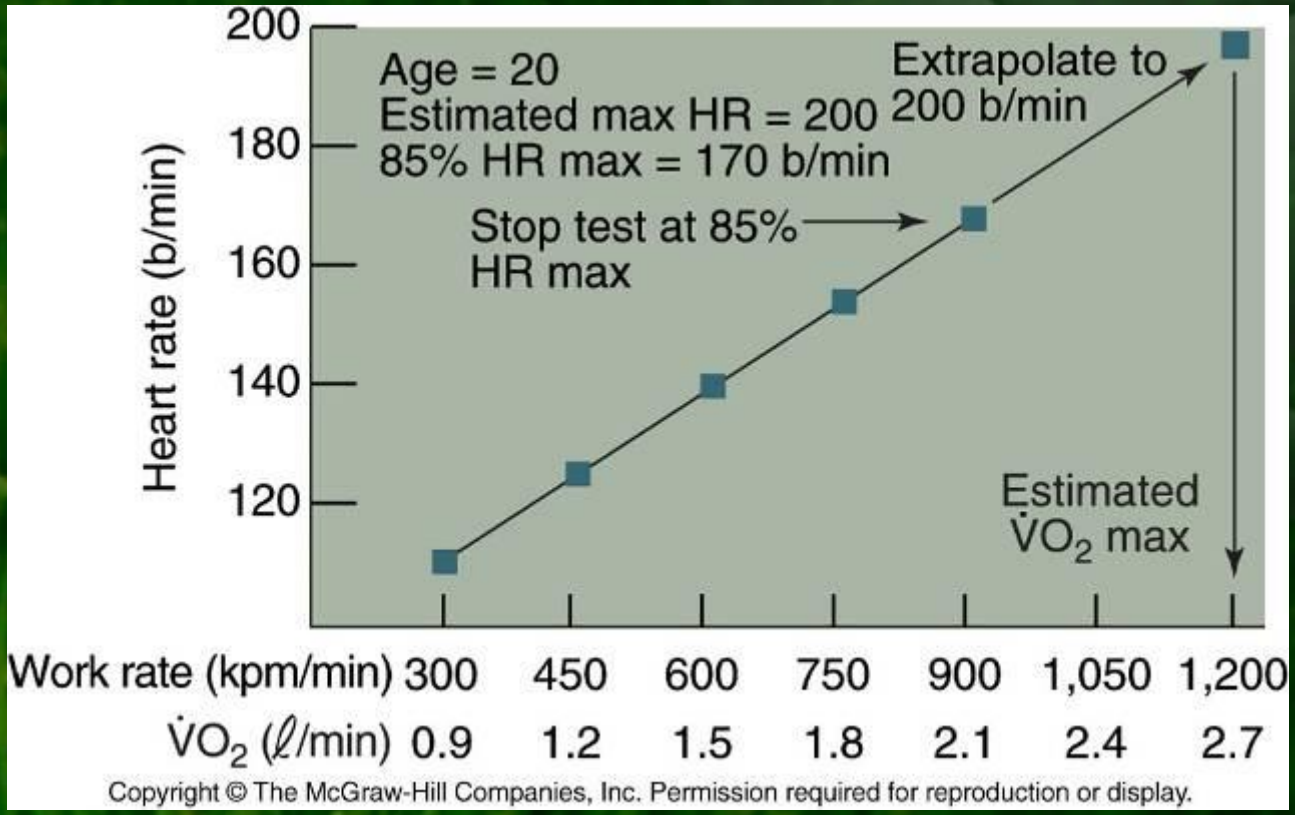
- Walking:

  $VO_2 = 0.1\ ml \cdot kg^{-1} \cdot min^{-1}$ per $m \cdot min^{-1} + 3.5\ ml \cdot kg^{-1} \cdot min^{-1}$

Estimation of VO_2 Max From Submaximal HR Response

- The test is stopped when the subject reaches 85% of maximal HR
- A line is drawn through the HR points measured during the test and is extrapolated to the age-adjusted estimate of maximal HR
- Another line is dropped down from that point to the x-axis, and the VO_{2max} is identified

Estimation of VO_2 max From Submaximal Cycle Ergometer Test



Graded Exercise Test: Protocols

- Consideration of the population tested
  - Submaximal vs. maximal test
  - Starting work rate
  - Rate of change of work rate
  - Mode of exercise
    - Treadmill
    - Cycle ergometer
    - Step test
- Subjects must follow instructions carefully
- Environmental conditions must be controlled
  - Temperature and humidity

Treadmill GXT Protocols

TABLE 15.5 Treadmill Protocols

A—NATIONAL EXERCISE AND HEART DISEASE PROTOCOL FOR POORLY FIT SUBJECTS (69)

Stage*	METs	Speed (mph)	% Grade
1	2.5	2	0
2	3.5	2	3.5
3	4.5	2	7.0
4	5.5	2	10.5
5	6.5	2	14.0
6	7.5	2	17.5
7	8.5	3	12.5
8	9.5	3	15.0
9	10.5	3	17.5

*Stage lasts three minutes.

B—STANDARD BALKE PROTOCOL FOR NORMAL, SEDENTARY SUBJECTS (11)

Stage*	METs	Speed (mph)	% Grade
1	4.3	3	2.5
2	5.4	3	5.0
3	6.4	3	7.5
4	7.4	3	10.0
5	8.5	3	12.5
6	9.5	3	15.0
7	10.5	3	17.5
8	11.6	3	20.0
9	12.6	3	22.5

*Stage lasts two minutes.

C—BRUCE PROTOCOL FOR YOUNG, ACTIVE SUBJECTS (18)

Stage*	METs	Speed (mph)	% Grade
1	5	1.7	10
2	7	2.5	12
3	9.5	3.4	14
4	13	4.2	16
5	16	5.0	18

*Stage lasts three minutes.

D—ÅSTRAND AND RODAHL PROTOCOL FOR VERY FIT SUBJECTS (7)

Stage*	METs	Speed (mph)	% Grade
1	12.9/18	7/10	2.5
2	14.1/19.8	7/10	5.0
3	15.3/21.5	7/10	7.5
4	16.5/23.2	7/10	10.0
5	17.7/24.9	7/10	12.5

*Stage lasts two minutes; vigorous warm-up precedes test.

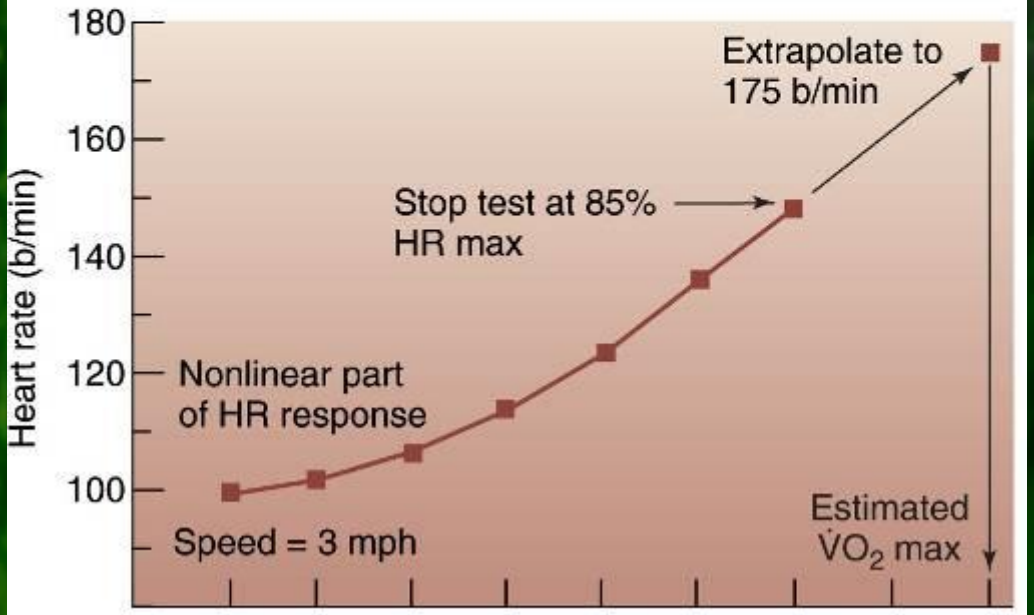
Treadmill

- Use natural activities
  - Walking and running
- Can accommodate a wide range of subjects
  - Least fit to most fit
- Involve increasing speed and/or grade
- Estimating VO_{2max}
  - Usually based on extrapolating submaximal HR
  - Could also be a single-stage test

Estimation of VO_2 Max From Submaximal Treadmill Test

Subject: male, age = 45 years
Estimated HR max = 175 b/min
85% HR max = 149 b/min

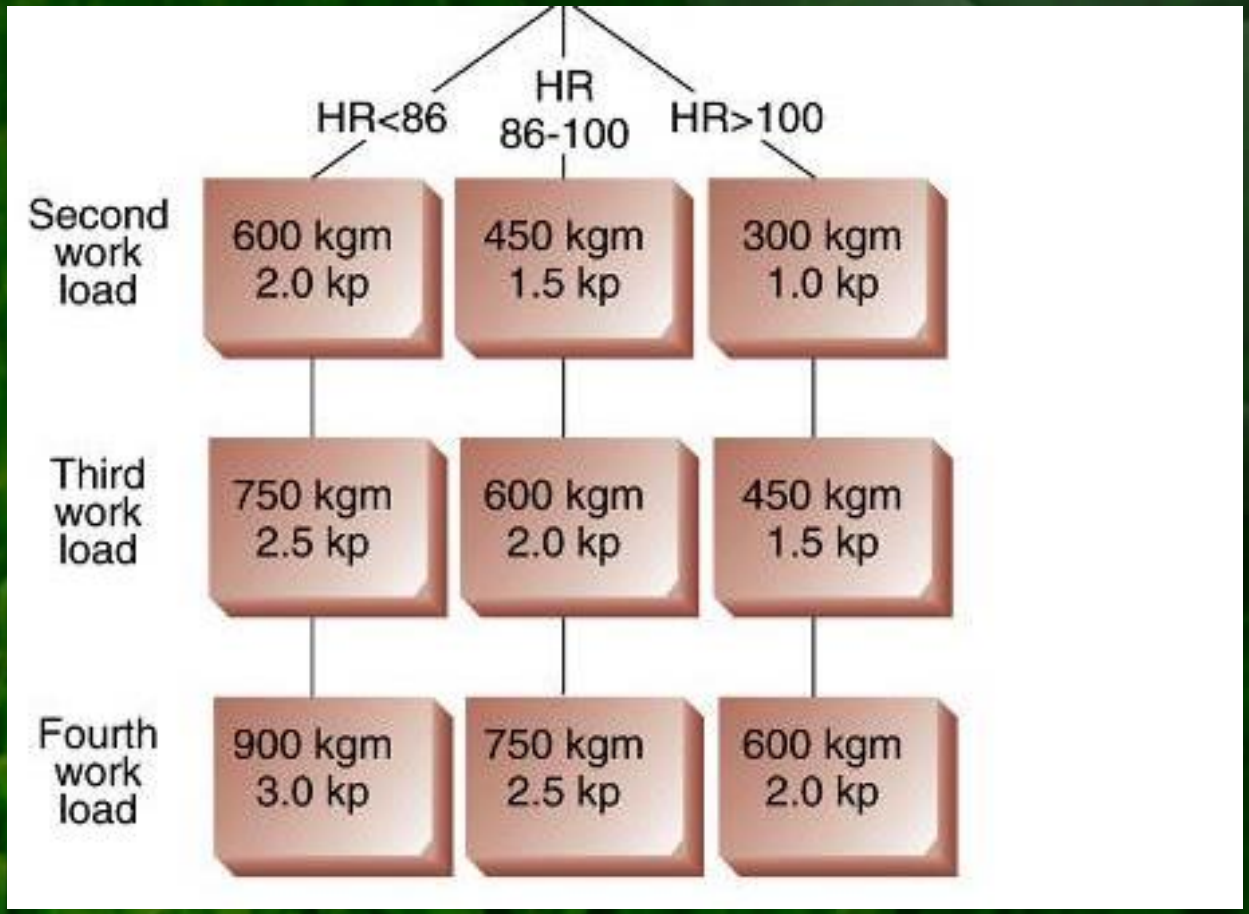
Data: % grade	HR (b/min)
0	100
2.5	102
5.0	108
7.5	110
10.0	123
12.5	136
15.0	149



Cycle Ergometer

- Body weight is supported
  - Can accommodate subjects with orthopedic limitations
- Work rate depends on resistance and pedal rate
  - Generally, pedal rate is maintained, and resistance is increased
- Estimating VO_{2max}
  - Based on extrapolating submaximal HR during incremental test
    - YMCA protocol
  - From a single stage, 6-minute test
    - Åstrand and Ryhming nomogram

YMCA Protocol

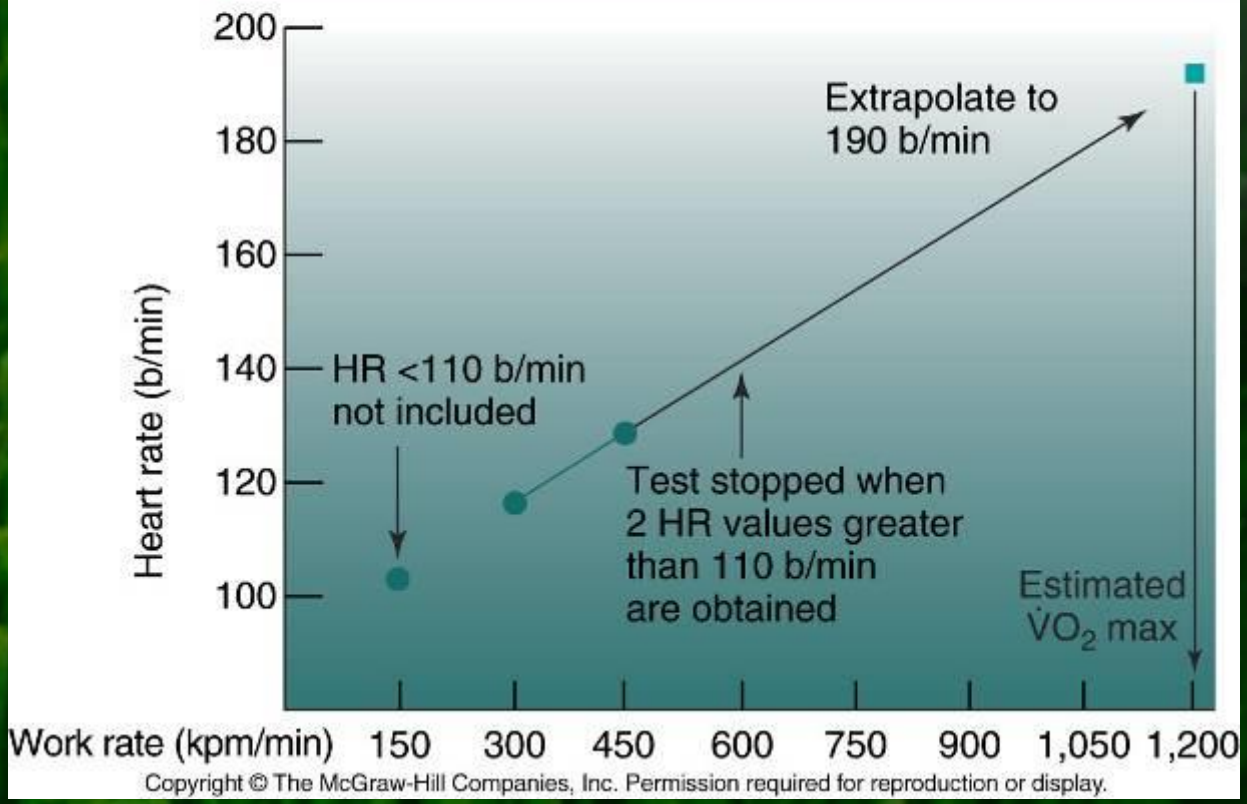


Example of the YMCA Protocol Used to Estimate VO_2 max

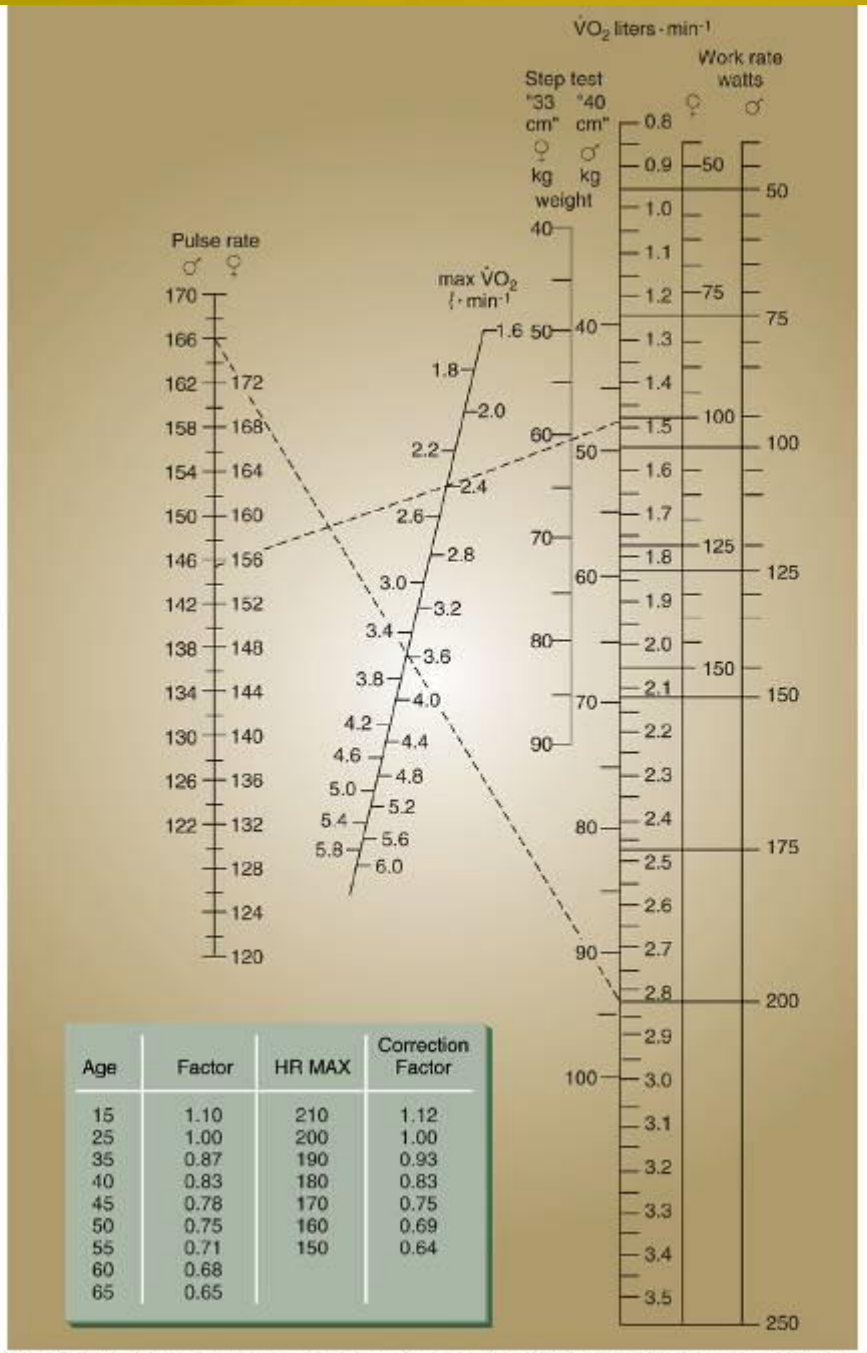
Subject: female, age = 30 years
Estimated HR max = 190 b/min
85% HR max = 162 b/min
Body weight = 60 kg

Data:

Work rate (kpm/min)	Heart rate (b/min)
150	103
300	115
450	128



Nomogram for Estimation of VO_2 max from Submaximal HR



Age	Factor	HR MAX	Correction Factor
15	1.10	210	1.12
25	1.00	200	1.00
35	0.87	190	0.93
40	0.83	180	0.83
45	0.78	170	0.75
50	0.75	160	0.69
55	0.71	150	0.64
60	0.68		
65	0.65		

Step Test

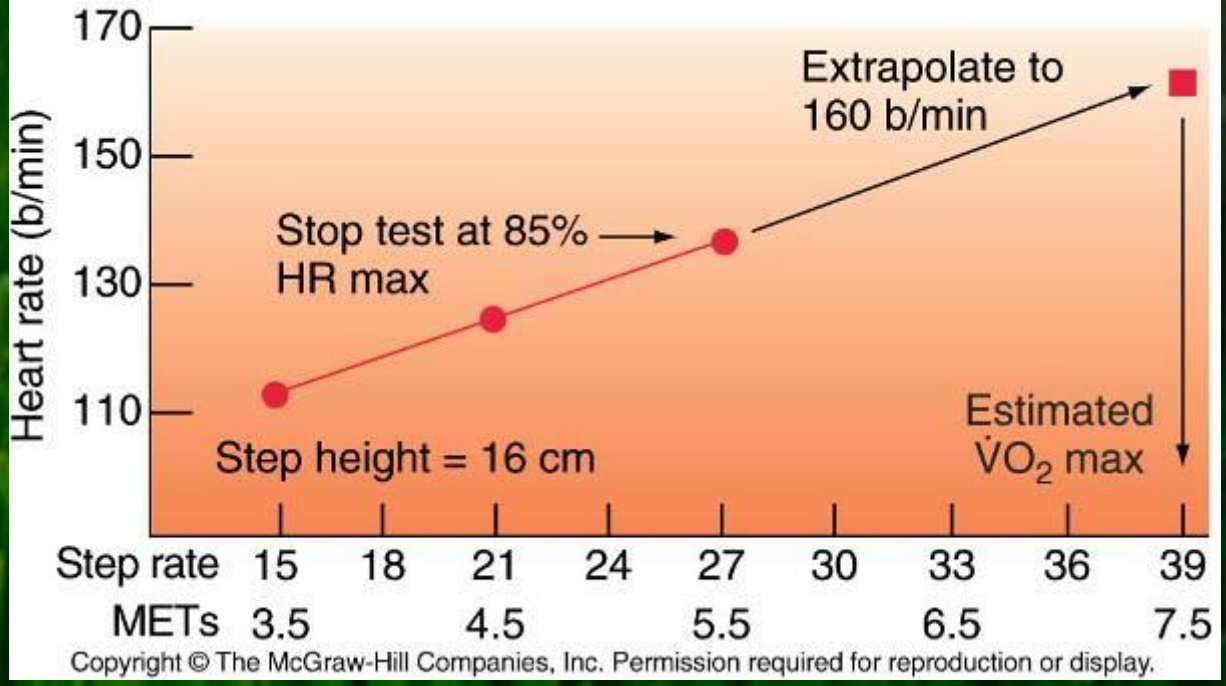
- Simple, inexpensive equipment
- Protocols differ in:
  - Step height
  - Step rate
- Estimating VO_{2max}
  - Based on extrapolating submaximal HR
  - Can also use Åstrand and Ryhming nomogram

Predicting VO_2 Max From Submaximal Step Test

Subject: female, age = 60 years
Estimated HR max = 160 b/min
85% HR max = 136 b/min

Data:

Step rate (lifts/min)	Heart rate (b/min)
15	112
21	124
27	136




Thank you

Reference

Theory and Application to Fitness and Performance, 6th edition
Scott K. Powers & Edward T. Howley