

Laboratory 4a - Field Laboratory: Predicting VO_{2max} from sub-maximal tests**ROCKPORT 1-MILE WALK TEST**

REFERENCE: Source: Exercise Physiology Laboratory Manual (4th ed.). Gene Adams, McGraw-Hill Publishers, New York, NY. 2002.

INTRODUCTION:

Aerobic run/walk tests are the most common field tests of cardiorespiratory fitness. These tests use minimal equipment, allow testing of large groups, and are easy to administer. Despite their value in measuring functional fitness, field tests are not usually considered replacement tests for the direct measurement of oxygen consumption in research studies.

Tests that prescribe walking may be most prudent for middle-aged and older adults because walking is a moderate exercise that is less stressful to the joints. The American College of Sports Medicine (ACSM) does not feel a need to recommend a medical examination for apparently healthy adults prior to performing tests of moderate exercise.

The Rockport 1.0 Mile Walk Test predicts aerobic fitness for individuals of all ages. This test incorporates the time to finish the walk, exercise heart rate, body mass, age, and gender into an equation to predict aerobic fitness.

RATIONALE:

Oxidative metabolism predominates for events that last for about two or more minutes. Oxygen is transported first by the respiratory (pulmonary) system to the cardiovascular system, and then to the contracting muscles. The muscles consume the oxygen in order to provide sufficient amounts of ATP for the muscle contraction (i.e. the myosin filaments pulling on the actin filaments). Without sufficient oxygen, there is not enough ATP produced to sustain muscular action beyond a couple of minutes. Thus, other factors being equal, the runner who can supply the highest rate of oxygen to the muscles will be able to perform aerobic exercise at a faster speed. The highest possible rate of oxygen consumption is called the maximal oxygen consumption (VO_{2max}).

METHODS:**Facility:**

The Rockport 1-Mile Walk Test will be performed on the Redman Stadium Track. Each lap around the track is 400 meters in length. Therefore, the walker must go 10 yards (approximately 10 full steps) beyond 4 laps for the 1-Mile Test. **IMPORTANT:** use the inside lane of the track – about 1 foot from the curb. In the case of inclement weather an alternative option for the test is a treadmill or Student Recreation Center's Indoor Track.

Equipment:

The only equipment that is absolutely necessary to conduct the test is a watch with a second hand. For greater accuracy in measuring heart rate (HR), an electronic Polar HR monitor may be used.

PROCEDURES: The Rockport Walk Test

Each student must first fill out a PAR-Q questionnaire (See my webpage for PAR-Q) prior to the exercise test and give it to Dr. Andreacci. This questionnaire helps to disclose persons who deserve cautionary measures or special guidance.

Select a partner to record your 1-mile time and post-exercise HR.

Have your partner weigh you in your walking attire.

At the “GO!” signal, all participants begin walking as fast as possible for one mile around the track. This will be done in two groups (you and then your partner).

HR is taken by your partner by electronic monitoring immediately upon crossing the 1 mile mark. If using radial pulse for HR determination, measure HR for 15s immediately after completion and multiply that number by 4 to get beats/minute.

Dr. Andreacci will yell out the participants’ time to the closest second. Recorders should write down your partner’s time and later convert it to the nearest hundredth minute. For example, if the participant finishes in 13 minutes 30 seconds, then that time is converted to the nearest hundredth minute by dividing the seconds (30) by 60 seconds. Thus, the time is 13.50 minutes.

During inclement weather the test can be completed on a treadmill. Walk 1-mile as fast as you can by adjusting the speed of the treadmill (do not jog or run). The grade must remain at 0% for the entire 1-mile test. Record time from the computer display and HR at the completion of the test.

Calculate VO_{2max} ($ml \cdot kg^{-1} \cdot min^{-1}$) according to the following equation for collegians.

$$VO_{2max} (ml \cdot kg^{-1} \cdot min^{-1}) = 88.768 + 8.892 (\mathbf{gender}) - 0.0957 (\mathbf{BM lb}) - 1.4537 (\mathbf{T}) - 0.1194 (\mathbf{HR})$$

Where:

gender = 0 for women, and 1 for men

BM = body mass (pounds) in walking shoes

T = time to walk 1 mile (converted to nearest hundredth minute)

HR = immediate post-exercise HR (beats/min)

Compare your calculated aerobic fitness levels to the values in Table I.

DATA SHEET

Name: _____

Lab Section: _____

Body Weight: _____ pounds

Gender: _____

1-Mile Time: _____ minutes _____ seconds

1-Mile Time: _____ nearest hundredth minute

*divide the seconds by 60s.

1-Mile HR (b/min): _____ beats/minute

Estimated VO₂max: _____ ml·kg⁻¹·min⁻¹

Aerobic Fitness Category: _____

*from Table I

TABLE I. AEROBIC FITNESS CATEGORIES FOR MEN AND WOMEN

Fitness Category		VO ₂ max (ml·kg ⁻¹ ·min ⁻¹)						
	Age	Excellent	Very Good	Good	Average	Fair	Poor	Very Poor
♂	18-20	>63	62-57	56-51	50-46	45-39	38-33	<33
	21-25	>62	62-56	55-51	50-45	44-38	37-32	<32
	26-30	>59	59-55	54-48	47-42	41-36	35-30	<30
♀	18-20	>53	53-48	47-43	42-38	37-33	32-28	<28
	21-25	>50	50-46	45-42	41-36	35-32	31-27	<27
	26-30	>48	48-44	43-40	39-35	34-31	30-26	<26

Table derived from graphs in Shvartz, E., & Reibold R.C. (1990). Aerobic fitness norms for males and females aged 6 to 75 years: A review. *Aviation, Space, and Environmental Medicine*, 61, 31-11.

UNIVERSITY OF HOUSTON NON-EXERCISE TEST

Subjects should determine their physical activity rating (PAR) using Table 2.

PAR score: _____

Determine the subject's BMI using the following formula:

$$\text{BMI} = \text{weight in kg} / (\text{height in meters})^2$$

$$\text{BMI} = \text{wt} \text{ ______ (kg) } \div \text{ht} (\text{ ______ m})^2 = \text{ ______ kg/m}^2$$

Determine the predicted maximal oxygen uptake (VO_2max) for the subject using the BMI and the physical activity rating according to the following formula:

Men: $\text{VO}_2\text{max} = 67.350 - (.381 \times \text{age}(\text{yrs})) - (.754 \times \text{BMI}) + (1.951 \times \text{PAR})$

Women: $\text{VO}_2\text{max} = 56.363 - (.381 \times \text{age}(\text{yrs})) - (.754 \times \text{BMI}) + (1.951 \times \text{PAR})$

Predicted VO_2max : _____ $\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$

Note: Enter this value in the chart in the "Results" section for comparison.

Table 2. University of Houston Non-Exercise Test

Use the appropriate number (0-7) which best describes your general physical activity (PAR) for the previous month:

- I. Do not participate regularly in programmed recreation, sport or physical activity
 - 0 Avoid walking or exertion, e.g., always use elevator, drive whenever**
 - 1 Walk for pleasure, routinely use stairs, occasionally exercise sufficiently to cause heavy breathing or perspiration.**

- II. Participate regularly in recreation or work requiring modest physical activity, such as golf, horseback riding, calisthenics, gymnastics, table tennis, bowling, weight lifting, yard work.
 - 2 10 to 60 minutes / week**
 - 3 Over 1 hr/week**

- III. Participate regularly in heavy physical exercise such as running or jogging, swimming, cycling, rowing, skipping rope, running in place or engaging in vigorous aerobic activity type exercise such as tennis, basketball or handball.
 - 4 Run less than 1 mile/week or spend less than 30 minutes/week in comparable physical activity.**
 - 5 Run 1 to 5 miles/week or spend 30 to 60 minutes/week in comparable physical activity.**
 - 6 Run 5 to 10 miles/week or spend over 3 hours/week in comparable physical activity.**
 - 7 Run over 10 miles/week or spend over 3 hours/week in comparable physical activity.**

3-MINUTE STEP TEST

- Subject should stand and face the 40 cm (~16 in) step bench.
- Start the metronome at 88 beats·min⁻¹ (women) and 96 beats·min⁻¹ (men).
- Have the subject start stepping on any metronome beat.
- Start timer as soon as subject starts movement.
- Initially announce cadence aloud: “up-one, up-two, down-one, down-two.”
- Remind subject to straighten the back and legs at top of step.
- Stop test and metronome at 3rd minute.
- Have subject stand quietly upon completion of test.
- Palpate radial pulse and count for 15 seconds, starting the count at 3:05 (5s after the test) and stopping at 3:20 OR record HR from Polar HR monitor.
- Record pulse count x 4 = _____ beats per minute.
- Have subject cool down by walking and stretching the gastrocnemius and quadriceps for the next 5 minutes.
- Compare the subject’s recovery heart rate to Table 3 and determine the Predicted VO₂max (ml·kg⁻¹·min⁻¹). If the subject’s recovery heart rate is not listed (i.e. too low) use the regression equations at the bottom to calculate the predicted VO₂max .

Predicted VO₂max _____ (ml·kg⁻¹·min⁻¹)

Note: Enter this value in the chart in the “Results” section for comparison.

RESULTS

Using the table below, enter the relative predicted $\text{VO}_{2\text{max}}$ values ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) for each respective test.

Using the predicted $\text{VO}_{2\text{max}}$ values from each of the three tests determine the level of cardiovascular fitness using the Aerobic Fitness Categories (Table 4) and enter into the chart below.

Chart

	Predicted $\text{VO}_{2\text{max}}$ ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$)	Fitness Level (Table 1.0)
Rockport Walk Test		
Univ of Houston N-Ex		
3-minute Step Test		

QUESTIONS

How did your estimated $\text{VO}_{2\text{max}}$ ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) rank for your respective age and gender? Is this what you expected? WHY?

Based on your $\text{VO}_{2\text{max}}$ ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) value what sports do you think you are better suited for and WHY?

If your $\text{VO}_{2\text{max}}$ is below what you desire, what can be done (if anything) to improve this value?

Compare the predicted $\text{VO}_{2\text{max}}$ values (i.e., aerobic fitness) using the three methods (i.e., walk test, step test, non-exercise test). Which method do you think was the most/least accurate? Why?

What predictors positively influence the University of Houston Non-Exercise Test? What would negatively influence the results (based on the formula)? Name a population that this test is ideally suited for.

Explain why sub-maximal predictive tests are better suited for intra- (same individual) rather than for inter- (between individual) comparisons of aerobic fitness.

TABLE 3. PERCENTILE RANKINGS FOR STEP TEST RECOVERY HEART RATE AND PREDICTED VO_{2max} FOR UNTRAINED MALE AND FEMALE COLLEGE STUDENTS.

Percentile Ranking	Recovery HR, Female	Pred. VO _{2max} (ml/kg/min)	Recovery HR, Male	Pred. VO _{2max} (ml/kg/min)
100	128	42.2	120	60.9
95	140	40.0	124	59.3
90	148	38.5	128	57.6
85	152	37.7	136	54.2
80	156	37.0	140	52.5
75	158	36.6	144	50.9
70	160	36.3	148	49.2
65	162	35.9	149	48.8
60	163	35.7	152	47.5
55	164	35.5	154	46.7
50	166	35.1	156	45.8
45	168	34.8	160	44.1
40	170	34.4	162	43.3
35	171	34.2	164	42.5
30	172	34.0	166	41.6
25	176	33.3	168	40.8
20	180	32.6	172	39.1
15	182	32.2	176	37.4
10	184	31.8	178	36.6
5	196	29.6	184	34.1

Equations Men: $VO_{2max} = 111.33 - (0.42 \times \text{beats} \cdot \text{min}^{-1})$
 Women: $VO_{2max} = 65.81 - (0.1847 \times \text{beats} \cdot \text{min}^{-1})$