

Testing as a Basis for Exercise Programs

For healthy clients

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For patients

- Testing for physical fitness of healthy individuals should be distinct from graded exercise testing of convalescing patients, individuals with symptoms of coronary heart disease, or individuals who are 35 years or older but asymptomatic.
- Regardless of the type of testing, the level of performance is based on the submaximum or maximum oxygen uptake ($\dot{V}O_2$) or the symptom-limited oxygen uptake.
- The capacity of the individual to transport and utilize oxygen is reflected in the oxygen uptake.

Fitness Testing of Healthy Subjects

- Field tests for determining cardiovascular fitness include the **time to run 1.5 miles or the distance run in 12 minutes**. These measures correlate well with VO₂ max, but their use is limited to young persons or middle-aged individuals who have been carefully screened and have been jogging or running for some time.
- Other field tests include the **1-mile walk test, 6-minute walk test**, and step tests. These tests are more suitable for individuals who are not as physically active.

Multistage testing

- Multistage testing can provide a **direct measurement of VO₂ max** by analyzing samples of expired air.
- Testing is usually completed in **four to six treadmill stages**, which progressively increase in speed and or grade.
- Each stage is **3 to 6 minutes** long.
- Electrocardiographic (ECG) monitoring is performed during the testing.
- Maximum oxygen uptake can be determined when the oxygen utilization **plateaus** despite an increase in workload



Stress Testing for Convalescing Individuals and Individuals at Risk

- Individuals undergoing stress testing should have a
- **physical examination,**
- **be monitored by the ECG,**
- **and be closely observed at rest, during exercise, and during recovery**

Principles of Stress Testing

- The principles of stress testing include the following.
- Changing the workload by increasing the speed and/or grade of the treadmill or the resistance on the bicycle ergometer
- An initial workload that is low in terms of the individual's anticipated aerobic threshold
- Maintaining each workload for 1 minute or longer
- Terminating the test at the onset of symptoms or a definable abnormality of the ECG
- When available, measuring the individual's maximum oxygen consumption

Purpose of Stress Testing

- In addition to serving as a basis for determining exercise levels or the exercise prescription, the stress test:
- Helps establish a diagnosis of **overt or latent heart disease**.
- Evaluates cardiovascular **functional capacity** as a means of **clearing individuals for strenuous work or exercise programs**.
- Determines the physical work capacity **in kilogram-meters per minute (kg-m/min) or the functional capacity in METs**.
- Evaluates **responses to exercise training and/or preventive programs**.
- Assists in the selection and evaluation of appropriate modes of treatment for **heart disease**.
- Increases individual **motivation** for entering and adhering to exercise programs.
- Is used clinically to evaluate patients with **chest sensations** or a history of chest pain to establish the probability that such patients have coronary disease. It can also evaluate the functional capacity of patients with chronic disease.

Preparation for Stress Testing

All individuals who are taking a stress test should:

- Have had a physical examination.
- Be monitored by ECG and closely observed at rest, during exercise, and during recovery.
- **Sign a consent form.**

Precautions during stress test

BOX 7.6 Precautions for Stress Testing and Exercise Program

Cardiopulmonary changes occur with stress testing and exercises. Monitor and recognize the following.

- Monitor the pulse to assess abnormal increases in heart rate.
- Blood pressure increases with exercise approximately 7 to 10 millimeters (mm) of mercury (Hg) per MET of physical activity.
 - Systolic pressure should not exceed 220 to 240 mm Hg.
 - Diastolic pressure should not exceed 120 mm Hg.
- Rate and depth of respiration increase with exercise.
 - Respiration should not be labored.
 - The individual should have no perception of shortness of breath.
- The increase in blood flow while exercising, which regulates core temperature and meets the demands of the working muscles, results in changes in the skin of the cheeks, nose, and earlobes. They become pink, moist, and warm to the touch.

Termination of Stress Testing

Endpoints requiring termination of the test period are

- Progressive angina.
- A significant drop in systolic pressure in response to an increasing workload.
- Lightheadedness, confusion, pallor, cyanosis, nausea, or peripheral circulatory insufficiency.
- Abnormal ECG responses including ST segment depression greater than 4 mm.
- Excessive rise in blood pressure.
- Subject wishes to stop.

Example

Mr. Smith is a 55-year-old sedentary man with a history of chest pain with exertion. He has undergone a stress test to assist in evaluating his angina. He is not taking any medications at the present time. He has been a smoker for 20 years.

PRE-STRESS-PHYSICAL EXAMINATIONS

- Resting electrocardiogram (ECG): normal
- Resting heart rate: 75 beats/min
- Age-predicted maximum heart rate: 165 beats/min
- Resting blood pressure: 128/86
- Resting respiration rate: 20 breaths/min
- Treadmill: Bruce protocol

Stage	Heart Rate	Blood Pressure	Comments
1	80		
	84		
	85	138/88	No complaints
2	88		
	90		
	92	142/90	No complaints
3	98		
	100		
	102	156/91	Complaining of leg fatigue
4	114		
	116		
	122	161/90	Complaining of minimal chest pain
5	133		
	135		
	137	174/89	Complaining of severe chest pain; test terminated

Conclusion

The stress test was terminated because of complaints of severe chest pain accompanied by a drop in the ST segment of the ECG to 4 mm. The symptom-limited maximum heart rate was determined to be 137 beats/min. Maximum oxygen consumption was determined to be 32 mL/kg/min.