CHAPTER

2

Preparticipation Health Screening

The previous versions of *Chapter 2* have recommended cardiovascular disease (CVD) risk assessment and stratification of all individuals, and a medical examination and symptom-limited exercise testing as part of the preparticipation health screening prior to initiating vigorous intensity, physical activity in individuals at increased risk for occult CVD. Individuals at increased risk in these recommendations were men ≥45 and women ≥55 yr, those with two or more major CVD risk factors, individuals with signs and symptoms of CVD, and those with known cardiac, pulmonary, or metabolic disease. These recommendations were designed to avoid exposing physically unfit individuals to the documented risks of exercise including sudden cardiac death and acute myocardial infarction (MI) as discussed in *Chapter 1*.

Compared to previous editions of the *Guidelines*, the present version of *Chapter 2* regarding the preparticipation health screening process:

- Reduces the emphasis on the need for medical evaluation (*i.e.*, medical examination and exercise testing) as part of the preparticipation health screening process prior to initiating a progressive exercise regimen in healthy, asymptomatic individuals.
- Uses the term *risk classification* to group individuals as low, moderate, or high risk based on the presence or absence of CVD risk factors, signs and symptoms, and/or known cardiovascular, pulmonary, renal, or metabolic disease.
- Emphasizes identifying those with known disease because they are at greatest risk for an exercise-related cardiac event.
- Adopts the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) risk stratification scheme for individuals with known CVD because it considers overall patient prognosis and potential for rehabilitation (32) (see *Chapter 9*).
- Supports the public health message that all individuals should adopt a physically active lifestyle.

This edition of the *Guidelines* continues to encourage atherosclerotic CVD risk factor assessment because such measurements are an important part of the preparticipation health screening process and good medical care, but does seek to simplify the preparticipation health screening process in order to remove unnecessary and unproven barriers to adopting a physically active lifestyle (24). This edition of the *Guidelines* also recommends health/fitness and clinical exercise professionals

consult with their medical colleagues when there are questions about patients with known disease and their ability to participate in exercise programs.

There are multiple considerations that have prompted these different points of emphasis in the present version of *Chapter 2*. The risk of a cardiovascular event is increased during vigorous intensity exercise relative to rest, but the absolute risk of a cardiac event is low in healthy individuals (see *Chapter 1*). Recommending a medical examination and/or stress test as part of the preparticipation health screening process for all individuals at moderate to high risk prior to initiating light-to-moderate intensity exercise programs implies being physically active confers greater risk than a sedentary lifestyle (7). Yet, the cardiovascular health benefits of regular exercise far outweigh the risks of exercise for the general population (28,29). There is also an increased appreciation that exercise testing is a poor predictor of CVD events in asymptomatic individuals probably because such testing detects flow-limiting coronary lesions, whereas sudden cardiac death and acute MI are usually produced by the rapid progression of a previously nonobstructive lesion (29).

Furthermore, there is lack of consensus regarding the extent of the medical evaluation (*i.e.*, medical examination, stress testing) needed as part of the preparticipation health screening process prior to initiating an exercise program even if it is of vigorous intensity. The American College of Cardiology (ACC)/American Heart Association (AHA) recommend exercise testing prior to moderate or vigorous intensity exercise programs when the risk of CVD is increased but recognize these recommendations are based on conflicting evidence and divergent opinions (12). The U.S. Preventive Services Task Force (USPSTF) concluded that there is an insufficient evidence to evaluate the benefits and harm of exercise testing before initiating a physical activity program and did not make a specific recommendation regarding the need for exercise testing (31). The *2008 Physical Activity Guidelines Advisory Committee Report* to the Secretary of Health and Human Services (24) states that even "symptomatic persons or those with cardiovascular disease, diabetes, or other active chronic conditions who want to begin engaging in *vigorous* physical activity and who have not already developed a physical activity plan with their health care provider may wish to do so," but does not mandate such medical contact. There is also evidence from decision analysis modeling routine screening that using exercise testing prior to initiating an exercise program is not warranted regardless of baseline individual risk (16). These considerations form the basis for the present American College of Sports Medicine (ACSM) recommendations made in *Chapter 2* of this edition of the *Guidelines*.

The present version of *Chapter 2* does not recommend abandoning all medical evaluation as part of the preparticipation health screening process, as implied by the *Physical Activity Guidelines Advisory Committee Report* (24). Such changes would be a radical departure from prior editions of the *Guidelines*. In addition, individuals at highest risk and those with possible CVD symptoms may benefit from an evaluation by a health care provider.

The present chapter provides guidance for:

- Identifying individuals with unstable symptoms of CVD who could benefit from medical evaluation and treatment (see *Table 2.1*).

TABLE 2.1. Major Signs or Symptoms Suggestive of Cardiovascular, Pulmonary, or Metabolic Disease[a]

Signs or Symptoms	Clarification/Significance
Pain; discomfort (or other anginal equivalent) in the chest, neck, jaw, arms, or other areas that may result from ischemia	One of the cardinal manifestations of cardiac disease, in particular coronary artery disease Key features *favoring an ischemic origin* include the following: • *Character*: constricting, squeezing, burning, "heaviness," or "heavy feeling" • *Location*: substernal, across midthorax, anteriorly; in one or both arms, shoulders; in neck, cheeks, teeth; in forearms, fingers in interscapular region • *Provoking factors*: exercise or exertion, excitement, other forms of stress, cold weather, occurrence after meals Key features *against an ischemic origin* include the following: • *Character*: dull ache; "knifelike," sharp, stabbing; "jabs" aggravated by respiration • *Location*: in left submammary area; in left hemithorax • *Provoking factors*: after completion of exercise, provoked by a specific body motion
Shortness of breath at rest or with mild exertion	Dyspnea (defined as an abnormally uncomfortable awareness of breathing) is one of the principal symptoms of cardiac and pulmonary disease. It commonly occurs during strenuous exertion in healthy, well-trained individuals and during moderate exertion in healthy, untrained individuals. However, it should be regarded as abnormal when it occurs at a level of exertion that is not expected to evoke this symptom in a given individual. Abnormal exertional dyspnea suggests the presence of cardiopulmonary disorders, in particular left ventricular dysfunction or chronic obstructive pulmonary disease.
Dizziness or syncope	Syncope (defined as a loss of consciousness) is most commonly caused by a reduced perfusion of the brain. Dizziness and, in particular, syncope *during* exercise may result from cardiac disorders that prevent the normal rise (or an actual fall) in cardiac output. Such cardiac disorders are potentially life threatening and include severe coronary artery disease, hypertrophic cardiomyopathy, aortic stenosis, and malignant ventricular dysrhythmias. Although dizziness or syncope shortly *after* cessation of exercise should not be ignored, these symptoms may occur even in healthy individuals as a result of a reduction in venous return to the heart.
Orthopnea or paroxysmal nocturnal dyspnea	Orthopnea refers to dyspnea occurring at rest in the recumbent position that is relieved promptly by sitting upright or standing. Paroxysmal nocturnal dyspnea refers to dyspnea, beginning usually 2–5 h after the onset of sleep, which may be relieved by sitting on the side of the bed or getting out of bed. Both are symptoms of left ventricular dysfunction. Although nocturnal dyspnea may occur in individuals with chronic obstructive pulmonary disease, it differs in that it is usually relieved after the individual relieves himself or herself of secretions rather than specifically by sitting up.
Ankle edema	Bilateral ankle edema that is most evident at night is a characteristic sign of heart failure or bilateral chronic venous insufficiency. Unilateral edema of a limb often results from venous thrombosis or lymphatic blockage in the limb. Generalized edema (known as anasarca) occurs in individuals with the nephrotic syndrome, severe heart failure, or hepatic cirrhosis.

(*continued*)

TABLE 2.1. Major Signs or Symptoms Suggestive of Cardiovascular, Pulmonary, or Metabolic Disease[a] (*Continued*)

Signs or Symptoms	Clarification/Significance
Palpitations or tachycardia	Palpitations (defined as an unpleasant awareness of the forceful or rapid beating of the heart) may be induced by various disorders of cardiac rhythm. These include tachycardia, bradycardia of sudden onset, ectopic beats, compensatory pauses, and accentuated stroke volume resulting from valvular regurgitation. Palpitations also often result from anxiety states and high cardiac output (or hyperkinetic) states, such as anemia, fever, thyrotoxicosis, arteriovenous fistula, and the so-called idiopathic hyperkinetic heart syndrome.
Intermittent claudication	Intermittent claudication refers to the pain that occurs in a muscle with an inadequate blood supply (usually as a result of atherosclerosis) that is stressed by exercise. The pain does not occur with standing or sitting, is reproducible from day to day, is more severe when walking upstairs or up a hill, and is often described as a cramp, which disappears within 1–2 min after stopping exercise. Coronary artery disease is more prevalent in individuals with intermittent claudication. Patients with diabetes are at increased risk for this condition.
Known heart murmur	Although some may be innocent, heart murmurs may indicate valvular or other cardiovascular disease. From an exercise safety standpoint, it is especially important to exclude hypertrophic cardiomyopathy and aortic stenosis as underlying causes because these are among the more common causes of exertion-related sudden cardiac death.
Unusual fatigue or shortness of breath with usual activities	Although there may be benign origins for these symptoms, they also may signal the onset of or change in the status of cardiovascular, pulmonary, or metabolic disease.

[a]These signs or symptoms must be interpreted within the clinical context in which they appear because they are not all specific for cardiovascular, pulmonary, or metabolic disease.

Modified from (14).

- Identifying those with diagnosed disease who could benefit from a medical evaluation that includes an exercise test.
- Providing appropriate recommendations regarding the initiation, continuation, or progression of an individual's physical activity program to minimize the potential for catastrophic cardiac events.

Potential participants should be screened for the presence of risk factors for various cardiovascular, pulmonary, and metabolic diseases as well as other health conditions (*e.g.*, pregnancy, orthopedic limitations) that require special attention (14,17,18) to (a) optimize safety during exercise testing; and (b) aid in the development of a safe and effective exercise prescription (Ex R_x).

The purposes of the preparticipation health screening include the following:

- Identification of individuals with medical contraindications that require exclusion from exercise programs until those conditions have been abated or controlled.
- Recognition of individuals with clinically significant disease(s) or conditions who should participate in a medically supervised exercise program.

- Detection of individuals who should undergo a medical evaluation and/or exercise testing as part of the preparticipation health screening process before initiating an exercise program or increasing the frequency and intensity of their current program.

PREPARTICIPATION HEALTH SCREENING

Preparticipation health screening before initiating physical activity or an exercise program is a multistage process that may include

1. Self-guided methods such as the Physical Activity Readiness Questionnaire (PAR-Q) (8) (see *Figure 2.1*) or the modified AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire (4) (see *Figure 2.2*);
2. CVD risk factor assessment and classification by qualified health/fitness, clinical exercise, or health care professionals; and
3. Medical evaluation including a physical examination and stress test by a qualified health care provider.

Preparticipation health screening before initiating an exercise program should be distinguished from a periodic medical examination (24). A periodic health examination or a similar contact with a health care provider should be encouraged as part of routine health maintenance and to detect medical conditions unrelated to exercise.

SELF-GUIDED METHODS

Preparticipation health screening by self-reported medical history or health risk appraisal should be done for all individuals wishing to initiate a physical activity program. These self-guided methods can be easily accomplished by using such instruments as the PAR-Q (8) (see *Figure 2.1*) or an adaptation of the AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire (4) (see *Figure 2.2*). Patients with cardiac symptoms often perceive chest discomfort rather than pain. The AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire may be more useful in these situations because it inquires about "chest discomfort" rather than "chest pain" as does the PAR-Q.

ATHEROSCLEROTIC CARDIOVASCULAR DISEASE RISK FACTOR ASSESSMENT

ACSM risk classification as delineated in *Figure 2.3* is based in part on the presence or absence of the CVD risk factors listed in *Table 2.2* (5,9,12,21,22,26,30,31). The completed PAR-Q or AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire should be reviewed by a qualified health/fitness, clinical exercise, or health care professional to determine if the individual meets any of the criteria for positive CVD risk factors shown in *Table 2.2*. If the presence or absence

Physical Activity Readiness Questionnaire - PAR-Q (revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO		
☐	☐	1.	**Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
☐	☐	2.	**Do you feel pain in your chest when you do physical activity?**
☐	☐	3.	**In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	4.	**Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	5.	**Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	6.	**Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	7.	**Do you know of any other reason why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____

SIGNATURE _____ DATE _____

SIGNATURE OF PARENT or GUARDIAN (for participants under the age of majority) _____ WITNESS _____

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

Supported by: Health Canada Santé Canada

continued on other side...

FIGURE 2.1. Physical Activity Readiness Questionnaire (PAR-Q) form. Reprinted from (8), with permission from the Canadian Society for Exercise Physiology, http://www.csep.ca. © 2002.

Assess your health status by marking all *true* statements

History
You have had:
____ a heart attack
____ heart surgery
____ cardiac catheterization
____ coronary angioplasty (PTCA)
____ pacemaker/implantable cardiac defibrillator/rhythm disturbance
____ heart valve disease
____ heart failure
____ heart transplantation
____ congenital heart disease

Symptoms
____ You experience chest discomfort with exertion
____ You experience unreasonable breathlessness
____ You experience dizziness, fainting, or blackouts
____ You experience ankle swelling
____ You experience unpleasant awareness of a forceful or rapid heart rate
____ You take heart medications

Other health issues
____ You have diabetes
____ You have asthma or other lung disease
____ You have burning or cramping sensation in your lower legs when walking short distance
____ You have musculoskeletal problems that limit your physical activity
____ You have concerns about the safety of exercise
____ You take prescription medications
____ You are pregnant

If you marked any of these statements in this section, consult your physician or other appropriate health care provider before engaging in exercise. You may need to use a facility with a ***medically qualified staff****.*

Cardiovascular risk factors
____ You are a man ≥45 yr
____ You are a woman ≥55 yr
____ You smoke or quit smoking within the previous 6 mo
____ Your blood pressure is ≥140/90 mm Hg
____ You do not know your blood pressure
____ You take blood pressure medication
____ Your blood cholesterol level is ≥200 mg · dL^{-1}
____ You do not know your cholesterol level
____ You have a close blood relative who had a heart attack or heart surgery before age 55 (father or brother) or age 65 (mother or sister)
____ You are physically inactive (*i.e.*, you get <30 min of physical activity on at least 3 d per week)
____ You have a body mass index ≥30 kg · m^{-2}
____ You have prediabetes
____ You do not know if you have prediabetes

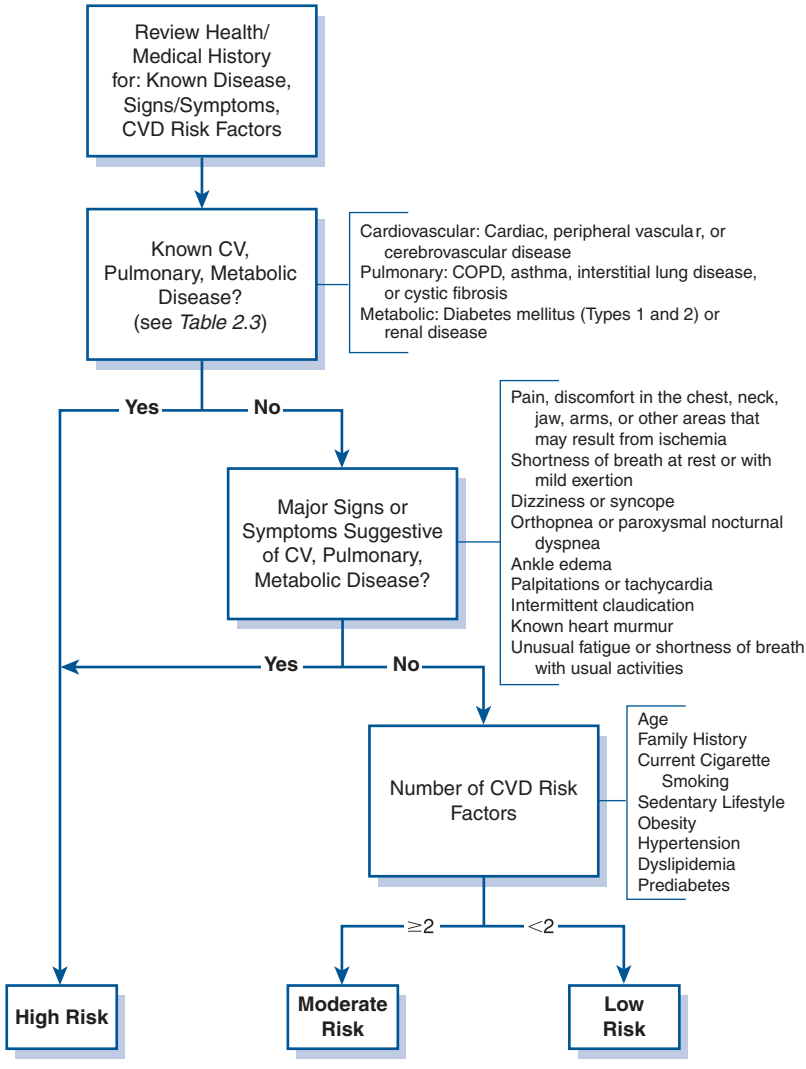
If you marked two or more of the statements in this section you should consult your physician or other appropriate health care as part of good medical care and progress gradually with your exercise program. You might benefit from using a facility with a ***professionally qualified exercise staff***[a] *to guide your exercise program.*

____ None of the above

You should be able to exercise safely without consulting your physician or other appropriate health care provider in a self-guide program or almost any facility that meets your exercise program needs.

[a]Professionally qualified exercise staff refers to appropriately trained individuals who possess academic training, practical and clinical knowledge, skills, and abilities commensurate with the credentials defined in *Appendix D*.

■ **FIGURE 2.2.** AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire. Individuals with multiple CVD risk factors (see *Table 2.2*) should be encouraged to consult with their physician prior to initiating a vigorous intensity exercise program as part of good medical care and should progress gradually with their exercise program of any exercise intensity. ACSM, American College of Sports Medicine; AHA, American Heart Association; CVD, cardiovascular disease, PTCA, percutaneous transluminal coronary angioplasty. Modified from (4).



■ **FIGURE 2.3.** Logic model for classification of risk. CV, cardiovascular; CVD, cardiovascular disease.

of a CVD risk factor is not disclosed or is not available, that CVD risk factor should be counted as a risk factor except for prediabetes. If the prediabetes criteria are missing or unknown, prediabetes should be counted as a risk factor for those (a) ≥45 yr, especially for those with a body mass index (BMI) ≥25 kg · m^{-2}; and (b) <45 yr with a BMI ≥25 kg · m^{-2} and additional CVD risk factors for prediabetes (*e.g.*, family history of diabetes mellitus). The number of positive risk factors is

TABLE 2.2. Atherosclerotic Cardiovascular Disease (CVD) Risk Factors and Defining Criteria (26,31)

Risk Factors	Defining Criteria
Age	Men ≥45 yr; women ≥55 yr (12)
Family history	Myocardial infarction, coronary revascularization, or sudden death before 55 yr in father or other male first-degree relative or before 65 yr in mother or other female first-degree relative
Cigarette smoking	Current cigarette smoker or those who quit within the previous 6 mo or exposure to environmental tobacco smoke
Sedentary lifestyle	Not participating in at least 30 min of moderate intensity, physical activity (40%–<60% $\dot{V}O_2R$) on at least 3 d of the week for at least 3 mo (22,30)
Obesity	Body mass index ≥30 kg · m^{-2} *or* waist girth >102 cm (40 in) for men and >88 cm (35 in) for women (10)
Hypertension	Systolic blood pressure ≥140 mm Hg and/or diastolic ≥90 mm Hg, confirmed by measurements on at least two separate occasions, *or* on antihypertensive medication (9)
Dyslipidemia	Low-density lipoprotein (LDL) cholesterol ≥130 mg · dL^{-1} (3.37 mmol · L^{-1}) *or* high-density lipoprotein[b] (HDL) cholesterol <40 mg · dL^{-1} (1.04 mmol · L^{-1}) *or* on lipid-lowering medication. If total serum cholesterol is all that is available, use ≥200 mg · dL^{-1} (5.18 mmol · L^{-1}) (21)
Prediabetes[a]	Impaired fasting glucose (IFG) = fasting plasma glucose ≥100 mg · dL^{-1} (5.55 mmol · L^{-1}) and ≤125 mg · dL^{-1} (6.94 mmol · L^{-1}) *or* impaired glucose tolerance (IGT) = 2 h values in oral glucose tolerance test (OGTT) ≥140 mg · dL^{-1} (7.77 mmol · L^{-1}) and ≤199 mg · dL^{-1} (11.04 mmol · L^{-1}) confirmed by measurements on at least two separate occasions (5)
Negative Risk Factors	**Defining Criteria**
High-density lipoprotein (HDL) cholesterol	≥60 mg · dL^{-1} (1.55 mmol · L^{-1})

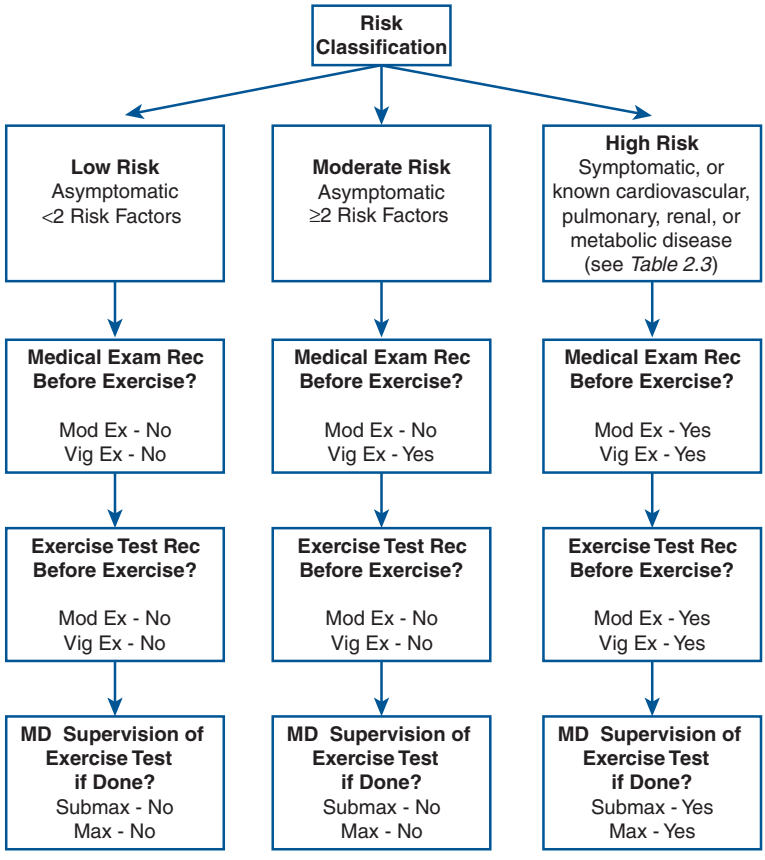
[a]If the presence or absence of a CVD risk factor is not disclosed or is not available, that CVD risk factor should be counted as a risk factor except for prediabetes. If the prediabetes criteria are missing or unknown, prediabetes should be counted as a risk factor for those ≥45 yr, especially for those with a body mass index (BMI) ≥25 kg · m^{-2}, and those <45 yr with a BMI ≥25 kg · m^{-2} and additional CVD risk factors for prediabetes. The number of positive risk factors is then summed.

[b]High HDL is considered a negative risk factor. For individuals having high HDL ≥60 mg · dL^{-1} (1.55 mmol · L^{-1}), for these individuals one positive risk factor is subtracted from the sum of positive risk factors.

$\dot{V}O_2R$, oxygen uptake reserve.

then summed. Because of the cardioprotective effect of high-density lipoprotein cholesterol (HDL), HDL is considered a negative CVD risk factor. For individuals having HDL ≥60 mg · dL^{-1} (1.55 mmol · L^{-1}), one positive CVD risk factor is subtracted from the sum of positive CVD risk factors.

CVD risk factor assessment provides the health/fitness, clinical exercise, and health care professionals with important information for the development of a client or patient's Ex R_x. CVD risk factor assessment in combination with the determination of the presence of various cardiovascular, pulmonary, renal, and metabolic diseases is important when making decisions about (a) the level of medical clearance; (b) the need for exercise testing; and (c) the level of supervision for exercise testing and exercise program participation (see *Figures 2.3* and *2.4*). Please refer to the case studies in *Box 2.1* that provide a framework for conducting CVD risk factor assessment and classification.



Mod Ex: Moderate intensity exercise; 40%–<60% $\dot{V}O_2R$; 3–<6 METs
"An intensity that causes noticeable increases in HR and breathing."

Vig Ex: Vigorous intensity exercise; ≥60% $\dot{V}O_2R$; ≥6 METs
"An intensity that causes substantial increases in HR and breathing."

Not Rec: Reflects the notion a medical examination, exercise test, and physician supervision of exercise testing are not recommended in the preparticipation screening; however, they may be considered when there are concerns about risk, more information is needed for the Ex R_x, and/or are requested by the patient or client.

Rec: Reflects the notion a medical examination, exercise test, and physician supervision are recommended in the preparticipation health screening process.

■ **FIGURE 2.4.** Medical examination, exercise testing, and supervision of exercise testing preparticipation recommendations based on classification of risk. Ex R_x, exercise prescription; HR, heart rate; METs, metabolic equivalents; $\dot{V}O_2R$, oxygen uptake reserve.

BOX 2.1 Case Studies to Conduct Cardiovascular Disease (CVD) Risk Factor Assessment and Determine Risk Classification

CASE STUDY I

Female, age 21 yr, smokes socially on weekends (~10–20 cigarettes). Drinks alcohol one or two nights a week, usually on weekends. Height = 63 in (160 cm), weight = 124 lb (56.4 kg), BMI = 22.0 kg · m^{-2}. RHR = 76 beats · min^{-1}, resting BP = 118/72 mm Hg. Total cholesterol = 178 mg · dL^{-1} (4.61 mmol · L^{-1}), LDL = 98 mg · dL^{-1} (2.54 mmol · L^{-1}), HDL = 57 mg · dL^{-1} (1.48 mmol · L^{-1}), FBG unknown. Currently taking oral contraceptives. Attends group exercise class two to three times a week. Reports no symptoms. Both parents living and in good health.

CASE STUDY II

Man, age 54 yr, nonsmoker. Height = 72 in (182.9 cm), weight = 168 lb (76.4 kg), BMI = 22.8 kg · m^{-2}. RHR = 64 beats · min^{-1}, resting BP = 124/78 mm Hg. Total cholesterol = 187 mg · dL^{-1} (4.84 mmol · L^{-1}), LDL = 103 mg · L^{-1} (2.67 mmol · L^{-1}), HDL = 52 mg · dL^{-1} (1.35 mmol · L^{-1}), FBG = 88 mg · dL^{-1} (4.84 mmol · L^{-1}). Recreationally competitive runner, runs 4–7 d · wk^{-1}, completes one to two marathons and numerous other road races every year. No medications other than over-the-counter ibuprofen as needed. Reports no symptoms. Father died at age 77 yr of a heart attack, mother died at age 81 yr of cancer.

CASE STUDY III

Man, age 44 yr, nonsmoker. Height = 70 in (177.8 cm), weight = 216 lb (98.2 kg), BMI = 31.0 kg · m^{-2}. RHR = 62 beats · min^{-1}, resting BP = 128/84 mm Hg. Total serum cholesterol = 184 mg · dL^{-1} (4.77 mmol · L^{-1}), LDL = 106 mg · dL^{-1} (2.75 mmol · L^{-1}), HDL = 44 mg · dL^{-1} (1.14 mmol · L^{-1}), FBG unknown. Walks 2–3 mi two to three times a week. Father had Type 2 diabetes and died at age 67 yr of a heart attack; mother living, no CVD. No medications; reports no symptoms.

CASE STUDY IV

Women, age 36 yr, nonsmoker. Height = 64 in (162.6 cm), weight = 108 lb (49.1 kg), BMI = 18.5 kg · m^{-2}. RHR = 61 beats · min^{-1}, resting BP = 114/62 mm Hg. Total cholesterol = 174 mg · dL^{-1} (4.51 mmol · L^{-1}), blood glucose normal with insulin injections. Type 1 diabetes diagnosed at age 7 yr. Teaches dance aerobic classes three times a week, walks approximately 45 min four times a week. Reports no symptoms. Both parents in good health with no history of CVD.

(continued)

BOX 2.1 Case Studies to Conduct Cardiovascular Disease (CVD) Risk Factor Assessment and Determine Risk Classification (*Continued*)

	Case Study I	Case Study II	Case Study III	Case Study IV
Known cardiovascular, pulmonary, and/or metabolic disease?	No	No	No	Yes — diagnosed Type 1 diabetes
Major signs or symptoms?	No	No	No	Yes
CVD risk factors:				
Age?	No	Yes	No	No
Family history?	No	No	No	No
Current cigarette smoking?	Yes	No	No	No
Sedentary lifestyle?	No	No	No	No
Obesity?	No	No	Yes — BMI >30 kg • m^{-2}	No
Hypertension?	No	No	No	No
Hypercholesterolemia?	No	No	No	No
Prediabetes?	Unknown — count as No in absence of age or obesity as risk factors	No	Unknown — count as Yes in presence of obesity	Diagnosed Type 1 diabetes
Summary	No known disease, no major signs or symptoms, one CVD risk factor	No known disease, no major signs or symptoms, one CVD risk factor	No known disease, no major signs or symptoms, two CVD risk factors	Diagnosed metabolic disease with major signs and symptoms
At low, moderate, or high risk?[a]	Low	Low	Moderate	High

[a]See *Figure 2.4* for medical examination, exercise testing, and supervision of exercise testing preparticipation recommendations based on classification of risk.

BMI, body mass index; BP, blood pressure; CVD, cardiovascular disease; FBG, fasting blood glucose; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; RHR, resting heart rate.

All individuals wanting to initiate a physical activity program should be screened at minimum by a self-reported medical history or health risk appraisal questionnaire such as the PAR-Q (8) (see *Figure 2.1*) or the modified AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire (4) (see *Figure 2.2*) for the presence of risk factors for various cardiovascular, pulmonary, renal, and metabolic diseases as well as other conditions (*e.g.*, pregnancy, orthopedic

injury) that require special attention when developing the Ex R_x (14,17,18). The answers to the self-guided methods of the preparticipation health screening process then determine the need for and degree of follow-up by a qualified health/fitness, clinical exercise, or health care provider before initiating physical activity or an exercise program. The ACSM recommendations regarding the need for and degree of follow-up are detailed in the following sections.

RECOMMENDATIONS FOR A MEDICAL EXAMINATION PRIOR TO INITIATING PHYSICAL ACTIVITY

The risk of an exercise-related event such as sudden cardiac death (27) or acute MI (13,19,27) is greatest in those individuals performing unaccustomed physical activity and is greatest during vigorous intensity, physical activity. However, the CVD risk of light-to-moderate intensity, physical activity approximates that at rest (33). Consequently, physically unfit individuals initiating a physical activity program should start with light-to-moderate intensity levels of exercise and progress gradually as their fitness improves. Moderate intensity in most studies of exercise-related CVD events is defined as activity requiring 3 to <6 metabolic equivalents (METs), but the relative intensity of any specific activity varies with the fitness and age of the subject. Moderate intensity, physical activity can also be defined as that requiring 40% to <60% oxygen uptake reserve ($\dot{V}O_2R$). This physical exertion level can be estimated without exercise testing and direct measurement of maximal oxygen consumption ($\dot{V}O_{2max}$) by instructing subjects to use a rating of perceived exertion scale (see *Chapter 7*) or by exercising to the point of developing moderate shortness of breath or dyspnea but still able to talk comfortably (6,23).

The present ACSM recommendations (see *Box 2.2*) are based on the observations that the absolute risk of an exercise-related CVD event is low especially for

BOX 2.2 Recommendations for a Medical Examination Prior to Initiating Physical Activity

- Individuals at moderate risk with two or more CVD risk factors (see *Table 2.2* and *Figure 2.3*) should be encouraged to consult with their physician prior to initiating a vigorous intensity exercise program as part of good medical care and should progress gradually with their exercise program of any exercise intensity (see *Figure 2.4*). Although medical evaluation is taking place for the initiation of vigorous intensity exercise, the majority of these individuals can begin light-to-moderate intensity exercise programs such as walking without consulting a physician.
- Individuals at high risk with symptoms or diagnosed disease (see *Table 2.1*) should consult with their physician prior to initiating an exercise program (see *Figure 2.4*).

CVD, cardiovascular disease.

individuals willing to initiate light-to-moderate intensity exercise and to progress gradually. The exceptions to these observations are individuals with diagnosed disease, with unstable symptoms, or at extremely high risk for occult disease (see *Table 2.1*).

RECOMMENDATIONS FOR EXERCISE TESTING PRIOR TO INITIATING PHYSICAL ACTIVITY

See *Table 2.3* for recommendations for exercise testing prior to initiating physical activity.

No set of guidelines for exercise testing prior to initiation of physical activity covers all situations. Local circumstances and policies vary, and specific program procedures are also properly diverse. To provide guidance on the need for a medical examination and exercise test before participation in a moderate-to-vigorous intensity exercise program, ACSM suggests the recommendations presented in *Figure 2.4* for determining when a medical examination and exercise test are appropriate and when physician supervision of exercise testing is recommended.

Exercise testing before initiating a physical activity program is not routinely recommended except for individuals at high risk as defined earlier (see *Tables 2.1* and *2.3*). Nevertheless, the information gathered from an exercise test may be useful in establishing a safe and effective Ex R_x for lower risk individuals. Recommending an exercise test for lower risk individuals may be considered if the purpose of the test is to design an effective Ex R_x. The exercise testing recommendations found in *Figure 2.4* reflect the notion that the risk of cardiovascular events increases as a direct function of exercise intensity (*i.e.*, vigorous > moderate > light intensity exercise) and the number of CVD risk factors (see *Table 2.2*

TABLE 2.3. New ACSM Recommendations for Exercise Testing Prior to Exercise-Diagnosed Cardiovascular Disease

Unstable or new or possible symptoms of cardiovascular disease (see *Table 2.2*)
Diabetes mellitus and at least one of the following:
Age >35 yr OR
Type 2 diabetes mellitus >10-yr duration OR
Type 1 diabetes mellitus >15-yr duration OR
Hypercholesterolemia (total cholesterol ≥240 mg · L^{-1}) (6.62 mmol · L^{-1}) OR
Hypertension (systolic blood pressure ≥140 or diastolic ≥90 mm Hg) OR
Smoking OR
Family history of CAD in first-degree relative <60 yr OR
Presence of microvascular disease OR
Peripheral artery disease OR
Autonomic neuropathy
End-stage renal disease
Patients with symptomatic or diagnosed pulmonary disease including chronic obstructive pulmonary disease (COPD), asthma, interstitial lung disease, or cystic fibrosis.

ACSM, American College of Sports Medicine; CAD, coronary artery disease.

and *Figure 2.3*). Although *Figure 2.4* provides both absolute (METs) and relative ($\%\dot{V}O_{2max}$) thresholds for moderate and vigorous intensity exercise, health/fitness and clinical exercise professionals should choose the most appropriate absolute or relative intensity threshold for their setting and population when making decisions about the level of preparticipation health screening needed before initiating an exercise program.

RECOMMENDATIONS FOR SUPERVISION OF EXERCISE TESTING

The degree of medical supervision of exercise testing varies appropriately from physician-supervised tests to situations in which there is no physician present (11). It is important to distinguish between patients who require an exercise test before exercise participation and patients who require a physician to supervise the exercise test. Exercise tests as part of the preparticipation health screening for individuals at moderate to high risk are often maximal tests done in those without prior exercise training. Both factors probably increase the risk of a cardiac event. Furthermore, there are legal implications for the testing facility if a complication occurs during testing and the testing is not physician or professionally supervised.

There is consensus that exercise testing of all patient risk groups can be supervised by nonphysician health care professionals if the professional is specially trained in clinical exercise testing and a physician is immediately available if needed (20). There is also general agreement that such testing in patients at low risk can be supervised by nonphysicians without a physician being immediately available. There is no consensus whether or not nonphysicians should supervise exercise testing in patients at moderate risk without a physician immediately available. Having a physician available for testing of patients at moderate risk is recommended, but whether or not a physician must be immediately available for exercise testing of patients at moderate risk will depend on local policies and circumstances, the health status of the patients, and the training and experience of the laboratory staff. See *Box 2.3* for a summary of these recommendations.

BOX 2.3 Recommendations for Supervision of Exercise Testing

Exercise testing of individuals at high risk can be supervised by nonphysician health care professionals if the professional is specially trained in clinical exercise testing with a physician immediately available if needed. Exercise testing of individuals at moderate risk can be supervised by nonphysician health care professionals if the professional is specially trained in clinical exercise testing, but whether or not a physician must be immediately available for exercise testing is dependent on local policies and circumstances, the health status of the patients, and the training and experience of the laboratory staff.

Physicians responsible for supervising exercise testing should meet or exceed the minimal competencies for supervision and interpretation of results as established by the AHA (25). In all situations in which exercise testing is performed, site personnel should at least be certified at a level of basic life support (cardiopulmonary resuscitation [CPR]) and have automated external defibrillator (AED) training. Preferably, one or more staff members should also be certified in first aid and advanced cardiac life support (ACLS) (15). All exercise testing facilities with or without physician supervision (a) should also have a written medical emergency response plan with procedures and contact numbers; (b) should practice this plan at least quarterly; and (c) be equipped with a defibrillator or an AED depending on staffing competencies (20).

RISK STRATIFICATION FOR PATIENTS WITH CARDIOVASCULAR DISEASE

Patients with CVD may be further stratified regarding safety during exercise using published guidelines (2). Risk stratification criteria from the AACVPR are presented in *Box 2.4* (2).

BOX 2.4 **American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) Risk Stratification Criteria for Patients with Cardiovascular Disease**

LOWEST RISK

Characteristics of patients at lowest risk for exercise participation (all characteristics listed must be present for patients to remain at lowest risk)

- Absence of complex ventricular dysrhythmias during exercise testing and recovery
- Absence of angina or other significant symptoms (*e.g.*, unusual shortness of breath, light-headedness, or dizziness, during exercise testing and recovery)
- Presence of normal hemodynamics during exercise testing and recovery (*i.e.*, appropriate increases and decreases in heart rate and systolic blood pressure with increasing workloads and recovery)
- Functional capacity ≥7 metabolic equivalents (METs)

Nonexercise Testing Findings

- Resting ejection fraction ≥50%
- Uncomplicated myocardial infarction or revascularization procedure
- Absence of complicated ventricular dysrhythmias at rest
- Absence of congestive heart failure
- Absence of signs or symptoms of postevent/postprocedure ischemia
- Absence of clinical depression

BOX 2.4 **American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) Risk Stratification Criteria for Patients with Cardiovascular Disease (*Continued*)**

MODERATE RISK

Characteristics of patients at moderate risk for exercise participation (any one or combination of these findings places a patient at moderate risk)

- Presence of angina or other significant symptoms (*e.g.*, unusual shortness of breath, light-headedness, or dizziness occurring only at high levels of exertion [≥7 METs])
- Mild to moderate level of silent ischemia during exercise testing or recovery (ST-segment depression <2 mm from baseline)
- Functional capacity <5 METs

Nonexercise Testing Findings

- Rest ejection fraction 40% to 49%

HIGHEST RISK

Characteristics of patients at high risk for exercise participation (any one or combination of these findings places a patient at high risk)

- Presence of complex ventricular dysrhythmias during exercise testing or recovery
- Presence of angina or other significant symptoms (*e.g.*, unusual shortness of breath, light-headedness, or dizziness at low levels of exertion [<5 METs] or during recovery)
- High level of silent ischemia (ST-segment depression ≥2 mm from baseline) during exercise testing or recovery
- Presence of abnormal hemodynamics with exercise testing (*i.e.*, chronotropic incompetence or flat or decreasing systolic BP with increasing workloads) or recovery (*i.e.*, severe postexercise hypotension)

Nonexercise Testing Findings

- Rest ejection fraction <40%
- History of cardiac arrest or sudden death
- Complex dysrhythmias at rest
- Complicated myocardial infarction or revascularization procedure
- Presence of congestive heart failure
- Presence of signs or symptoms of postevent/postprocedure ischemia
- Presence of clinical depression

Reprinted from (32), with permission from Elsevier.

The AACVPR guidelines provide recommendations for participant and/or patient monitoring and supervision and for activity restriction. Clinical exercise professionals should recognize the AACVPR guidelines do not consider comorbidities (*e.g.*, Type 2 diabetes mellitus, morbid obesity, severe pulmonary disease, debilitating neurologic, orthopedic conditions) that could result in modification of the recommendations for monitoring and supervision during exercise training.

THE BOTTOM LINE

The ACSM Preparticipation Health Screening Recommendations are the following:

- All individuals wishing to initiate a physical activity program should be screened at minimum by a self-reported medical history or health risk appraisal questionnaire. The need and degree of follow-up is determined by the answers to these self-guided methods.
- Individuals at moderate risk with two or more CVD risk factors (see *Table 2.2* and *Figures 2.3* and *2.4*) should be encouraged to consult with their physician prior to initiating a vigorous intensity, physical activity program. Although medical evaluation is taking place, the majority of these individuals can begin light-to-moderate intensity exercise programs such as walking without consulting their physician.
- Individuals at high risk with symptoms or diagnosed disease (see *Table 2.1*) should consult with their physician prior to initiating a physical activity program (see *Figure 2.4*).
- Routine exercise testing is recommended only for individuals at high risk (see *Table 2.3* and *Figures 2.3* and *2.4*) including those with diagnosed CVD, symptoms suggestive of new or changing CVD, diabetes mellitus, and additional CVD risk factors, end-stage renal disease, and specified lung disease.
- Exercise testing of individuals at high risk can be supervised by nonphysician health care professionals if the professional is specially trained in clinical exercise testing with a physician immediately available if needed. Exercise testing of individuals at moderate risk can be supervised by nonphysician health care professionals if the professional is specially trained in clinical exercise testing, but whether or not a physician must be immediately available for exercise testing is dependent on a variety of considerations.

These recommendations are made to reduce barriers to the adoption of a physically active lifestyle because (a) much of the risk associated with exercise can be mitigated by adopting a progressive exercise training regimen; and (b) there is an overall low risk of participation in physical activity programs (24).

Online Resources

ACSM Exe*R*xcise is Medicine:
http://exerciseismedicine.org

2008 Physical Activity Guidelines for Americans (1):
http://www.health.gov/PAguidelines

REFERENCES

1. *2008 Physical Activity Guidelines for Americans* [Internet]. Rockville (MD): Office of Disease Prevention & Health Promotion, U.S. Department of Health and Human Services; 2008 [cited 2010 Sep 22]. 76 p. Available from: http://www.health.gov/paguidelines
2. American Association of Cardiovascular and Pulmonary Rehabilitation. *Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs*. 4th ed. Champaign (IL): Human Kinetics; 2004. 280 p.
3. American Association of Cardiovascular and Pulmonary Rehabilitation. *Guidelines for Pulmonary Rehabilitation Programs*. 3rd ed. Champaign (IL): Human Kinetics; 2004. 188 p.
4. American College of Sports Medicine Position Stand, American Heart Association. Recommendations for cardiovascular screening, staffing, and emergency policies at health/fitness facilities. *Med Sci Sports Exerc*. 1998;30(6):1009–18.
5. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2007;30 Suppl 1:S42–7.
6. Brawner CA, Vanzant MA, Ehrman JK, et al. Guiding exercise using the talk test among patients with coronary artery disease. *J Cardiopulm Rehabil*. 2006;26(2):72–5; quiz 76–7.
7. Buchner DM. Physical activity to prevent or reverse disability in sedentary older adults. *Am J Prev Med*. 2003;25(3 Suppl 2):214–5.
8. *Canada's Physical Activity Guide to Healthy Active Living* [Internet]. Ontario (Canada): Public Health Agency of Canada; [cited 2007 Jun 15]. Available from: http://www.phac-aspc.gc.ca/pau-uap/paguide/index.html
9. Chobanian AV, Bakris GL, Black HR, et al. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA*. 2003;289(19):2560–72.
10. Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. *Arch Intern Med*. 1998;158(17):1855–67.
11. Fletcher GF, Balady GJ, Amsterdam EA, et al. Exercise standards for testing and training: a statement for healthcare professionals from the American Heart Association. *Circulation*. 2001; 104(14):1694–740.
12. Gibbons RJ, Balady GJ, Bricker JT, et al. ACC/AHA 2002 guideline update for exercise testing: summary article. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1997 Exercise Testing Guidelines). *J Am Coll Cardiol*. 2002;40(8):1531–40.
13. Giri S, Thompson PD, Kiernan FJ, et al. Clinical and angiographic characteristics of exertion-related acute myocardial infarction. *JAMA*. 1999;282(18):1731–6.
14. Gordon SMBS. Health appraisal in the non-medical setting. In: Durstine JL, editor. *ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*. 2nd ed. Philadelphia: Williams & Wilkins; 1993. p. 219–28.
15. Kern KB, Halperin HR, Field J. New guidelines for cardiopulmonary resuscitation and emergency cardiac care: changes in the management of cardiac arrest. *JAMA*. 2001;285(10):1267–9.
16. Lahav D, Leshno M, Brezis M. Is an exercise tolerance test indicated before beginning regular exercise? A decision analysis. *J Gen Intern Med*. 2009;24(8):934–8.
17. Maron BJ, Araujo CG, Thompson PD, et al. Recommendations for preparticipation screening and the assessment of cardiovascular disease in masters athletes: an advisory for healthcare professionals from the working groups of the World Heart Federation, the International Federation of Sports Medicine, and the American Heart Association Committee on Exercise, Cardiac Rehabilitation, and Prevention. *Circulation*. 2001;103(2):327–34.

18. Maron BJ, Thompson PD, Puffer JC, et al. Cardiovascular preparticipation screening of competitive athletes. A statement for health professionals from the Sudden Death Committee (clinical cardiology) and Congenital Cardiac Defects Committee (cardiovascular disease in the young), American Heart Association. *Circulation*. 1996;94(4):850–6.
19. Mittleman MA, Maclure M, Tofler GH, et al. Triggering of acute myocardial infarction by heavy physical exertion. Protection against triggering by regular exertion. Determinants of Myocardial Infarction Onset Study Investigators. *N Engl J Med*. 1993;329(23):1677–83.
20. Myers J, Arena R, Franklin B, et al. Recommendations for clinical exercise laboratories: a scientific statement from the American Heart Association. *Circulation*. 2009;119(24):3144–61.
21. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation*. 2002;106(25):3143–421.
22. Pate RR, Pratt M, Blair SN, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA*. 1995;273(5):402–7.
23. Persinger R, Foster C, Gibson M, Fater DC, Porcari JP. Consistency of the talk test for exercise prescription. *Med Sci Sports Exerc*. 2004;36(9):1632–6.
24. *Physical Activity Guidelines Advisory Committee Report, 2008* [Internet]. Washington (DC): U.S. Department of Health and Human Services; 2008 [cited 2011 Jan 6]. 683 p. Available from: http://www.health.gov/paguidelines/Report/pdf/CommitteeReport.pdf
25. Rodgers GP, Ayanian JZ, Balady G, et al. American College of Cardiology/American Heart Association clinical competence statement on stress testing. A report of the American College of Cardiology/American Heart Association/American College of Physicians-American Society of Internal Medicine Task Force on Clinical Competence. *Circulation*. 2000;102(14):1726–38.
26. Roger VL, Go AS, Lloyd-Jones DM, et al. Heart Disease and Stroke Statistics—2012 Update: a report from the American Heart Association. *Circulation*. 2012;125(1):e2–220.
27. Siscovick DS, Weiss NS, Fletcher RH, Lasky T. The incidence of primary cardiac arrest during vigorous exercise. *N Engl J Med*. 1984;311(14):874–7.
28. Thompson PD, Buchner D, Pina IL, et al. Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: a statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity). *Circulation*. 2003;107(24):3109–16.
29. Thompson PD, Franklin BA, Balady GJ, et al. Exercise and acute cardiovascular events placing the risks into perspective: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism and the Council on Clinical Cardiology. *Circulation*. 2007;115(17):2358–68.
30. U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, CDC, National Center for Chronic Disease Prevention and Health Promotion; 1996. 278 p.
31. U.S. Preventive Services Task Force. Screening for coronary heart disease: recommendation statement. *Ann Intern Med*. 2004;140(7):569–72.
32. Williams MA. Exercise testing in cardiac rehabilitation. Exercise prescription and beyond. *Cardiol Clin*. 2001;19(3):415–31.
33. Willich SN, Lewis M, Lowel H, Arntz HR, Schubert F, Schroder R. Physical exertion as a trigger of acute myocardial infarction. Triggers and Mechanisms of Myocardial Infarction Study Group. *N Engl J Med*. 1993;329(23):1684–90.