

**Section 01:
Health-Related Physical Fitness Defined
Risks and Benefits Associated with
Physical Activity**

**ACSM Guidelines: Chapter 1 - Benefits and Risks
Associated with Physical Activity**

ACSM Manual: Chapter 1 – Introduction (pp. 1-6)

**HPER 4450
Dr. Cheatham**



 **Definitions**

- **Physical Activity (PA):**
 - Bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure
- **Exercise:**
 - A type of physical activity that is defined as planned, structured, and repetitive bodily movement done to improve or maintain on or more components of physical fitness



Definitions (cont'd)

- **Physical Fitness (PF):**

- A multidimensional concept that has been defined as a set of attributes that people possess or achieve that relates to the ability to perform physical activity

- Comprised of health-related, skill related, and physiologic components

TABLE 1.1. DEFINITIONS OF PHYSICAL FITNESS	
SOURCE	DEFINITION
Getchell (3)	Physical fitness is the capability of the heart, blood vessels, lungs, and muscles to perform at optimal efficiency.
Howley & Franks (5)	Fitness is the capacity to achieve the optimal quality of life.
Miller et al. (6)	General physical fitness is a state of ability to perform sustained physical work characterized by an effective integration of cardiorespiratory endurance, strength, flexibility, coordination, and body composition.
President's Council on Physical Fitness and Sports (8)	Physical fitness is the ability to carry out daily tasks with vigor and alertness without undue fatigue and ample energy to enjoy leisure-time pursuits and meet unforeseen emergencies.

Copyright © 2010 American College of Sports Medicine



Physical Activity vs. Physical Fitness

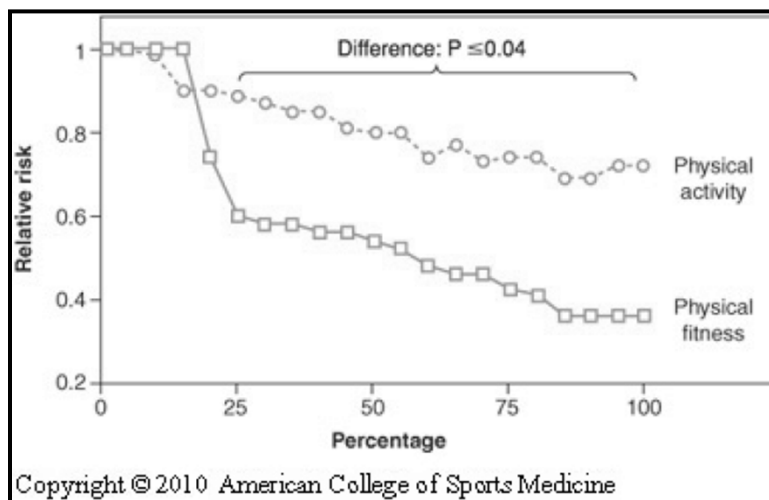


Figure 1.1, ACSM Guidelines, P. 6



Health-Related PF

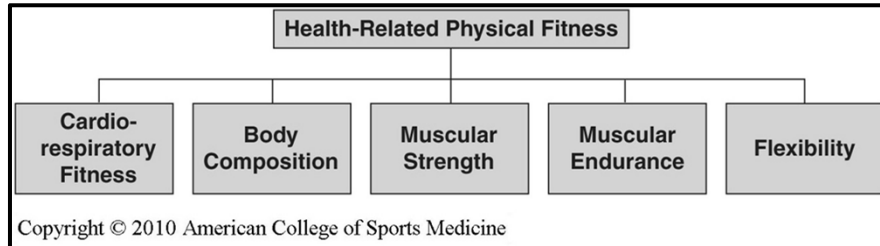


Figure 1-1, ACSM Manual, P. 3



Health-Related PF

- **Cardiorespiratory Fitness/CV Endurance**
 - The ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity
 - Primarily Assessed Variable: Maximal Oxygen Consumption (VO_{2max})
 - Major Physiological Systems:
 - Respiratory/Pulmonary (Oxygenate Blood)
 - Cardiovascular (Deliver O_2 rich blood)
 - Skeletal Muscle (Utilize O_2)



Health-Related PF

- **Body Composition**

- The relative amounts of muscle, fat, bone, and other vital parts of the body
- Also includes general variables to assess level of obesity
- Primarily Assessed Variables:
 - % body fat, body mass index, waist-to-hip ratio

- **Flexibility**

- The range of motion available at a joint
- Joint specific



Health-Related PF

- **Muscular Strength**

- The ability of muscle to exert force
- Primarily Assessed Variable: 1-RM

- **Muscular Endurance**

- The ability of muscle to continue to perform without fatigue.



Health-Related vs. Skill-Related PF

BOX 1.1

Health-Related and Skill-Related Physical Fitness Components

HEALTH-RELATED PHYSICAL FITNESS COMPONENTS

- Cardiovascular endurance: The ability of the circulatory and respiratory system to supply oxygen during sustained physical activity.
- Body composition: The relative amounts of muscle, fat, bone, and other vital parts of the body.
- Muscular strength: The ability of muscle to exert force.
- Muscular endurance: The ability of muscle to continue to perform without fatigue.
- Flexibility: The range of motion available at a joint.

Adapted from U.S. Department of Health and Human Services. *Physical activity and health: a Report of the Surgeon General*. Atlanta, GA: Centers for Disease Control and Prevention; 1996. President's Council on Physical Fitness. Definitions: health, fitness, and physical activity. [Internet]. 2000. Available from http://www.fitness.gov/digest_mar2000.htm

Copyright © 2010 American College of Sports Medicine

Box 1.1, ACSM Guidelines, P. 3



Health-Related vs. Skill-Related PF

BOX 1.1

Health-Related and Skill-Related Physical Fitness Components

SKILL-RELATED PHYSICAL FITNESS COMPONENTS

- Agility: The ability to change the position of the body in space with speed and accuracy.
- Coordination: The ability to use the senses, such as sight and hearing, together with body parts in performing tasks smoothly and accurately.
- Balance: The maintenance of equilibrium while stationary or moving.
- Power: The ability or rate at which one can perform work.
- Reaction time: The time elapsed between stimulation and the beginning of the reaction to it.
- Speed: The ability to perform a movement within a short period of time.

Adapted from U.S. Department of Health and Human Services. *Physical activity and health: a Report of the Surgeon General*. Atlanta, GA: Centers for Disease Control and Prevention; 1996. President's Council on Physical Fitness. Definitions: health, fitness, and physical activity. [Internet]. 2000. Available from http://www.fitness.gov/digest_mar2000.htm

Copyright © 2010 American College of Sports Medicine

Box 1.1, ACSM Guidelines, P. 3



Physiologic Fitness

- **Physiologic fitness** differs from health-related fitness in that it includes non-performance components that relate to biological systems influenced by habitual activity
 - **Metabolic fitness:** The status of metabolic systems and variables predictive of the risk for diabetes and cardiovascular disease
 - **Morphologic fitness:** The status of body compositional factors such as body circumference, body fat content, and regional body fat distribution
 - **Bone integrity:** The status of bone mineral density



Benefits of PA and/or Exercise

BOX 1.2 Benefits of Regular Physical Activity and/or Exercise

IMPROVEMENT IN CARDIOVASCULAR AND RESPIRATORY FUNCTION

- Increased maximal oxygen uptake resulting from both central and peripheral adaptations
- Decreased minute ventilation at a given absolute submaximal intensity
- Decreased myocardial oxygen cost for a given absolute submaximal intensity
- Decreased heart rate and blood pressure at a given submaximal intensity
- Increased capillary density in skeletal muscle
- Increased exercise threshold for the accumulation of lactate in the blood
- Increased exercise threshold for the onset of disease signs or symptoms (e.g., angina pectoris, ischemic ST-segment depression, claudication)

Adapted from references 3, 22, 26: U.S. Department of Health and Human Services. *Physical activity and health: a Report of the Surgeon General*. Atlanta, GA: Centers for Disease Control and Prevention; 1996. Kesaniemi YK, Danforth Jr E, Jensen MD, et al. Dose-response issues concerning physical activity and health: an evidence-based symposium. *Med Sci Sports Exerc.* 2001; 33:S351-8. Nelson M, Rajeski JW, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc.* 2007;39(8):1435-45.

Copyright © 2010 American College of Sports Medicine



Benefits of PA and/or Exercise

BOX 1.2 Benefits of Regular Physical Activity and/or Exercise

REDUCTION IN CORONARY ARTERY DISEASE RISK FACTORS

- Reduced resting systolic/diastolic pressures
- Increased serum high-density lipoprotein cholesterol and decreased serum triglycerides
- Reduced total body fat, reduced intra-abdominal fat
- Reduced insulin needs, improved glucose tolerance
- Reduced blood platelet adhesiveness and aggregation

Adapted from references 3, 22, 26: U.S. Department of Health and Human Services. *Physical activity and health: a Report of the Surgeon General*, Atlanta, GA: Centers for Disease Control and Prevention; 1996. Kesaniemi YK, Danforth Jr E, Jensen MD, et al. Dose-response issues concerning physical activity and health: an evidence-based symposium. *Med Sci Sports Exerc.* 2001; 33:S351-8. Nelson M, Rajeski JW, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc.* 2007;39(8):1435-45.

Copyright © 2010 American College of Sports Medicine



Benefits of PA and/or Exercise

BOX 1.2 Benefits of Regular Physical Activity and/or Exercise

DECREASED MORBIDITY AND MORTALITY

- Primary prevention (i.e., interventions to prevent the initial occurrence)
 - Higher activity and/or fitness levels are associated with lower death rates from coronary artery disease
 - Higher activity and/or fitness levels are associated with lower incidence rates for combined cardiovascular diseases, coronary artery disease, stroke, type 2 diabetes, osteoporotic fractures, cancer of the colon and breast, and gallbladder disease
- Secondary prevention (i.e., interventions after a cardiac event [to prevent another])
 - Based on meta-analyses (pooled data across studies), cardiovascular and all-cause mortality are reduced in postmyocardial infarction patients who participate in cardiac rehabilitation exercise training, especially as a component of multifactorial risk factor reduction
 - Randomized controlled trials of cardiac rehabilitation exercise training involving postmyocardial infarction patients do not support a reduction in the rate of nonfatal reinfarction

Adapted from references 3, 22, 26: U.S. Department of Health and Human Services. *Physical activity and health: a Report of the Surgeon General*, Atlanta, GA: Centers for Disease Control and Prevention; 1996. Kesaniemi YK, Danforth Jr E, Jensen MD, et al. Dose-response issues concerning physical activity and health: an evidence-based symposium. *Med Sci Sports Exerc.* 2001; 33:S351-8. Nelson M, Rajeski JW, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc.* 2007;39(8):1435-45.

Copyright © 2010 American College of Sports Medicine



Benefits of PA and/or Exercise

BOX 1.2

Benefits of Regular Physical Activity and/or Exercise

OTHER BENEFITS

- Decreased anxiety and depression
- Enhanced physical function and independent living in older persons
- Enhanced feelings of well-being
- Enhanced performance of work, recreational, and sport activities
- Reduced risk of falls and injuries from falls in older persons
- Prevention or mitigation of functional limitations in older adults
- Effective therapy for many chronic diseases in older adults

Adapted from references 3, 22, 26: U.S. Department of Health and Human Services. *Physical activity and health: a Report of the Surgeon General*, Atlanta, GA: Centers for Disease Control and Prevention; 1996. Kesaniemi YK, Danforth Jr E, Jensen MD, et al. Dose-response issues concerning physical activity and health: an evidence-based symposium. *Med Sci Sports Exerc.* 2001; 33:S351-8. Nelson M, Rajeski JW, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc.* 2007;39(8):1435-45.

Copyright © 2010 American College of Sports Medicine



Benefits of PA and/or Exercise

TABLE 1.3. EVIDENCE FOR DOSE-RESPONSE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND HEALTH OUTCOME

VARIABLE	EVIDENCE FOR INVERSE DOSE-RESPONSE RELATIONSHIP	CATEGORY OF EVIDENCE
All-cause mortality	Yes	C
Cardiovascular and coronary heart disease	Yes	C
Blood pressure and hypertension	No ^a	B
Blood lipids and lipoproteins	Insufficient data	
Coagulation and hemostatic factors	Insufficient data	
Overweight, obesity, and fat distribution	Yes	C
Type 2 diabetes mellitus	Yes ^b	C
Colon cancer	Yes	C
Low back pain, osteoarthritis, and osteoporosis	Insufficient data	
Quality of life and independent living in older persons	Yes	C
Depression and anxiety	No ^a	B



Risks Associated with Exercise

- Habitual PA reduces the incidence of atherosclerotic cardiovascular disease
- Vigorous PA also acutely and transiently increases the risk of sudden cardiac death and acute myocardial infarction.
- Exercise only provokes a CV event in individuals with preexisting heart disease, whether diagnosed or occult.
- Exercise does not provoke CV events in individuals with normal CV systems.



Risks Associated with Exercise

- **Sudden Death Among Young Individuals**
 - Among younger individuals (<35 yrs), the risk of sudden cardiac death is low because the prevalence of occult disease is low
 - Absolute incidence of death during or within one hour of sports participation among U.S. high school and college athletes:
 - One death per year for every 133,000 men and 769,000 women.
 - These numbers overestimate the incidence of a CV event because only 100 of the 136 deaths were caused by CV disease



Risks Associated with Exercise

TABLE 1.4. CARDIOVASCULAR CAUSES OF EXERCISE-RELATED SUDDEN DEATH IN YOUNG ATHLETES^a

	VAN CAMP (n = 100) ^b (47)	MARON (n = 134) (27)	CORRADO (n = 55) ^c (9)
Hypertrophic CM	51	36	1
Probable hypertrophic CM	5	10	0
Coronary anomalies	18	23	9
Valvular and subvalvular aortic stenosis	8	4	0
Possible myocarditis	7	3	5
Dilated and nonspecific CM	7	3	1
Atherosclerotic CVD	3	2	10
Aortic dissection/rupture	2	5	1
Arrhythmogenic right ventricular CM	1	3	11
Myocardial scarring	0	3	0
Mitral valve prolapse	1	2	6
Other congenital abnormalities	0	1.5	0
Long QT syndrome	0	0.5	0
Wolff-Parkinson-White syndrome	1	0	1
Cardiac conduction disease	0	0	3
Cardiac Sarcoidosis	0	0.5	0
Coronary artery aneurysm	1	0	0
Normal heart at necropsy	7	2	1
Pulmonary thromboembolism	0	0	1

CM, cardiomyopathy; CVD, atherosclerotic cardiovascular disease.



Risks Associated with Exercise

- **Exercise-Related CV Events in Adults**
 - The risks of exercise in adults are considerably higher than in younger individuals
 - Incidence of sudden cardiac death during vigorous exertion in health adults:
 - One death per year for every 15,000 to 18,000 individuals
 - Exercise also acutely increases the risk of acute, nonfatal myocardial infarctions
 - Why?
 - Acute coronary plaque rupture leading to coronary thrombosis



Risks Associated with Exercise

- **Risks of CV Events During Exercise Testing**
 - The risk of exercise varies with the prevalence of underlying coronary artery disease in the population
 - Therefore, the risk of exercise stress testing also varies with the populations studied
 - The overall risk of exercise testing in a mixed subject population is:
 - 6 CV events (MI, VF, other major dysrhythmia, or death) per 10,000 tests



Risks Associated with Exercise

TABLE 1.5. CARDIAC COMPLICATIONS DURING EXERCISE TESTING^a

REFERENCE	YEAR	SITE	NO. TESTS	MI	VF	DEATH	HOSPITALIZATION	COMMENT
Rochmis (37)	1971	73 U.S. centers	170,000	NA	NA	1	3	34% of tests were symptom limited; 50% of deaths in 8 hr; 50% over next 4 days
Irving (20)	1977	15 Seattle facilities	10,700	NA	4.67	0	NR	
McHenry (28)	1977	Hospital	12,000	0	0	0	0	
Atterhog (3)	1979	20 Swedish centers	50,000	0.8	0.8	6.4	5.2	
Stuart (41)	1980	1,375 U.S. centers	518,448	3.58	4.78	0.5	NR	VF includes other dysrhythmias requiring treatment
Gibbons (14)	1989	Cooper Clinic	71,914	0.56	0.29	0	NR	Only 4% of men and 2% of women had CVD
Knight (23)	1995	Geisinger Cardiology Service	28,133	1.42	1.77	0	NR	25% were inpatient tests supervised by non-MDs

MI, myocardial infarction; VF, ventricular fibrillation; CVD, atherosclerotic cardiovascular disease; MD, medical doctor; NA, not applicable; NR, not reported.
Events are per 10,000 tests.
Copyright © 2010 American College of Sports Medicine



Risks Associated with Exercise

- **Risks of CV Events During Cardiac Rehabilitation**
 - Individuals with diagnosed coronary artery disease are at the highest risk of experiencing a CV event during exercise and it has been estimated that vigorous exercise increases the risk of a CV event 100 times in this population
 - Nevertheless, studies of CV events during cardiac rehabilitation document that the risk of vigorous exercise in such supervised populations is extremely low.



Risks Associated with Exercise

TABLE 1.6. SUMMARY OF CONTEMPORARY EXERCISE-BASED CARDIAC REHABILITATION PROGRAM COMPLICATION RATES

INVESTIGATOR	YEAR	PATIENT EXERCISE HOURS	CARDIAC ARREST	MYOCARDIAL INFARCTION	FATAL EVENTS	MAJOR COMPLICATIONS*
Van Camp (48)	1980-1984	2,351,916	1/111,996 ^b	1/293,990	1/783,972	1/81,101
Digenio (10)	1982-1988	480,000	1/120,000 ^c		1/160,000	1/120,000
Vongvanich (49)	1986-1995	268,503	1/89,501 ^d	1/268,503 ^d	0/268,503	1/67,126
Franklin (13)	1982-1998	292,254	1/146,127 ^d	1/97,418 ^d	0/292,254	1/58,451
Average			1/116,906	1/219,970	1/752,365	1/81,670

*MI and cardiac arrest
^bFatal 14%
^cFatal 75%
^dFatal 0%

Used with permission from American Heart Association. 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;116:43-55.

Copyright © 2010 American College of Sports Medicine