

Power Prescription: Unlocking Health, Longevity and Weight Maintenance through Exercise

Patricia Marie Tan, MD

Market Chief Medical Officer, E&I (Employer and Individual) AZ and NM Obesity Medicine Physician



Objectives

- 1. Understand Key Concepts and Terminology
- 2. Recognize the Benefits of Exercise
- 3. Learn Principles and Guidelines for Effective Physical Fitness Training
- 4. Determine When a Treadmill Stress Test is Necessary
- 5. Develop Skills for Prescribing Exercise for Cardiorespiratory Fitness
- 6. Develop Skills for Prescribing Exercise for Resistance Training
- 7. Explore the Risks and Benefits of Extreme Training
- 8. Utilize Available Resources for Fitness and Health Guidance

Background

- Approximately **25% of American adults** are not active at all during their leisure time. BRFSS reported that in 2019, nearly **47% of adults were not sufficiently active** to achieve health benefits (CDC, 2020).
- Data from the YRBSS in 2019 indicate that **only about 26% of high school students met the physical activity guidelines** of 60 minutes per day (CDC, 2019).
- Physical inactivity is associated with an **increased risk** of several chronic conditions, including heart disease, stroke, type 2 diabetes, some cancers, and obesity. Physical inactivity contributes to **one in ten premature deaths annually** in the United States (CDC, 2021).
- The direct medical costs associated with physical inactivity are substantial. A report published in The Lancet in 2016 estimated that **physical inactivity costs the U.S. healthcare system approximately \$117 billion annually** (Ding et al., 2016).
- The shift towards more sedentary jobs has also contributed to physical inactivity. More than **80% of jobs in the U.S. are predominantly sedentary**, compared to 50% in the 1960s (American Heart Association, 2016).

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U.S. Trends in Overweight, Obesity, and Severe Obesity Adults > 20 years



Graph Credit to Weill Cornell Medicine https://www.cdc.gov/nchs/data/hestat/obesity-adult-17-18/obesity-adult.htm

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Terminology (Garber CE, 2011)

- Physical Fitness is the ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy pursuits and to meet unforeseen emergencies.
- Physical fitness is operationalized as "**measurable health and skill-related attributes**" that include cardiorespiratory fitness, muscular strength and endurance, body composition and flexibility, balance, agility, reaction time and power.
- Physical activity that is planned, structured, and repetitive and has as a final or intermediate objective the improvement or maintenance of physical fitness.



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Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, Nieman DC, Swain DP; American College of Sports Medicine. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Med Sci Sports Exerc. 2011 Jul;43(7):1334-59. doi: 10.1249/MSS.0b013e318213fefb. PMID: 21694556.



Terminology

Peak Aerobic Performance (VO_{2 max})

- Oxygen consumption, uptake and measure of cardiorespiratory fitness
- Greatest amount of oxygen a person can use during physical exercise
- Ability to take in, transport and deliver oxygen to skeletal muscle for use by tissue
- · Commonly expressed as liters/min or ml/Kg/min

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Terminology

Standard Metabolic Equivalent (MET)

- One MET is the amount of energy expended sitting quietly at rest adjusted to body weight.
- Physical activity intensity is often expressed in MET units
- Walking at a 14 min per mile pace is expressed as an intensity of 6 METs (defines vigorous versus moderate

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Rating of Perceived Exertion (RPE) or Borg Scale ludes the following:

- How fast you're breathing.
- How fast your heart is beating.
- How tired your muscles are.
- How much you're sweating.

Borg's Rating of Perceived Exertion (RPE) Scale			
Perceived Exertion Rating	Description of Exertion		
6	No exertion; sitting and resting		
7	Extremely light		
8			
9	Very light		
10			
11	Light		
12			
13	Somewhat hard		
14			
15	Hard		
16			
17	Very hard		
18			
19	Extremely hard		
20	Maximal exertion		

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Force and Types of Muscle

Contractions

Isotonic contractions generate force by changing the length of the muscle and can be concentric contractions or eccentric contractions.

- A concentric contraction causes muscles to shorten, thereby generating force.
- Eccentric contractions cause muscles to elongate in response to a greater opposing force.

Isometric contractions generate force without changing the length of the muscle.



Terminology

Muscle Fiber Hypertrophy refers to the increase in the size of individual muscle fibers (increase in # of myofibrils, actin and myosin filaments), which collectively leads to an overall increase in muscle mass.

This process occurs primarily because of resistance training or other forms of exercise that place a significant load on the muscles.







 Early strength gains influenced by neural factors. Long-term strength gains due to muscle hypertrophy.



https://image.slideserve.com/62004/process-of-strength-gains-l.jpg

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Measures of Physical Fitness

Cardiorespiratory Fitness

- measure of the efficiency with which the cardiovascular and respiratory systems work together to supply oxygen to the muscles and other tissues during sustained physical activity.
- reflects the ability of these systems to support prolonged exercise and is an important indicator of overall health and physical conditioning.

Muscular strength

- maximum amount of force that a muscle or a group of muscles can generate during a single contraction.
- reflects the muscle's ability to exert force against a resistance and is a key component of overall physical fitness.

Muscular endurance

- ability of a muscle or group of muscles to sustain repeated contractions or to continue applying force against a fixed resistance for an extended period
- It is a measure of how long muscles can perform a task before becoming fatigued.

Body Composition

The quantitative analysis of the different components that make up a person's body, typically divided into fat mass and fat-free mass. It provides a detailed breakdown of the body's constituents, offering insights into a person's physical health and fitness.

How do you measure?

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- Bioelectrical Impedance Analysis (BIA)
- Dual-Energy X-Ray Absorptiometry (DEXA or DXA)
- Hydrostatic Weighing (Underwater Weighing)
- Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) Scans





DEXA Scan Results

Flexibility

An important health-related component of physical fitness that refers to the range of motion (ROM) available at a joint or group of joints.

How do you measure?

- · Sit-and-Reach Test
- Goniometry

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- Trunk Lift Test
- Shoulder Flexibility Test (Apley's Scratch Test) or Back Scratch Test:
- Hip Flexor and Hamstring Flexibility Tests ROM is assessed using a goniometer or by measuring the angle of the limb relative to the body
 - Thomas test (for hip flexors)
 - Straight leg raise test (for hamstrings) are used.





Neuromotor Fitness

Functional or Integrated Fitness

New component of fitness per the American College of Sports Medicine (ACSM)

Key Components of Neuromotor Fitness:

- **Balance:** The ability to maintain the body's position, whether stationary or moving, and to prevent falls.
- **Coordination:** The ability to smoothly and efficiently integrate movements of different parts of the body.
- **Agility:** The ability to quickly and effectively change direction and position of the body.
- Proprioception: The sense of the relative position of body parts and the strength of effort being employed in movement.
- Reaction Time: The ability to respond quickly to stimuli.

Benefits of Exercis

Key Points:

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Question What is the association between cardiorespiratory fitness and long-term mortality? Findings In this cohort study of 122 007 consecutive patients undergoing exercise treadmill testing, cardiorespiratory fitness was inversely associated with all-cause mortality without an observed upper limit of benefit. Extreme cardiorespiratory fitness (≥2 SDs above the mean for age and sex) was associated with the lowest risk-adjusted all-cause mortality compared with all other performance groups. Meaning Cardiorespiratory fitness is a modifiable indicator of long-term mortality, and health care professionals should encourage patients to achieve and maintain high levels of fitness.

Mandsager K, Harb S, Cremer P, Phelan D, Nissen SE, Jaber W. Association of Cardiorespiratory Fitness With Long-term Mortality Among Adults Undergoing Exercise Treadmill Testing. JAMA Netw Open. 2018;1(6):e183605. doi:10.1001/jamanetworkopen.2018.3605



C Comorbidities and performance groups

Variable	нк (95% CI)	P Value	
Comorbidity			
Smoking	(1.410.36-1.46)	<.001	•
CAD	1.29 (1.24-1.35)	<.001	
Diabetes	1.40 (1.34-1.46)	<.001	-
Hypertension	1.21 (1.16-1.25)	<.001	•
ESRD	2.78 (2.53-3.05)	<.001	
Group comparison			
Low vs Elite	5.04 (4.10-6.20)	<.001	
Low vs High	3.90 (3.67-4.14)	<.001	•
Low vs Above Average	2.75 (2.61-2.89)	<.001	+
Low vs Below Average	1.95 (1.86-2.04)	<.001	-
Below Average vs Elite	2.59 (2.10-3.19)	<.001	
Below Average vs High	2.00 (1.88-2.14)	<.001	
Below Average vs Above Average	(1.41(1.34-1.49)	<.001	+
Above Average vs Elite	1.84 (1.49-2.26)	<.001	
Above Average vs High	1.42 (1.33-1.52)	<.001	+
High vs Elite	1.29 (1.05-1.60)	.02	

Adjusted HR

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Adjusted HR

Principles and Guidelines for Effective Physical Fitness Training

Progressive Overload is the gradual increase of stress placed upon the body during exercise training, designed to stimulate continuous physical adaptation and improvements in strength, endurance, and overall fitness. It is a fundamental principle in S&C that involves gradually increasing the stress placed on the body during exercise to continually stimulate muscle growth, strength gains, and overall fitness improvements.

Overload Principle is the concept that to achieve improvements in physical fitness, the body must be subjected to a workload that exceeds its current capacity, thereby stimulating physiological adaptations and enhancing performance.

*Both principles are integral to the design of effective training programs and are often used together to optimize fitness progress and performance.

SAID Principle (Specific Adaptation to Imposed Demands)

The body will adapt specifically to the types of demands placed upon it. In other words, the adaptations and improvements your body makes are specific to the type of training performed.

Importance

Understanding the SAID principle helps in designing training programs that are specific to the goals you want to achieve. For instance, a sprinter and a marathon runner will have vastly different training regimens tailored to their specific performance needs.

Principle of Reversibility

"Effects of Detraining on Cardiovascular and Muscular Parameters in Young Endurance Athletes" (Published in 2012)

Authors: Bosquet, L., Mujika, I., & Gouadec, K.

Findings:

- marked reduction in VO2 max, indicating a decrease in cardiovascular fitness,
- increase in resting heart rate, which suggested diminished cardiovascular efficiency.
- noticeable decline in muscle strength, particularly in the lower body, and a reduction in muscular endurance
- In terms of body composition, there was a reduction in lean muscle mass, indicating muscle atrophy due to inactivity, and an increase in body fat percentage

Periodization

The systematic planning of athletic or physical training. It involves dividing the training program into specific cycles or periods, each with particular goals and focuses, to optimize performance and recovery.

WHY?

- · Periodization helps prevent overtraining
- · Reduces the risk of injury
- Ensures that athletes peak at the right time for competitions; help patient achieve their goals
- It allows for systematic progression and recovery phases, enhancing long-term performance.



"What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?"

Recovery (Critical!)

"This is initiated by a disturbance in homeostasis; unclear when complete"

Necessary Process that links training and adaptation

Inadequate Recovery = Fatigue

Importance

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Without adequate recovery, the risk of overtraining, injury, and burnout increases. Recovery allows the body to adapt to the training stimulus, leading to improved performance and fitness levels over time.





Concept of LOAD

The amount of stress placed on an athlete or individual during physical activity. It is typically divided into two categories: <u>external</u> load and <u>internal</u> load. Both are essential for understanding how the body responds to training and for optimizing performance while minimizing the risk of injury or overtraining.

- External load refers to the objective, measurable physical work performed during training or exercise. It is the "dose" of exercise imposed on the body, often quantified using tools or technology. (Example: weight lifted, distance, speed, number of reps or sets, duration)
- Internal load refers to the individual physiological and psychological response to the external load. It reflects how the body perceives and reacts to the stress of training, which can vary from person to person, even if the external load is the same. (example: HR, RPE, lactate level, oxygen consumption, fatigue, etc)

FINDING THE BALANCE Training Strength Training load Control Volume Flexibility Intensity Tissue Frequency sensitivity Tissue Туре **Biomechanics** load Running gait capacity Work Previous Habits injury Etc. Etc. RUNNINGPHYSIG (3)

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Who needs a treadmill stress test?

Meta-Analysis: Exercise and Acute Cardiovascular Events (Riebe et al., 2015)

Key Findings:

This review summarized multiple studies showing that the risk of acute MI and SCD is transiently elevated during vigorous exercise, particularly in individuals with low physical fitness or underlying cardiovascular disease. Habitual physical activity was shown to greatly reduce these risks and provide long-term cardiovascular protection.

Conclusion: The transient risks of exercise-related cardiac events are outweighed by the long-term benefits of regular physical activity, but unfit individuals should approach vigorous exercise gradually and under medical supervision.



Habitual Frequency of Vigorous Physical Activity

FIGURE 1—Relative risk of AMI at rest (baseline risk) and during vigorous physical activity (\geq 6 METs) in sedentary and physically active individuals, with specific reference to the habitual frequency of vigorous exertion (d·wk⁻¹). (Adapted from Mittleman MA, Maclure M, Tofler GH, Sherwood JB, Goldberg RJ, Muller JE. 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):1677–1683. Used with permission. Adapted from Franklin BA. Preventing exercise-related cardiovascular events: is a medical examination more urgent for physical activity or inactivity? Circulation. 2014;129:1081–1084. Used with permission.)

Riebe, D., Franklin, B. A., Thompson, P. D., Garber, C. E., Whitfield, G. P., Magal, M., & Pescatello, L. S. (2015). Updating ACSM's recommendations for exercise preparticipation health screening. Circulation, 131(11), e298–e323.



Riebe, D., Franklin, B. A., Thompson, P. D., Garber, C. E., Whitfield, G. P., Magal, M., & Pescatello, L. S. (2015). Updating ACSM's recommendations for exercise preparticipation health screening. Circulation, 131(11), e298–e323.

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Recommendations for Prescribing Exercise for Cardiorespiratory Fitness

Frequency: at least 5d/week of moderate intensity; at least 3 days/week of vigorous intensity **Intensity:** moderate and/or vigorous defined by HRMax (mod 64-76% of HRmax, vig 77-95% of HRmax); RPE or Borg scale (slide 8); Talk test

Time: 150min/week of moderate (30-60mins/session); 75min/week vigorous (20-60 mins/session)

Type: Exercise should primarily involve large muscle groups and be continuous, rhythmic, and aerobic in nature (eg walking running cycling, swimming, rowing, dancing, group classes, recreational activities)

Volume: 500-1000 MET minutes/week or 7000 steps/day

Progression: Gradual progression of frequency, intensity, and/or duration is recommended to enhance adherence and reduce the risk of injury.

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., ... & Swain, D. P. (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine & Science in Sports & Exercise*, 43(7), 1334–1359.

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Monitor Exercise Intensity

Heart rate

% of Maximum Heart Rate (HRMax)

• Formula = 220 – age

 Target HR zones based on intensity: Mod 64-76% of HRmax, Vig 77-95% of HRmax Example: For a 40-year-old, HRmax = 180 beats per minute (bpm).
 Moderate intensity: 115–137 bpm.
 Vigorous intensity: 138–171 bpm.

Heart Rate Reserve Method (HRR or Karvonen Method)

- Formula: HRR = (HRmax resting HR)
- Target HR = Resting HR + % desired of HRR

Example: For a 40-year-old with HRmax = 180 bpm and resting HR = 60 bpm: Moderate intensity: $60 + [(180 - 60) \times 0.40] = 108$ bpm. Vigorous intensity: $60 + [(180 - 60) \times 0.60] = 132$ bpm.

Monitor Exercise Intensity

PACE

RPE (Borg Scale)

METS – used in cardiovascular rehabilitation

- light intensity is below Moderate intensity which is about 2-3 METS
- moderate intensity is 40-60% of HRR about 3-6 METS
- vigorous intensity is 60% of HRR 6 METS, 14 RPE

MET TABLES online

Calculating METs using Wicks:

HR Index is activity HR divided by resting HR (example: 140bpm/70bpm = HR Index of 2)

METs = $(6 \times HR Index) - 5 = 7$

Blood lactate - used in elite athletes

WALKING WITH A WEIGHTED VEST Good Idea Or Bad?



PROGRESSION

Initial Conditioning Stage – last 4-5 weeks beginning about 40% of Hrmax progressing to 70% - 12-20 mins with a frequency of 3 sessions/week

Improvement Stage – lasts 4-5 months – intensity progresses to 60-85% of Hrmax; duration about 20 mins increasing to 30 minutes with a frequency of 3-5 sessions/week

Maintenance Stage – frequency of 3 sessions a week, intensity of 70-85% HR max and lasting about 30-45 minutes per bout

Adjust:

- 1. Frequency have your patient commit to this first
- 2. Duration from 10 mins to 20 mins to 30 mins
- 3. Intensity Low \rightarrow mod \rightarrow vigorous

Recommendations for Prescribing Exercise for Resistance Training

Frequency: train each major muscle group 2-3 days per week on non-consecutive days to allow for recovery
Intensity: Intensity is typically expressed as a percentage of your 1-repetition maximum (1RM) or by the number of repetitions performed before failure
Time: 30-60 minutes training session
Type: variety – multi and single joint
Volume: 1-3 sets per exercise for beginners; 2-4 sets for intermediate to advanced 8-12 reps for strength and 15-20 reps for endurance; rest 30-90 seconds between sets

Progression: resistance, repetitions, frequency altered for effect

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., ... & Swain, D. P. (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine & Science in Sports & Exercise*, 43(7), 1334–1359. 31

ACSM General Exercise Prescription for Resistance Training

- Train a minimum of **8-10 separate exercise** that train the major muscle groups in a week
- Keep the sessions **less than an hour** (>1 hour associated with higher dropout rate)
- Perform 8-12 reps of each of these exercises to the point of volitional fatigue (you should be tired!)
- At least 2 days a week
- Adherence to **proper form and technique** for performing a given exercise
- Perform using full range of motion
- Perform the lifting (concentric) and lowering (eccentric) portions of the resistance exercise in a **controlled** manner
- Hold weights firmly but not too tightly in the hand
- Maintain normal breathing pattern





Extreme training?

- High levels of exercise, especially with inadequate recovery, can lead to **overtraining syndrome (OTS)**, which is characterized by fatigue, decreased performance, increased risk of injury, and negative effects on physical and mental health.
- In extreme cases, excessive exercise may increase the risk of adverse effects like immune suppression, cardiac dysfunction, or hormonal imbalances.
- For athletes, this is where training volume/intensity exceeds their ability to recover, leading to **maladaptation** rather than improvement.

RESOURCES

Franklin, B. A., Wedig, I. J., Sallis, R. E., Lavie, C. J., & Elmer, S. J. (2023). Physical activity and cardiorespiratory fitness as modulators of health outcomes. Mayo Clinic Proceedings, 98(2), 316–331.

https://www.mayoclinicproceedings.org/article/S0025-6196(22)00546-8/fulltext

Exercise is Medicine

https://www.exerciseismedicine.org/



Rx for Health Series

A selies on today's most common chronic conditions and their exercise prescriptions

Exercise is Medicine[®] created the Rx for Health series to provide essential guidelines on exercise for sedentary individuals and those with various chronic diseases and medical conditions. An extensive group of ACSM subject matter experts (including research scientists and clinicians) contributed to the development of this series.

These handouts are designed to be used by health care providers and exercise professionals to support their physical activity recommendations to patients/clients. Each handout can printed and given to a patient or scanned into the electronic health record (EHR) to be added to the after-visit summary (AVS).

We hope these materials will support your efforts to guide and inspire your patients and clients to become more physically active and achieve the numerous benefits associated with an active lifestyle.

Foundational Exercise Rx

- Sit Less. Move More: English Version Spanish Version
- Being Active for a Better Life: English Version Spanish Version
- Being Active with Your Young Child: English Version Spanish Version
- Being Active as a Teen: English Version Spanish Version
- Being Active as We Get Older: English Version Spanish Version
- Staying Active When Frail: English Version Spanish Version

Exercise Rx for Medical Conditions

- Alzheimer's: English Version Spanish Version
- Aneurysm: English Version Spanish Version
- Asthma: English Version Spanish Version
- Atrial Fibrillation: English Version Spanish Version
- Bleeding Disorder: English Version Spanish Version
- Blood Lipid Disorders: English Version Spanish Version
- Cancer: English Version Spanish Version

RESOURCES

COVID-19 Handout - Adults

- English (PDF)
- Arabic (PDF)
- Croatian (PDF)
- Farsi (PDF)
- French (PDF)
- Hebrew (PDF)
- Greek (PDF)
- Italian (PDF)
- Mandarin (PDF)
 Polish (PDF)
- Portuguese (PDF)
 Spanish (PDF)
- Spanish (PDF)
- Spanish (España) (PDF)

COVID-19 Handout - Children

- English (PDF)
- Greek (PDF)
- Italian (PDF)
- Mandarin (PDF)
- Spanish (PDF)
- Spanish (España) (PDF)

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RESOURCES

Exercise is Medicine

https://www.exerciseismedicine.org/

The Miracle Drug: Exercise is Medicine®



In an era of spiraling health care expenditures, getting patients to be more active may be the ultimate low-cost therapy for achieving improved health outcomes. Studies show that regular physical activity (PA) has health benefits at any body weight and is critical for long-term weight management. Decades of research have shown that exercise is as effective as prescription medication in the management of several chronic diseases. Just as weight and blood pressure are addressed at nearly every health care visit, so should attention be given to PA.

Assessment: Use the Physical Activity Vital Sign to Assess Weekly PA Levels

Add these two simple questions to the health history form and electronic health record to determine if the patient is meeting the PA guidelines:

1.	On average,	how many	days/week	do you	engage in	moderate
	to vigorous l	PA (like bri	isk walking)?		

2. On average, how many minutes do you engage in PA at this level?

Total Activity (days/week x minutes/day) = ____ minutes/week

 days minutes

Brief Advice/Prescription: Basic Exercise Recommendations

 Encourage your patient to meet the PA guidelines (see chart). At minimum, adults should be more active over the course of a day (i.e., take frequent breaks from sitting, walk the dog, use the stairs). Every minute counts! Children and adolescents should engage in sports, dance, outdoor recreation and active games.
 Provide the <u>EIM "Sit Less. Move More"</u> handout to your patients. The <u>EIM Rx for Health Series</u> also provides condition-specific handouts.

2018 Physical Activity Guidelines for Americans				
Age (yrs old)	Aerobic Activity Recommendations	Muscle Strengthening Recommendations		
6-17	60 minutes of moderate or vigorous physical activity (PA)/day including at least 3 days of vigorous PA/wk	3 days/week and included as part of the 60 minutes of daily PA. Also include bone-loading activity		
18-64	150-300 minutes of moderate PA/wk, 75 minutes of vigorous PA/wk or equivalent combination spread throughout the week	Muscle strengthening activities at moderate or greater intensity (all major muscle groups) on 2 or more days/wk		
65+	Same as adults, or be as active as abilities and health conditions allow	Same as adults, but include balance training and combination activities (strength and aerobic training together)		
All Ages	Sit less. Move more. All physical activity counts.			

Referral and Resources

Advise patients to take advantage of local parks and recreation programs. Develop referral relationships with
fitness facilities and exercise professionals who can provide support and guidance.

· Visit the EIM website at www.exerciseismedicine.org for the EIM Health Care Provider Action Guide.

Health care providers who are more active, are more likely to counsel patients regarding physical activity. It's not enough to "talk the talk," you have to literally "walk the walk." YOU will feel better and move better as well.

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https://www.exerciseismedicine.org/wp-content/uploads/2021/02/EIM-miracle-drug-handout.pdf