Promoting Physical Activity

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Relationship of Reduced Physical Activity and Chronic Disease

Infectious diseases have accounted for the majority of deaths for most of human history, but since the middle of the twentieth century chronic diseases have been the leading cause of death in the US [1, 2]. One cause of the increase in deaths from chronic disease is a decrease in physical activity, which is a major risk factor contributing to deaths and disease burden, even more so than obesity. Increasing physical activity in the general population would reduce all-cause mortality risk by mitigating the impact of cardiovascular disease, diabetes, and cancer [3].

The 2018 National Health Interview Survey showed 74% of US adults participate in leisure-time physical activity [4, 5]. Persons aged 65 years and older are the most sedentary age group, with only 78% participating in sufficient amounts of physical activity. As life expectancy continues to rise, those aged 60 years and older are the fastest growing population in the Western Hemisphere [6, 7]. This makes understanding the link between active aging, physical activity, and chronic disease prevention and treatment increasingly important [3].

Aging and Exercise

Physical performance comprises neuromuscular endurance, strength, capacity, and power, all of which decline after the age of 60 [7]. Sarcopenia, the gradual loss of muscle due to aging, results from reduced regenerative capacity and perfusion with increased oxidative stress, mitochondrial dysfunction, and chronic inflammation [8]. The physiologic changes that result in sarcopenia position it as a mediator between chronic diseases and frailty [9, 10]. Older, less active individuals have a low ratio of appendicular (arms and legs) lean mass to body mass index (ALM_{BMI}) and this is associated with a 50% increased risk of mortality [11]. ALM_{BMI} is measured using dual-energy Xray absorptiometry (DEXA) to calculate the sum of lean mass in the arms and legs only [12]. Physical activity and structured exercise can reverse the effects of sarcopenia and age-related decline in function and cognition.

VO_{2max} is the calculation used to estimate aerobic capacity and can be estimated by the following calculation: [(maximum heart rate ÷ resting heart rate) × 15.3]. Aerobic endurance training improves aerobic capacity (VO_{2max}), which helps to reduce frailty in older adults [8]. Aerobic exercise improves muscle insulin sensitivity and prevents decline in mitochondrial respiratory capacity, leading to increased muscle endurance. Resistance exercise induces remarkable gains in strength and power in older adults, showing increases in muscle mass of 16–23% after four months of resistance training [8, 13]. These improvements provide health benefits and increase quality of life.

Frailty

Frailty is an age-related condition caused by neurally modulated multisystem decline in physiologic reserve and function [14]. The Clinical Frailty Scale is a widely used tool to evaluate categories including comorbidity, function, cognition, and other domains to develop a frailty score associated with health outcomes ranging from very fit (score of 1) to terminally ill (score of 9) [15]. Frailty is associated with disability, falls, hospital admissions, premature death, and lower quality of life among community-dwelling older adults [16–18]. Pharmacologic and non-pharmacologic interventions, proteins to reduce cell damage, and exercise are being investigated as possible strategies to reduce frailty in aging adults. Adequate aerobic and resistance training prevent or reduce frailty through increased muscle mass, strength, and endurance, which improves physical function [8].

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Obesity and Chronic Disease

Obesity is defined by the World Health Organization as a weight-for-height ratio, known as body mass index (BMI), of 30 kg/m^2 or higher [18]. Other methods of obesity classification include the Edmonton Obesity Staging System, which ranges from Stage 0 to Stage 4 and classifies obesity based on a person's metabolic profile, psychologic health, and physical function [19]. Body fat percentage and waist circumference have also been studied as definitions of obesity [20]. Normal weight obesity, defined in persons with BMIs within normal limits but high body fat percentages, significantly increase the risk of cardiovascular disease, metabolic syndrome, and mortality [19]. However, the measurer-dependent discrepancies in estimating body fat percentage and the need for advanced imaging such as computed tomography or DEXA scans for accurate measurements limit the use of this measure in directing clinical outcomes. Globally, the BMI remains the most widely used definition of obesity [20].

The prevalence of obesity in US adults is high, with 42% of adults considered obese and 9% severely obese. Adults aged 40–59 years, women, and non-Hispanic Black adults have higher rates of severe obesity than other age groups, men, and other ethnicities and races respectively [21]. The association of obesity with comorbid chronic diseases is well established. Abnormal fat deposition around vasculature disrupts adipokine and cytokine-mediated vasoregulation, which, combined with inappropriate immune response, altered bioavailability of nitric oxide, and increased production of reactive oxygen species and other inflammatory factors, leads to the endothelial dysfunction that is the cause of the deleterious sequelae of obesity [22, 23]. Adults with obesity have an increased risk of coronary artery disease, stroke, hypertension, diabetes, insulin resistance, end stage renal disease, dyslipidemia, gall bladder disease, asthma, sleep apnea, arthritis, and many cancers compared with adults of normal weight [24–26]. Even persons who meet the BMI criteria but have normal metabolic profiles, known as metabolically healthy obesity, are at increased risk of hypertension, cardiovascular disease, and earlier mortality [27, 28].

Furthermore, the fat increases and muscle mass decreases that can occur with aging, known as 'sarcopenic obesity,' can lead to metabolic and functional impairment [20, 21]. Eighty percent of patients with non-alcoholic fatty liver disease are obese, particularly those with high amounts of visceral adipose tissue, which exacerbates the chronic inflammation and free fatty acid deposition into the venous system [22]. Every 5 kg/m^2 increase in BMI above 25 kg/m^2 increases the risk of rheumatoid arthritis by 13%, deaths due to vascular complications and diabetes by 41% and 210% respectively, and overall mortality by 29%, with the top three causes of death in patients with obesity being heart disease, cancer, and diabetes [23, 24]. Obesity increases the risk of depression and anxiety, cancer, and cancer-related deaths [25–27]. People with a BMI of 40–59 kg/m^2 live up to 13.7 years less than those with normal BMI [28].

The financial ramifications of this are staggering, with the direct costs related to the care of these diseases totaling $149 billion dollars annually, with the cost predicted to increase to $957 billion by 2030 [29, 30]. Indirect costs related to loss of productivity and employee absenteeism range from 3 to 6 billion dollars [31]. The burdens of obesity are many, and the factors that contribute to this issue are complex. However, physical activity and exercise, along with a healthy diet, are effective means by which some of these burdens may be lessened. Balancing net energy intake from calories consumed each day with total energy expenditure used for exercise plays a part in maintenance of appropriate weight. Intentional weight loss may reduce insulin levels, insulin-like growth factor 1, cholesterol, glucose, and pro-inflammatory adipokines and cytokines, thereby reducing the risk of chronic diseases including cancer [32].

Primary Prevention of Chronic Disease

Exercise can affect longevity, with a dose–response relationship between exercise and mortality [33]. The American Heart Association recommends that adults engage in at least 150–300 min of *moderate* exercise per week or 75–150 min of *vigorous* exercise per week, both of which confer significant health benefits [34].

Energy expenditure is commonly measured in metabolic equivalency of task units, or METs. One MET is equivalent to the rate of energy expenditure of an individual at rest. Moderate-intensity exercise is classified as 3.0–5.9 METs, which is to say that the relative energy expenditure of moderate activities such as brisk walking and doubles tennis is 3–5.9 times more energy than a resting state. Vigorous physical activities, such as jogging, running, or carrying heavy loads, confer a MET of 6 or above. A common measurement for activity is the *MET minute*s, which is the MET multiplied by the time in minutes spent at that level of energy expenditure. Even individuals who engage in limited physical activity (defined as 0–1999 MET minutes/month) have survival benefits, with those engaging in five times the recommended amount of moderate to vigorous physical activity (>20,000 MET minutes/month) having the greatest benefit, with as much as a 45% risk reduction of all-cause mortality [35].

Cardiovascular disease is the leading cause of death in both men and women in the US [2]. Exercise can prevent coronary artery disease and stroke by increasing cardioprotective cholesterol, improving endothelial function, normalizing blood pressure, and reducing glucose [36, 37]. Men engaged in fitness lower their risk of stroke and subsequent mortality by 68% when compared to low-fitness counterparts [36, 38].

Physical activity is associated with lower risk of breast and colon cancer, likely due to a reduction of circulating sex hormone levels, increase in insulin-like growth factor receptor binding protein, and decrease in prostaglandin levels [38,

39]. Physical activity in the US population at the level recommended in the physical activity guidelines would prevent 46,000 cancer cases annually [40].

As of 2020, one in five US adults experience mental illness, and there is evidence that exercise intervention can reduce or prevent symptoms of anxiety and depression [41]. In patients with depression, regular exercise is effective in prevention and symptom reduction [42, 43]. In the short term, exercise can directly reduce acute anxiety states, while longer-term regular exercise can reduce anxiety traits in individuals both with and without anxiety disorders [44]. In school-aged children and adolescents, regular exercise reduces the risk of depression and improves academic performance, executive function, and memory, especially in certain conditions such as attention deficit and hyperactivity disorders [45]. Exercise also improves sleep quality and efficiency, which can help support equilibrium in anxious or depressive states [46, 47]. Exercise is also associated with decreased risk of cognitive decline and dementia [48–50]. Physical activity is a low-risk intervention, and is beneficial for the primary prevention of many conditions and can be modified to suit an individual's limitations. A summary of the health benefits associated with physical activity can be found in Table 3.1 [51].

Table 3.1 Health Benefits Associated with Regular Physical Activity (Adapted from *Physical Activity Guidelines for Americans 2nd edition*, 2018) [51]

Children and adolescents
• Improved bone health (ages 3 through 17 years) • Improved weight status (aged 3 through 17 years) • Improved cardiovascular and muscular fitness (ages 6 through 17 years) • Improved cardiometabolic health (ages 6 through 17 years) • Improved cognition (ages 6 through 13 years) • Reduced risk of depression (ages 6 through 13 years)
Adults
• Lower risk of all-cause mortality • Lower risk of cardiovascular disease mortality • Lower risk of cardiovascular disease (including heart disease and stroke) • Lower risk of hypertension • Lower risk of type 2 diabetes • Lower risk of adverse blood lipid profile • Lower risk of cancers of the bladder, breast, colon, endometrium, esophagus, kidney, lung, and stomach • Improved cognition • Reduced risk of dementia (including Alzheimer's disease) • Improved quality of life • Reduced anxiety and depression • Improved sleep • Slowed or reduced weight gain • Weight loss, particularly when combined with reduced calorie intake • Prevention of weight regain after initial weight loss • Improved bone health • Improved physical function • Lower risk of falls and fall-related injuries (older adults)

Note: The Advisory Committee rated the evidence of health benefits of physical activity as strong, moderate, limited, or grade not assignable. Only outcomes with strong or moderate evidence of effect are included in this table

Secondary Prevention of Chronic Disease

Diabetes Mellitus

Patients with poorly controlled diabetes have a three to four times higher risk of stroke and heart disease [52]. Exercise improves glycemic control and cardiovascular health [53]. A structured aerobic exercise program that includes resistance training, walking, cycling, or jogging reduces hemoglobin A1c values by 0.6%, which is significant given that a 1% decrease in hemoglobin A1c is associated with a 20% reduction in major cardiovascular events and a 37% reduction in microvascular complications [54]. The combination of both aerobic and resistance exercises is superior to either type of exercise alone in improving hemoglobin A1c due to increased insulin sensitivity, reduced ectopic fat, better lipid values, and lowered blood pressure [55]. Still, only 39% of adults with diabetes are physically active [56].

The American College of Sports Medicine and the American Diabetes Association recommend that patients with diabetes perform 30 min of moderate- to vigorous-intensity aerobic exercise at least five days a week or a total of 150 min per week [54, 57]. This activity should occur at least three days per week with no more than two days in a row without exercise. The US Preventive Services Task Force does not recommend pre-exercise program stress testing in asymptomatic individuals with a low coronary artery disease (CAD) risk (<10% risk of a cardiac event over 10 years). However, ECG stress testing may be indicated in patients with diabetes for more than 10 years or with signs of end-organ disease. Patients with certain complications of diabetes require special consideration [54]. For example, those with diabetic peripheral neuropathy are at increased risk of falls and benefit from balance exercises and activities with less fall risk, such as stationary bike and swimming. Patients with proliferative retinopathy from their diabetes are at risk of vitreous hemorrhage and retinal detachment with exercise and should avoid heavy lifting and vigorous exercise and focus instead on low-impact activities such as biking, walking in a pool, slow hiking, and elliptical machines.

Cardiovascular Diseases

Regular physical activity is an effective tool for secondary prevention of cardiovascular diseases [58–61]. Patients with coronary artery disease (CAD) have an increased risk of sudden cardiac death and/or acute myocardial infarction with vigorous exercise and therefore should undergo stress testing and assessment of left ventricular function prior to starting an exercise routine [62]. Clinicians and patients should then engage in shared decision-making regarding results, considering risks versus benefits of exercise. The recommended amount of physical activity is three to four 40-min sessions of moderate to vigorous aerobic activity per week, which

improves both survival and quality of life in people with CAD. [58, 59, 61, 63, 64]

Hypertension is the most common modifiable cardiovascular condition among the general population, affecting 160 million US adults [64, 65]. Physical activity is effective as secondary prevention for hypertension and reduces the incidence of stroke and all-cause and cardiovascular mortality [66–68]. Both systolic blood pressure (SBP) and diastolic blood pressure (DBP) remain lower for up to 24 hours after aerobic exercise [69].

For those with stage 1 hypertension (SBP 140–159 mmHg or DBP 90–99 mmHg), there are no restrictions to initiating exercise, provided blood pressure is monitored every few months. Stage 1 patients with sustained hypertension following exercise should have an echocardiogram. Patients with stage 2 hypertension (SBP >160 mmHg or DBP >100 mmHg) should avoid high static sports (weightlifting, wrestling, etc.) until blood pressure is controlled [64].

Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease (COPD) causes airflow obstruction, prolonged expiratory phase, air trapping, and inflammation [70]. COPD is the third leading cause of death in the US, accounting for more than 3 million deaths in 2019 [71]. Patients with COPD have fatigue, shortness of breath, poor functional status and quality of life, and poor exercise tolerance [72]. All of this improves with exercise, not by improving lung function, but by maximizing the function of other body systems. Gains in muscle strength and endurance allow a patient to work harder with delayed fatigue and decreased ventilation demand, which allows for more time for expiration of air [73, 74]. Psychological factors, such as increased tolerance to dyspnea, are positively affected with exercise [75]. This may be due to the antidepressant effects of exercise, social interaction, and distraction when participating in pulmonary rehabilitation programs with other people having the same condition or education of patients regarding their disease.

Although the benefit of exercise is clearly established in patients with COPD, there are risks. Musculoskeletal injury is a concern as most patients with COPD are debilitated and may need supervision [72]. Exercise-induced bronchospasm is not uncommon, and patients need to have their bronchodilators on hand. Patients with COPD are at increased risk for cardiovascular death and may need stress testing before starting an exercise program [76, 77].

Pulmonary rehabilitation is an interdisciplinary intervention that can be started at any stage of disease. Endurance and resistance exercise for the upper and lower extremities is central to any pulmonary rehabilitation program and improves function [72]. High-intensity workouts are preferred, targeting 60% of VO_{2max}, but even low-intensity exercise produces benefit. Health benefits are seen after just six weeks of exercise with longer programs likely sustaining benefit [78–80].

Osteoporosis

Osteoporosis is characterized by low bone mass and microarchitecture deterioration of bone tissue leading to bone fragility and increase in fracture risk. Over 200 million people are currently diagnosed with osteoporosis, and the incidence rate increases with age [81]. Between 30% and 50% of women and 15–20% of men will suffer an osteoporotic fracture in their lifetime, often as the presenting symptom of the disease [82].

Though there are pharmaceutical treatments for osteoporosis, physical activity is still the first recommendation in the prevention of osteoporosis and fragility fractures. Resistance training and weight-bearing exercises are likely to help build and preserve bone mass. Exercise enhances muscular strength and coordination, which reduces the risk of falling, the major risk factor for fragility fractures and the most common cause of mortality and morbidity from osteoporosis. A physically active lifestyle is associated with a 50% decrease of hip fractures, presumably related to a decrease in fall risk [83–85]. Exercises such as tai chi focus on posture and weight bearing using low-velocity movements of the body, which increases muscular strength and improves balance, postural stability, and flexibility, reducing the risk of falls in older adults by 50%. Starting physical activity at a young age likely contributes to higher peak bone mass later in life, and short-term gains in bone density can be measured in children and adolescents [86, 87].

In women, multi-component exercise programs with jogging, walking, or stair climbing and resistance training improve the bone density at both the lumbar spine and the femoral neck. Programs that focus solely on resistance training or weight-bearing exercise result in changes to only the lumbar spine and femoral neck, respectively [88–91]. Walking and endurance training alone have little to no effect on femoral neck or lumbar spine bone density. High-impact jumping programs without other exercises are also ineffective [92–96].

Studies on the effects of exercise on bones in men are limited but show that high-intensity progressive resistance training combined with moderate-impact to high-impact weight-bearing exercises performed at least three times a week can improve femoral neck bone density [82, 97]

Exercise programs that involve weight-bearing activities that are variable in nature and applied rapidly, such as skipping, dancing, jumping, and hopping, and are performed three to five times a week for up to 45 min per session are most effective in increasing bone strength [98–100]. In older adults where high-impact exercises may be contraindicated,

low- to moderate-impact weight-bearing exercise in combination with progressive resistance and/or agility training is safe and effective [95, 97, 101]. In frail elderly patients who are prone to fall, regular low-impact aerobics, dance exercises, or resistance training on machines may be a safe option. In younger subjects, nonlinear high-impact and high-loading activities at least twice weekly are beneficial and safe [102–104].

Osteoarthritis

Osteoarthritis (OA) is a chronic degenerative joint disorder and the most frequent cause of disability among adults in the US [105]. It affects more than 50 million adults and is the fourth most common cause of hospitalization. In 2020, almost 1.8 million knee and hip replacements were performed at a cost of over $60 billion [106]. The risk of OA by age 85 is one in two and increases to two in three for those who are obese [6, 106, 107]. Other risk factors are family history, female sex, past trauma, muscular weakness, and advancing age.

OA often asymmetrically affects the hands, knees, hips, and spine. Although any joint can be affected, knees followed by hips are the most affected joints [108]. The disease process involves the whole joint, including cartilage, bone, ligament, and muscle, with joint pain the predominant symptom. OA is defined radiographically by joint space narrowing, bony osteophytes, bone contour deformity, and/or sclerosis, and clinically by descriptions that consider age, stiffness, warmth, crepitus, tenderness, and bony enlargement [109]. These symptoms lead to physical and psychological disabilities and impaired quality of life.

Despite evidence that exercise is beneficial, most people with OA do not achieve recommended levels of physical activity. This leads to muscle weakness which worsens joint biomechanics, making joints less stable and subject to pathologic shear, which causes microtrauma and cartilage degeneration, subchondral bone sclerosis, and malalignment [110]. Exercise and muscle strengthening is the cornerstone of nonsurgical management of OA and reduces pain while increasing physical function, so patients can pursue social, domestic, occupational, and recreational activities [111–113]. Land-based exercises reduce pain and improve physical function in those with knee OA [108]. There is less evidence regarding hip OA.

Any weight loss in beneficial, with weight loss of greater than 5% per week leading to significant improvement in disability and reductions in the load placed on the knee in individuals with knee osteoarthritis [114]. Incorporating strength training during weight loss helps prevent muscle wasting and increase lean mass while dieting to achieve weight loss [115].

Exercise therapy should be individualized with patient age, mobility, comorbidities, and preferences considered. Aquatic therapy or seated exercises may be better tolerated by patients who are deconditioned or obese. Exercise may be effectively delivered via individual treatments or supervised groups, or can be performed unsupervised [116]. Some supervision may lead to improvement in movement and walking pain in the long term. General exercise programs are safe and well tolerated for most people with lower limb OA but are often limited by discomfort at the affected joint, which may require modification to the exercise regimen. Adequate footwear, proper warm-up and cooldown, correct exercise technique, proper clothing, and gradual increases in exercise dose are recommended [117].

Promoting Physical Activity

There are innumerable benefits of physical activity for a host of chronic diseases. Most practitioners are at least partially aware of these benefits and the crucial role that exercise can play in a comprehensive treatment plan, yet many consistently fail to incorporate activity recommendations into the plan of care. Only a third of patients report that their physician has advised them to be physically active [118]. Many clinicians are uncertain as to how to write an appropriate exercise prescription or do not know what counseling strategies are effective. Only 6% of medical schools include exercise guidelines in their core curriculum [119, 120]. System factors include lack of time during visits, an emphasis on acute issues rather than preventive medicine, and lack of financial reimbursement for exercise counseling. Although these barriers exist, physicians can influence patients' physical activity. Patients provided with physician advice and written materials had about a 1 kcal/kg/day increase in physical activity six months after the initial encounter. In an 80 kg man, this would translate into almost a 600 kcal/week increase in physical activity, indicating that effective counseling on physical activity is a worthwhile use of time in a physician–patient encounter. Several successful models are highlighted below [121].

Exercise as a Vital Sign

Exercise is Medicine is a campaign that began as a collaboration between the American College of Sports Medicine, the American Medical Association, and the US Surgeon General. Part of this campaign is the concept of "Exercise as a Vital Sign," which encouraged providers to prescribe exercise to patients [122, 123]. In addition to the usual vital signs, patients were asked "On average, how many days per week do you engage in moderate to vigorous physical activity (like brisk walking)?" and "On average, how many minutes do you engage in physical activity at this level?" The answers were multiplied to obtain the total number of minutes of

physical activity per week and recorded in the patient's medical record. These initiated discussions of physical activity highlight the importance of exercise, are associated with modest weight loss in overweight patients, and improve glucose control in people with diabetes. By recording physical activity in an electronic medical record, clinicians can track values over time and patient progression toward exercise goals. From a public health standpoint, aggregating physical activity data may be a tool for analysis of health discrepancies by geographical area.

The Exercise Prescription

Providing a written prescription for exercise may be effective in motivating patients to be more active. One effective and simple prescription is known as the FITT model and includes specific recommendations regarding **F**requency (number of days per week), **I**ntensity (moderate or vigorous), **T**ype (modality of activity, often dependent on the resources available to the patient, limitations of the chronic medical conditions, and their personal interests), and **T**ime (length of the session or the number of repetitions) [123]. As patients advance it is important to increase duration or frequency before increasing intensity. Exercise prescriptions should include a recommendation for two days/week of strength training. All sessions should include a dynamic warm-up, the main cardiorespiratory phase, and then a cooldown period [122].

Defining Physical Activity and Exercise

Physical activity is defined as bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure. Exercise is defined as a type of physical activity that is planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness. Exercise occurs outside the expected or unexpected activities of the day [124].

Exercise can generally be divided into four subtypes [125]:

1. Aerobic/endurance: any activity requiring the body's large muscle groups to move in a rhythmic pattern for sustained periods of time. Examples include walking, hiking, jogging, cycling, and swimming.
2. Balance/neuromotor training: combination of activities to improve lower body strength and reduce the chances of falling. Examples include single leg stance, tandem walking, yoga, and tai chi.
3. Resistance/strength training: exercises that require muscles to work or hold against an applied force or weight. Examples include weight machines, handheld weights, push-ups, use of resistance bands, and heavy lifting (groceries, furniture, etc.).
4. Flexibility training: exercises designed to maintain or extend range of motion of joints. Examples include static stretching (holding a stretch for period of time), dynamic stretching (gradual transition from one body position to another), ballistic stretching (momentum of moving body part to produce the stretch), and proprioceptive neuromuscular facilitation (isometric contraction of muscle-tendon unit immediately followed by static stretching of same body part, i.e., contract-relax) [57].

Recommendations for Adults

The 2018 Department of Health and Human Services Physical Activity Guidelines recommend that all adults strive to be more active and sit less, and conclude that some physical activity is better than none [51]. To achieve substantial health benefits, adults should perform 150–300 min of moderate-intensity aerobic exercise per week or 75–150 min of vigorous-intensity aerobic exercise per week spread across three separate days [51, 57]. Additional health benefits can be achieved by increasing weekly physical activity above 300 min of moderate-intensity exercise or 150 min of vigorous-intensity exercise. The talk test is a practical, valid, and reliable test that can be used to determine if an exercise is of moderate to vigorous intensity. If a person can talk but not sing during aerobic activity, this is considered moderate intensity. If a person cannot say more than a few words without pausing to breathe, this is considered vigorous intensity [126]. Table 3.2 lists examples of activities classified as moderate or vigorous intensity [43].

Table 3.2 Examples of different aerobic physical activities and intensities, based on absolute intensity (adapted from *Physical Activity Guidelines for Americans 2nd edition*, 2018)

Moderate-intensity activities
• Walking briskly (2.5 miles per hour or faster) • Recreational swimming • Bicycling slower than 10 miles per hour on level terrain • Tennis (doubles) • Active forms of yoga (e.g.,, vinyasa or power yoga) • Ballroom or line dancing • General yard work and home repair work • Exercise classes like water aerobics
Vigorous-intensity activities
• Jogging or running • Swimming laps • Tennis (singles) • Vigorous dancing • Bicycling faster than 10 miles per hour • Jumping rope • Heavy yard work (digging or shoveling, with heart rate increases) • Hiking uphill or with a heavy backpack • High-intensity interval training • Exercises class like vigorous aerobic or kickboxing

Muscle strengthening exercises should be performed for all major muscle groups at least two days per week with at least one set of eight to 12 repetitions. The American College of Sports Medicine recommends flexibility exercises involving most major muscle groups at least two days per week as well as neuromotor/balance training at least two days per week [57].

Recommendations for Older Adults

Physical activity guidelines for older adults are the same as for their younger adult counterparts [51]. For those older adults who cannot do 150 min of moderate-intensity aerobic activity per week because of chronic conditions, it is recommended they determine their level of activity relative to their fitness level and be as physically active as their health allows. Older adults should incorporate balance training into their physical activity regimen along with aerobic and resistance training exercise.

Recommendations for Obese Patients

Though the benefits of exercise outweigh the risks in obese patients, there are some points to consider when recommending an exercise prescription to these patients. Gradual increase in duration and intensity level should be recommended [127]. This prevents stress fractures and other overuse injuries and allows for confidence building with each successfully completed level. Avoiding high-impact activities minimizes joint forces and lowers the risk for early osteoarthritis. Obese patients have lowered proprioception sense and joint awareness predisposing them to falls, acute ligament sprains, and muscle tears. Thermoregulation is diminished, so education regarding heat exhaustion and heat stroke is crucial and appropriate hydration strategies should be advised for before, during, and after exercise. Although the risk is low for a cardiac event during low-intensity exercise, a patient's risk factors for cardiovascular disease should be evaluated prior to initiating an exercise regimen [127, 128].

Current recommendations for exercise in adults suggest 150 min or greater of moderate-intensity exercise per week or 75 min per week of vigorous exercise [127, 129]. While any level of exercise improves health, a high-intensity regimen is required to produce significant weight loss. Patients should aim for gradual lessening of daily caloric intake with increasing levels of physical activity [127, 128, 130]. For able-bodied patients, 150–200 min of walking per week can prevent weight gain and improve cardiovascular fitness, but a minimum of 60 min of moderate-intensity exercise per day is often needed to achieve weight loss. Aerobic activity results in improved endurance, weight loss, and a decrease in abdominal and visceral fat. Resistance training demonstrates improved muscle mass and strength. Each of these exercise types is important for obese patients and should be included in exercise prescriptions [127, 128].

Recommendations for Children

Sedentary behavior in childhood is associated with poorer cardiometabolic health and weight status/adiposity (Fig. 3.1) [51]. Preschool-aged children (3–5 years of age) should be physically active for at least 3 h a day to support growth and development [51]. School-aged children and adolescents (6–17 years of age) should aim to do at least 60 min per day of moderate-to-vigorous physical activity. A variety of activities constitute physical activities in young people (Table 3.3). Much of this time should be devoted to moderate or vigorous

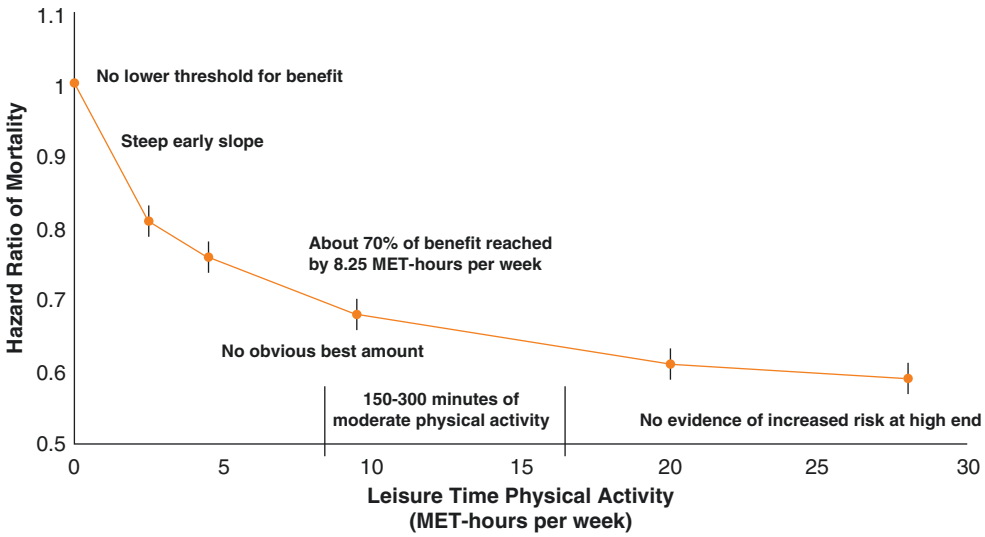

Fig. 3.1 Relationship of moderate-to-vigorous physical activity to all-cause mortality

Source: Adapted from data found in Moore SC, Patel AV, Matthews CE. Leisure time physical activity of moderate to vigorous intensity and mortality: a large pooled cohort analysis. PLoS Med. 2012;9(11):e1001335. doi:10.1371/journal.pmed.1001335.

Table 3.3 Examples of aerobic, muscle-, and bone-strengthening physical activities for children and adolescents (adapted from *Physical Activity Guidelines for Americans 2nd edition*, 2018)

Type of physical activity	Preschool-aged children	School-aged children	Adolescents
Moderate-intensity aerobic	• Games such as tag or follow the leader • Playing on a playground • Tricycle or bicycle riding • Walking, running, skipping, jumping, dancing • Swimming • Playing games that require catching • Gymnastics or tumbling	• Brisk walking • Bicycle riding • Active recreation, such as hiking, riding a scooter without a motor, swimming • Playing games that require catching and throwing, such as baseball and softball	• Brisk walking • Bicycle riding • Active recreation, such as kayaking, hiking, swimming • Playing games that require catching and throwing, such as baseball and softball • House and yard work, such as sweeping or pushing a lawn mower • Some video games that include continuous movement
Vigorous-intensity aerobic	• Games such as tag or follow the leader • Playing on a playground • Tricycle or bicycle riding • Walking, running, skipping, jumping, dancing • Swimming • Playing games that require catching, throwing, and kicking • Gymnastics or tumbling	• Running • Bicycle riding • Active games involving running and chasing, such as tag or flag football • Jumping rope • Cross-country skiing. • Sports such as soccer, basketball, swimming, tennis • Martial arts • Vigorous dancing	• Running • Bicycle riding • Active games involving running and chasing, such as flag football • Jumping rope • Cross-country skiing • Sports such as soccer, basketball, swimming, tennis • Martial arts • Vigorous dancing
Muscle strengthening	• Games such as tug of war • Climbing on playground equipment • Gymnastics	• Games such as tug of war • Resistance exercises using body weight or resistance bands • Rope or tree climbing • Climbing on playground equipment • Some forms of yoga	• Games such as tug of war • Resistance exercises using body weight, resistance bands, weight machines, hand-held weights • Some forms of yoga
Bone strengthening	• Hopping, skipping, jumping • Jumping rope • Running • Gymnastics	• Hopping, skipping, jumping • Jumping rope • Running • Sports that involve jumping or rapid change in direction	• Jumping rope • Running • Sports that involve jumping or rapid change in direction

aerobic exercise, which includes muscle- and bone-strengthening exercises, at least three days per week. Adults should encourage and provide age-appropriate and enjoyable activities to inspire youth to be physically active.

Community and Clinic Initiatives

The cost of an individual gym or fitness program membership can be a barrier for many people. Some communities, health care systems, or corporations sponsor and encourage physical activity through free programs in local parks. Shopping mall walking programs positively impact individuals and communities [131, 132]. Physical education classes are often cut as part of cost-saving measures in school systems, which can be detrimental to the health of the students. The rise in childhood obesity and the well-documented individual and public health issues secondary to obesity should underscore why physical education and activity must remain a cornerstone of our school systems [133].

Future Trends

Primary care has an integral role in improving the lives of the population. The transition to value-based care payment models, where doctors are paid for keeping people well rather than for performing procedures, will appropriately incentivize care approaches that improve health and prevent disease [134, 135]. Physical activity is foundational in the health of individuals and populations, including in the prevention and management of chronic diseases.

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