

Clinical Review

The Role of Physical Activity in Older Adults and Practical Intervention

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Abstract

Description

Physical inactivity (PI), defined as not meeting guidelines for physical activity beyond baseline daily living activities, is common among older adults (age 65 and older) and contributes to increased morbidity, increased mortality and increased health care spending. Understanding the clinical impact of PI on common medical conditions among older adults will help primary care physicians (PCPs) to educate these patients successfully. Physical activity and exercise are effective in the primary and secondary prevention of chronic diseases that can lead to physical impairments, disability and/or premature death. Physical activity and exercise have been shown to improve cognitive dysfunction and painful musculoskeletal disorders as well as diminish frailty and reduce falls, which are highly prevalent among older adults with a significant impact on their ability to function and perform daily activities. Improving PCPs' ability to identify PI, educate patients about the health impact of physical activity and advocate and prescribe appropriate exercise will prevent adverse health outcomes related to PI.

Keywords

physical activity; physical inactivity; sedentary behavior; exercise; older adults; evaluation; intervention; prevention

Introduction

Physical activity (PA) is decreased among older adults aged 65 years and older, the most rapidly growing age group in the United States (US). Between 20 to 50% of older adults are physically inactive, with a greater prevalence of physical inactivity (PI) in women, in urban populations and wealthier countries worldwide.¹ Decreased PA is a large contributor to a number of health problems and is associated with an increase in mortality comparable to that of smoking, diabetes, hypertension, obesity or excessive alcohol consumption.² The World Health Organization ranks PI as the fourth leading risk factor for overall morbidity and mortality worldwide.³ PI contributes to 1–2.6% of total health care costs worldwide, with a large portion of health care spending utilized by older adults with physical limitations.⁴ Despite these figures, in one national study, only 34% of older women were coun-

seled about physical exercise by their primary care providers (PCPs).⁵

PI, often used interchangeably with insufficient PA, has been defined as not meeting the general guidelines for PA: vigorous-intensity PA for 20 minutes or more per day on at least three days per week, moderate-vigorous intensity PA 30 minutes or more per day on at least five days per week, or at least 600 metabolic equivalent (MET)-minutes/week.¹ PA levels should always be modified to suit the individual patient, taking into account his or her age, comorbidities, [dis]ability or baseline level of function. The practical evaluation of PI in a clinical setting is a rich topic for review to improve provider recognition and enhance our ability to prescribe proper interventions.

It is important to recognize common risk factors for PI. Sedentary behavior, particularly increased sitting time, is a well-known risk fac-

tor for PI and is associated with many chronic medical disorders and overall mortality.^{6,7} Other individual risk factors include the presence of musculoskeletal (MSK) disease, mobility limitation, poor health, perceived barriers to exercise, lack of knowledge and/or depressive symptoms.⁸ These risk factors can be mitigated in physically active people.

This review briefly covers the impact of PI on selective medical problems affecting the activities of daily living (ADL) of older adults, the practical evaluation of PI and pragmatic approaches to intervention from a clinician perspective.

Impact of Physical Inactivity and Activity on Specific Medical Conditions

PI is a contributing factor to at least 35 chronic medical conditions, including cognitive dysfunction, cardiorespiratory disorders and a range of MSK disorders.⁹ PA and exercise can be effective in primary and secondary prevention of chronic diseases that can lead to physical impairments, disability and premature death.¹⁰ In addition, PA and exercise are associated with improved quality of life, successful aging and reduced health care burden.

Cognitive Dysfunction

Studies on older women have shown that PI is associated with cognitive impairment, Alzheimer's disease and dementia of any type in greater than 15% of cases, while regular PA and exercise were associated with decreased risk of cognitive impairment and dysfunction.¹¹ Although the exact underlying mechanisms of PA on cognitive function in patients with mild cognitive impairment and dementia are unknown, the theory that reciprocal stimulation of neuroplasticity with an enriched environment from PA is commonly posited.¹² Other proposed mechanisms include increased blood flow to the brain, improved cardiovascular and metabolic health, prevention and treatment of depression and improved sleep quality.¹³ In addition, PA and exercise increase the volume of the hippocampus and improve white matter integrity.¹⁴

A recent systemic review demonstrated that

home-based PA programs, such as walking, are safe and effective in delaying cognitive decline and improving ADL and physical fitness in patients with dementia; further, such programs have high adherence.¹⁵ PA and exercise can be combined with cognitive exercise, with potentially synergistic effects on cognitive function in older adults who have either mild cognitive impairment or dementia, as measured by global cognitive function, ADL and mood.

Falls

Aging can lead to an increase in accidental falls, due to the deterioration of muscle strength, dynamic balance and speed of movement execution. We might thus expect that low levels of PA among older adults would be associated with increased risk of falls, but the relationship between PA and increased fall risks is complex. Increased fall risk is most often attributed to physical limitations, rather than being directly attributable to the low PA level.¹⁶ At the same time, increased PA lowers fall-related injuries by 32 to 40%.¹⁷ The association between PA and fracture is also controversial. PA may be associated with fracture due to activity-related injury, such as from bicycling,¹⁸ but protective against osteoporotic fractures.¹⁹

Musculoskeletal System

MSK pain is strongly associated with decreased physical function among older adults, and chronic MSK pain is known to increase with advancing age. PI is either a cause or contributor to many MSK disorders, and reduced PA has been associated with an increased number of chronic MSK pain sites. For example, 37% of the arthritis population is physically inactive.²⁰ This may be due to the fact that muscle strength around a joint, an important factor in preventing the progression of osteoarthritis (OA), decreases with PI.²¹ MSK pain is often cited as a barrier to engaging in PA and exercise and can lead to a vicious cycle of deteriorating function. PA, when appropriately prescribed, can improve muscle mass and strength, protecting the joint complex and thus preventing and reducing the pain and dysfunction associated with MSK disorders.²²

Frailty

Frailty is a state of increased vulnerability, which has been operationally defined as a

condition meeting three out of the following five phenotypic criteria: low grip strength, low energy, slow walking speed, low PA, and unintentional weight loss. It is one of the major geriatric syndromes, with a prevalence of 7–16% in older adults aged 65 years and older.²³ Frailty is closely associated with adverse health outcomes, such as disability, falls, hospitalization and death.²⁴ While PI is a cardinal feature of frailty, it worsens frailty by affecting multiple physiologic systems, such as with the classically-observed consequences of prolonged bed rest during hospitalization, including reductions in muscle mass, strength, gait speed and physical function.²⁵ PA, particularly aerobic and strengthening exercises, are key therapies in the management of frailty.

Evaluation of Physical Activity

The first step in addressing PI in older adults is measuring their current level of PA. Evaluation methods can be divided into self-report questionnaires, diaries/logs, direct observation and wearable devices. Regardless of the method, several aspects of PA should be measured, including PA type, intensity, frequency, duration, participant's burden, cost and individual-specific limitations.²⁶ This information can be used not only to diagnose PI but also as a baseline to objectively monitor progress during follow-up.

There are several survey instruments available to evaluate physical activity levels in community-dwelling older adults. The Physical Activity Scale for the Elderly (PASE), Community Healthy Activities Model Program for Seniors (CHAMPS) Questionnaire and the Yale Physical Activity Survey (YPAS) were extensively studied in different older adult populations and reported to correlate with performance-based (6-minute walk test) and other self-reported quality measures (such as the Short-From-36 survey).²⁷⁻²⁹

Assessment questionnaires used in health care settings include the Rapid Assessment of Physical Activity (RAPA) and the two-question "Exercise Vital Sign" by the American College of Sports Medicine (ACSM).³⁰ The RAPA is a 9-item questionnaire covering the range of PA from sedentary to regular vigorous PA, as well as strength training and flexibility.³¹ Assessing the "Exercise Vital Sign" involves asking about

the weekly frequency of at least moderate activity, as well as the duration of engagement for those activities on a given day.³⁰

Wearable monitoring devices can be useful for obtaining objective measurements of PA. In addition, these activity tracking devices can be useful to enhance behavioral changes to maintain a physically active lifestyle by self-monitoring and goal setting.^{32,33} Commonly used devices include pedometers, accelerometers, heart rate monitors and armbands with mobile phone apps. Pedometers are traditionally used to measure step counts, allowing varying levels of PA to be divided into classifications such as highly active (>10,000 steps/day), moderately active (5000–10,000 steps/day) and below active (<5000 steps/day).³⁴ Accelerometers can provide more detailed information regarding the intensity and level of PA. With the advancement of mobile health technology, the accelerometers in smartphones, smartwatches and other wearable devices can provide increased data related to PA, including heart rate (HR) monitoring, profiles of PA throughout the day and intensity of activity (such as moderate to vigorous PA).

The correlation of the above-mentioned self-reported survey measures (PASE, YAPS, CHAMPS) with sensor-based activity monitors around the ankle and waist ranged from 0.36 to 0.61 with acceptable validity. When compared to the total energy expenditure, the "gold standard" metric of PA, only CHAMPS was significantly correlated ($r=0.28$) among self-reported survey measures, while pedometers, accelerometers and armbands were significantly correlated with the total energy expenditure ($r=0.48$ to 0.60).^{27,29,35}

Interventions to Promote Physical Activity: Education and Prescription

PA guidelines are widely available to the public from different federal agencies and from Despite the widespread availability of this information, there are still barriers to optimal adherence to PA guidelines among the general public. PCPs have an important role in optimizing patient adherence by educating patients about the clinical impact of PI and PA on morbidity and mortality.³ Older adults, espe-

Table 1. Exercise Prescription Based on Physical Activity (PA) Guideline for Older Adults (Modified from *Physical Activity Guidelines for Americans*, 2nd edition, US Department of Health and Human Services and Exercise is Medicine, American College of Sports Medicine)³⁶

	Goal	Other exercises
Intensity Type of PA <input type="checkbox"/> Light <input type="checkbox"/> Moderate <input type="checkbox"/> Vigorous <input type="checkbox"/> Walk: <input type="checkbox"/> 2500 <input type="checkbox"/> 5000 <input type="checkbox"/> 7000 <input type="checkbox"/> 9000 <input type="checkbox"/> Jog/Run <input type="checkbox"/> Bike <input type="checkbox"/> Swim/water aerobics <input type="checkbox"/> Dancing <input type="checkbox"/> Others: <input type="checkbox"/> Relative intensity : ___ (0-10, 0: sitting, 10: highest level) Balance exercise <input type="checkbox"/> Narrow stance <input type="checkbox"/> Semi-tandem stance <input type="checkbox"/> Lunges <input type="checkbox"/> Walking sideways/backwards/Carioca <input type="checkbox"/> One leg stance	Moderate-intensity: brisk walking, 5-6 in 0-10 relative intensity scale Vigorous-intensity: jogging or running, 7-9 in 0-10 relative intensity scale	<ul style="list-style-type: none"> • Daily activities: some yard work, such as raking and pushing a lawnmower • Sports: tennis or basketball, walking as part of golf, hiking • Some forms of yoga
Frequency of PA <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 days per week	<ul style="list-style-type: none"> • Total of 150- 300 mins (30-60 mins/day for 5 days/week) for moderate-intensity PA • Additional benefits with 300 mins per week exercise • Or 75-150 mins weekly for vigorous-intensity PA • Balance exercise frequency: 3 sessions per week 	
Time duration each session <input type="checkbox"/> 10 <input type="checkbox"/> 20 <input type="checkbox"/> 30 <input type="checkbox"/> 45 <input type="checkbox"/> ≥ 60 minutes		
Strengthening exercise <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 days per week <input type="checkbox"/> Chair rise <input type="checkbox"/> Push up (wall, kitchen counter to floor) <input type="checkbox"/> Planks or bridges <input type="checkbox"/> Semi-squat <input type="checkbox"/> Dumbbells/kettlebells lifting <input type="checkbox"/> ___ lbs <input type="checkbox"/> Elastic bands (color/resistance): _____ <input type="checkbox"/> 3 <input type="checkbox"/> 5 <input type="checkbox"/> 8 <input type="checkbox"/> 10 repetitions <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 times a day	Frequency goal: ≥2/week 10 repetitions, 3-4/day	<ul style="list-style-type: none"> • Daily activities: digging, lifting, and carrying as part of gardening, carrying groceries • Weight machines at the gym • Some yoga postures and some form of tai chi

Abbreviation: mins=minutes

cially those with chronic medical comorbidities, should be counseled from the first encounter. Patient education should improve self-efficacy, such that they feel confident to engage in safe PA, and be encouraged to make changes that minimize sedentary behavior. (**Appendix**) A simple PA assessment questionnaire such as the two-question "Exercise Vital Sign" can be included on the initial intake form.

The American College of Sports Medicine has proposed the concept of "Exercise is Medicine," positioning "exercise prescription" as a standard medical intervention. Exercise prescription has been shown to be effective at increasing PA levels,³⁶ and should be specific with regard to the following domains: frequency, duration, intensity and mode of exercises. Frequency and duration are familiar concepts to PCPs and patients alike, but intensity (e.g., moderate to vigorous activity during ADLs or exercise) may be less familiar and more difficult to grasp. A metabolic equivalent (MET), the ratio of work metabolic rate to standard (quiet) resting metabolic rate of 1 (4.184 kJ*kg⁻¹*hour⁻¹), is a commonly used measure of the intensity of PA. Walking briskly (2.5 to 4.0 mph) and raking leaves are both considered moderate-intensity activities (about 3 to 5.9 METs). Vigorous-intensity activities (over 6 METs) include jogging or running, carrying heavy groceries or partici-

pating in a strenuous fitness class. (**Table 2**) Alternatively, with the increasing use of wearable devices and fitness trackers, HR monitoring can be used in guiding the intensity of exercise through a target HR. The target HR range can be easily calculated from maximum HR (220-0.7*age), multiplied by 0.64–0.76 for moderate-intensity activity and by 0.77–0.93 for vigorous-intensity activity.³⁹ Thirty to 40 minutes of moderate-to-vigorous intensity PA was shown to mitigate the risk of death associated with increased sitting time (>8 hours/day).⁴⁰

Typical PA/exercise programs for older adults include balance exercises for patients at risk of falls, flexibility training to improve mobility, aerobic endurance exercise designed to improve cardiovascular health and muscle-strengthening exercise, which can be effective at improving frailty and pain from degenerative joint disease.⁴¹ An individualized approach is key for the successful design of any PA/exercise plan.

There is evidence that a combination of aerobic exercise and resistance training is better than either form alone. Multimodal physical exercise therapy (strength, flexibility and aerobic exercise in each session) appears to be more effective at improving quality of life than generalized activity such as walking in patients with knee OA;⁴² however, generalization of

Table 2. Metabolic Equivalentents for Different Daily Activities and Physical Exercises³⁷

Intensity of activity, relative intensity	Metabolic equivalent (MET)	Daily activities (MET)	Physical exercises
Resting Sedentary	1 MET	Lying in bed, sitting quietly, watching a movie	
Light-intensity physical activity <ul style="list-style-type: none"> • Very light to fairly light* • Can talk and sing 	1.5-3 MET	Computer work (1.8 MET) Laundry (2.2 MET) Preparing and serving food (2.3 MET) Washing dishes (2.3 MET) Ironing (2.3 MET)	Standing (2 MET), Walking on slow (2.0 mph), level, firm surface (2.5 MET)
Moderate-intensity physical activity <ul style="list-style-type: none"> • Fairly light to somewhat hard* • Can talk but not sing 	3-6 MET	Sweeping floors or vacuuming (3-3.5 MET) Gardening (4 MET) Raking leaves (4.2 MET) Carrying and stacking wood (5.5 MET) Stair climbing (5.5 MET)	Yoga (3.2MET) Walking briskly at 2.5 to 4 mph (3-5.9 MET) Golf (4.3-4.5 MET) Badminton (4.5MET) Swimming gently in a pool (1.2 mph: 4.3 MET) Tennis double play (4-5 MET)
Vigorous-intensity physical activity <ul style="list-style-type: none"> • Somewhat hard to very hard* • Talking is interrupted by large breaths 	Over 6 MET	Shoveling sand, coals (7 MET) Carrying heavy loads such as bricks (7.5 MET) Heavy farming such as bailing hay (8 MET) Shoveling, digging ditches (8.5 MET)	Aerobic dancing (6.5 MET) Stair machine Swimming at 1.6 mph (6.8 MET) Strenuous fitness class Jogging at 5 mph (8 MET) Tennis single play (8 MET) Running (13 MET with running at 8 mph)

Abbreviation: mph=miles per hour

*Borg perceived rate of exertion scale

this approach is limited due to the scarcity of available studies. High-intensity interval training (HIIT) involves alternating high-intensity aerobic exercise with light-recovery exercise or rest between intervals. It can be more effective at improving cardiorespiratory fitness, vascular function, skeletal muscle metabolism and cognitive function.⁴³

PCPs can be instrumental in educating community-dwelling older adults using community resources such as exercise classes at local senior centers, or local fitness centers with a personal trainer who is experienced in training this population. If there are significant functional deficits and neuromuscular challenges, a referral to a Physical Medicine and Rehabilitation specialist (physiatrist) should be considered.

Challenges

Despite common worries among patients and health care providers, there is scant evidence to suggest that older adults are at high risk of

injury secondary to PA. Nonetheless, fear of injury has been cited as a barrier to PA, as has lack of motivation, lack of time and perceptions related to age, health status or level of fitness.⁴⁴ Other external barriers include lack of transportation, poor weather conditions and lack of social and/or financial support. Addressing these barriers to PA can help to improve patient compliance.

The interpretation of PA measurement by different modalities can be challenging, as these provide different metrics without a universal scale widely accepted by both patients and PCPs. Although PA monitoring-based interventions were reported to be effective at improving PA among older adults, the effectiveness varies with different instruments and among different subgroups of older adults; for example, there is limited efficacy of wearable activity trackers among adults aged 80 years or greater.^{33,45} Furthermore, there was limited evidence of PA monitoring devices directly promoting

health outcomes.⁴⁶⁻⁴⁸ If patient access to PA monitoring devices is limited, PCPs may utilize survey-based monitoring.

Newer and more recently popularized modes of exercise are less well known to patients and PCPs, leading to more concerns among older adults. For example, HIIT was less utilized due to low familiarity and concern for injury, despite the absence of any reports of serious adverse events associated with HIIT.⁴⁹⁻⁵¹

Although there is an overall reduction in the risk of cardiac death with exercise, it is true that exercise can precipitate malignant ventricular arrhythmias and increase the risk of cardiac arrest in sedentary adults with preexisting coronary artery disease or with risk factors.⁵⁰ Pre-exercise testing, with graded exercise testing, may be indicated before vigorous exercise in this population.

MSK pain can make PA challenging for older adults, leading to reduced quality of life and disability. Common MSK injuries related to PA have been characterized as acute, overuse/repetitive strain or sprain (more frequently reported in the lower body), with falls and overexertion cited as common causes of injuries. However, MSK injuries associated with PA can be prevented by choosing safer forms of PA, tailoring individualized exercise approaches and educating patients about strategies for preventing MSK injuries, such as pre-exercise warmups.

Conclusion

PI is prevalent among older adults and can negatively affect chronic medical conditions, cognitive function and physical abilities, leading to decreased quality of life and increased mortality. To improve patient outcomes and reduce health care expenditure, physicians should strive to evaluate PA, educate patients about the health impact of PA, and prescribe detailed and appropriate exercise. Exercise prescriptions can be reviewed in detail, including frequency, duration, intensity and mode, while barriers can be discussed and managed for successful outcomes.

Conflicts of Interest

The authors declare they have no conflicts of interest.

Drs. Lee, Patel and Werner are employees of Sunrise Health GME Consortium, an organization affiliated with the journal's publisher.

This research was supported (in whole or in part) by HCA Healthcare and/or an HCA Healthcare affiliated entity. The views expressed in this publication represent those of the author(s) and do not necessarily represent the official views of HCA Healthcare or any of its affiliated entities.

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