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Falls

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Synonyms

Accidental falls

Definition

A fall is an event during which a person inadvertently comes to rest on the ground or other lower level (WHO 2007).

Overview

Falls are more common as people age, but the consequences of a fall can dramatically change people's life trajectory, causing disability (See ▶ "Physical Disability"), functional limitation and, for some, early institutionalization. The good news is that evidence suggests many falls can be prevented, which can help older adults maintain quality of life, health, and capacity to participate in home- and community-based activities (See ▶ "Ageing and Dance"). Fall prevention interventions such as exercise programs and home safety checks have been proven to be cost-effective (See ▶ "Aerobic Exercise Training and Healthy Aging"). This entry focuses on falls among community-dwelling older adults (≥65 years); there is a vast literature on falls in other settings (e.g., hospitals, nursing homes, assisted living facilities). Falls are a common

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cause of disability and functional limitation among older adults (See ▶ "Disability Measurement" and ▶ "Functional Limitation"). According to the World Health Organization (WHO) Global Report on Falls Prevention in Older Age, 28–35% of all older adults fall each year globally with higher rates among older groups (WHO 2007). Approximately 646,000 people die globally due to falls each year; more than 80% of these deaths happen in low- and middle-income countries, and 60% of these happen in the Western Pacific and Southeast Asia (WHO 2018). Even when people do not die, falls can have serious consequences. Injuries occur in 40–60% of the falls, and emergency department or primary care physician visits are required for approximately 25% of all falls (Masud and Morris 2001; Tinetti and Speechley 1989). In a longitudinal study, 68% of fallers had injuries, of which 24% needed health care, and 35% reported functional decline (Stel et al. 2004). Falls are the leading cause of unintentional injury and injury-related disability and deaths among older adults in the USA (29,668 deaths, 61.6/100,000), and the rate of fall-related deaths among older adults increased 31% from 2007 to 2016 (Burns and Kakara 2018). An older adult goes to an emergency room in the USA due to a fall every 11 s (3 million visits per year), and an older adult dies from a fall-related injury every 19 min (National Council on Aging 2016). Falls are responsible for 40% of nursing home admissions (Spoelstra et al. 2012). Close to 95% of hip fractures are falls-related (See ▶ "Hip Fracture"); 95% of the hip fracture patients are discharged to nursing homes, and 20% die within a year (Florida Department of Health 2011; Schnell et al. 2010).

Key Research Findings

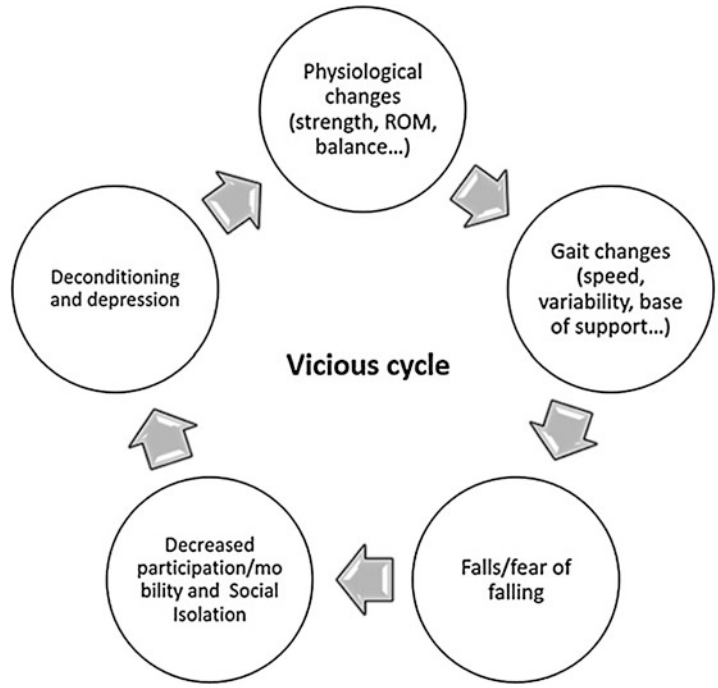
Risk Factors

Falls among older adults are multifactorial and include intrinsic and extrinsic risk factors; examples of intrinsic factors, those within the individual include fear of falling, poor balance, gait impairments (See ▶ "Sarcopenia"), lower limb weakness, reduced physical activity, and frailty (Oliveira et al. 2018; Vieira et al. 2016) (See ▶ "Physical Activity, Sedentary Behaviors, and Frailty"). Additional intrinsic risk factors include cognitive, visual, and hearing impairments as well as certain chronic conditions (See ▶ "Chronic Disease Self-Management") (e.g., arthritis, diabetes, stroke, Parkinson's disease, neurological diseases, incontinence) (See ▶ "Parkinson's Disease") and associated medication issues (e.g., polypharmacy, interactions, psychoactives) (Lord et al. 2001). Examples of extrinsic factors include environmental risks that exist within and/or external to the individual's home (Ambrose et al. 2013). Common examples of environmental risk factors within the home include excessive clutter, throw rugs, and exposed cords, lack of handrails or grab bars in the bathroom, and children or pets under foot. Common examples of environmental risk factors external to the home include slippery surfaces due to weather and outdoor conditions (e.g., rain, sleet, snow), uneven walkways and sidewalks, and crowds. Further, risk factors such as dim or insufficient lighting can exist within and external to the home. Table 1 presents common risk factors for falls among older adults (Adapted from Vieira et al. 2016).

In terms of physical functioning, walking slower than 0.8 m/s and being unable to complete at least eight chair rises in 30 s indicate increased risk of falls and frailty (Guccione et al. 2011) (See ▶ "Frailty Screening"). Decreased physical reserve capacity is associated to frailty and increased risk of falling in older people (Fried 2001) (See ▶ "Biology of Frailty"). Therefore, falls are associated with a cycle of aging-related physiological declines, biomechanical/mobility impairments (See ▶ "Changes in Body Composition and Energy Expenditure") (e.g., gait and balance), falls, fear of falling, decreased physical activity, functional decline, deconditioning, frailty, social isolation, reduced quality of life, depression, and increased risk of subsequent falls (Vieira et al. 2016; Mikaela et al. 2011) (See ▶ "Mobility and Frailty"). Fallers have 66% chance of suffering a subsequent fall within a year (Nevitt et al. 1989). Figure 1 illustrates the cycle of aging-related changes that increase the risk of falls among older adults.

Falls, Table 1 Common risk factors for falls among older adults (Adapted from Vieira et al. 2016)

Risk	Characterization
Previous falls	During the previous 12 months
Fear of falling	Low fall efficacy confidence scale scores
Balance problems	Increased postural center of pressure sway
Gait and mobility problems	Increased variability of step length, shorter single support time during dual task gait, timed up, and go test time >12 s
Pain	Lower limb and foot pain
Drugs	Polypharmacy (≥4), psychotropic, antidepressants, benzodiazepine (See ▶ "Benzodiazepines")
Cognitive impairment	Decreased attention, verbal ability, processing speed (executive function), and immediate memory
Urinary incontinence	Rushing to the bathroom at night
Stroke	Decreased paretic limb contribution to standing balance control, increased variability of step length, inability to step with the blocked limb (See ▶ "Stroke")
Diabetes	Peripheral neuropathy, as well as accelerated balance, somatosensory, visual, vestibular, and cognitive function decline



Falls, Fig. 1 Cycle of changes and factors associated with falls among older adults

Gait changes associated with falls include decreased speed, increased variability, decreased step length, increased single (stance) and double support times, and decreased swing time (time with only one foot on the ground) (Toebes et al. 2012; Verghese et al. 2009). Balance impairments associated with falls include increased center of pressure displacement area and velocity during one-leg stance – area under the curve = 0.72, sensitivity = 78%, and specificity = 68% (Oliveira et al. 2018). Cognitive impairments also affect gait and are associated with falls and therefore should be considered when designing interventions (Zhang et al. 2019) (See ▶ "Age-Related Cognitive Impairment").

Prevention

Prevention is a term used often to describe efforts to reduce fall occurrences. However, given the multifactorial nature of falls, and the effects of aging-related physiological changes and functional decline, "falls reduction" is more precise because some falls will always happen. With that disclosure, we will discuss some of the evidence-based strategies used to "prevent"/reduce falls among older adults living in the community. Guidelines have been published to guide efforts to reduce falls among older adults (e.g., AGS et al. 2001; Tinetti and Speechley 1989). A vast collection of evidence documents the effectiveness of falls reduction strategies, which can be implemented in a variety of settings (e.g., health care, community, home) and populations (based on risk factors, race/ethnicity, frailty level, mobility), are available in the literature. Table 2 contains a select list of online resources that report the effectiveness of interventions based on randomized controlled trials and community-based translations of such interventions.

These resources contain systematic reviews, compendiums, and recommendations for implementing interventions. For example, the CDC website presents "A Guide to Implementing Effective Community-Based Fall Prevention Programs"; the guide lists programs and implementation strategies for community-based organizations. It includes examples and explains the resources need to implement and sustain the programs (CDC 2015). Some of the most commonly used and effective strategies to reduce falls among older adults include exercise, improvement in environmental, and home safety (Vieira et al. 2016).

Exercise (See ▶ "Sport and Healthy Aging")

Exercise is an effective intervention to reduce falls among older adults (Albert and King 2017) (See ▶ "Yoga Practice and Health Among Older Adults"). Gait and balance training and lower limb strengthening exercises and physical therapy reduce falls among community-dwelling older adults from 20% to 30% (Gillespie et al. 2012; Sherrington et al. 2017). Exercise and physical therapy help retrain, recover, and improve balance, strength, and gait, as well as reduce fear of falls and falls in community-dwelling older adults (risk ratio = 0.87, 95%CI = 0.81–0.94) (Michael et al. 2010). To maintain the body in a state of balance, three major postural control strategies are used (i.e., ankle, hip trunk, and step); this control depends on optimum functioning of the neural and locomotor systems (Horak 1987). Therefore, exercises to improve these three strategies are needed to improve balance and prevent falls among older adults with postural control deficits. This fact is further supported by a recently published Cochrane review, which found high-certainty evidence that exercise programs primarily involving balance and functional exercises reduce the number of falls and the number of fallers among community-dwelling older adults (Sherrington et al. 2019). Further, as reported, these programs only present nonserious adverse events, if any. Examples of evidence-based exercise programs to reduce falls are presented next.

The Otago Exercise Program (OEP) was originally developed by the Falls Prevention Research Group at the University of Otago Medical School in New Zealand as an individually tailored exercise program delivered by a nurse or physical therapist within the older adult's home (Campbell et al. 1997). The program was shown to significantly reduce falls by 35% among high-risk older adults (Colligan et al. 2015). Based on its history of success, OEP was adopted by the Centers for Disease Control and Prevention and translated for use in the

USA in 2012 (Shubert et al. 2015). The program includes a series of 17 strength ($n = 5$) and balance ($n = 12$) exercises. The participant receives six face-to-face visits over a 1-year period, four within the first 8 weeks, and then another after 6 and 12 months, respectively. When possible, the program is complemented by telephone sessions, and participants are encouraged to engage in a self-led walking program. Studies have confirmed the effectiveness of the translated version, which is shown to significantly improve participants' actual and perceived functional performance (Shubert et al. 2017a). From that time, to account for the complexities of

Falls, Table 2 Select online resources for falls reduction

Resource	Website
Centers for Disease Control and Prevention (CDC)	https://www.cdc.gov/homeandrecreationalsafety/falls/community_preventfalls.html
Cochrane library	https://www.cochrane.org
National Council on Aging (NCOA) National Falls Prevention Resource Center	https://www.ncoa.org/center-for-healthy-aging/falls-resource-center
National Institutes on Aging	https://www.nia.nih.gov/health/topics/falls-and-falls-prevention
US Preventive Services Task Force	https://www.uspreventiveservicestaskforce.org/Page/Document/final-evidence-summary24/falls-prevention-in-older-adults-counseling-and-preventive-medication

the health-care system in the USA and increase dissemination, additional group-based and Internet-delivered models have been developed with similar effectiveness (Shubert et al. 2017b, 2019).

The Stepping On fall prevention program is a small group program underpinned by cognitive behavioral theory, adult learning principles, and self-management strategies. This multifaceted program was developed by a group of researchers at the University of Sydney in Australia (Clemson and Swann 2019). It was proven effective in reducing falls by 31% in older people with a history of a fall in the past year or who were concerned about falling. The program runs for seven weekly 2-h sessions with a follow-up phone call or home visit and a 3-month booster session. The program covers a range of issues, including personal fall risk, strength and balance exercises, home hazards, safe footwear, vision and falls, safety in public places, community mobility, coping after a fall, and understanding how to initiate a medication review. It includes specific practical strategies and resources that assist participants to self-regulate changes and taps into social and environmental influences to maintain self-selected actions and lifestyle changes (Clemson and Swann 2019) (See ▶ "Healthy Lifestyle"). Training in Stepping On commenced in the USA in 2006 with a series of translational projects which determined key features for delivery (Mahoney et al. 2017) and supported its applicability and effectiveness in practice (Ory et al. 2014; Strommen et al. 2017). The program is supported by the CDC (Stevens and Burns 2015), and ongoing training is offered by the Wisconsin Institute for Healthy Aging enabling widespread distribution (See ▶ "Healthy Aging").

As part of the evidence-based movement in the USA, the Administration for Community Living (ACL) has supported the development of a training and delivery infrastructure to disseminate evidence-based programs for older adults through the aging services network (Boutaugh et al. 2014). Through a series of grants, 37 ACL grantees delivered 1 or more of 8 evidence-based fall prevention programs to 45,812 older adults across 22 states from 2014 to 2017 (Smith et al. 2018). The expanding number of programs supported by ACL and other funding mechanisms enable a diverse set of interventions to be available to older adults with varying levels of fall-related risk and mobility. Because these programs were purposively created for particular populations based on their content, structure, and activities, these interventions can have unique benefits for older adults. Based on the participant's level of fall risk, they may enroll in a particular program, and upon its conclusion, they may enroll in another program that is more challenging or includes higher levels of physical activity (See ▶ "Physical Activities"). Such enrollment can be sequential or concurrent and is intended to sustain or incrementally improve upon the benefits received from the initial program (Lee et al. 2018).

Environmental/Home Safety (See ▶ "Home Modifications")

The physical environment at home and in the community may pose risks for falls among older

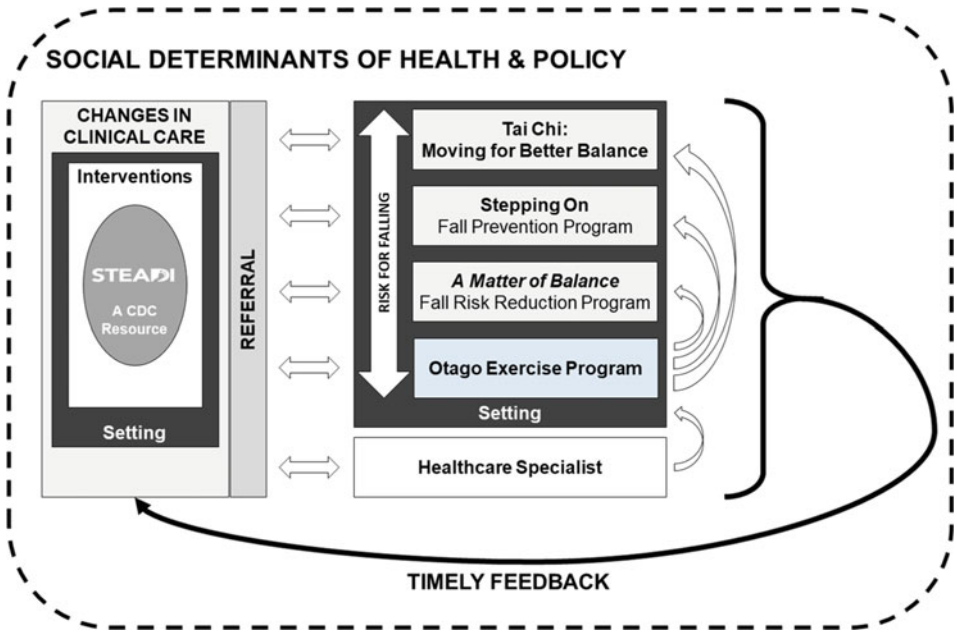
adults. For example, a fall may happen when an older adult gets up from bed at night to go to the bathroom and trips on the shoes or some other piece of closing she/he left on the ground on the way to the bathroom or the person may trip on a cord or hit a poorly placed piece of furniture. We all tend to accumulate things over time; reducing clutter, removing rugs and mats, and properly placing furniture can minimize the risk of slips, trips, and falls. Another common environmental risk factor are stairs, which may have been fine for many years, but start posing a risk as the person gets older and starts to decline physically. Grab bars and rails may also need to be placed strategically around the home and in bathrooms and showers. Other things as simple as the placement of often used pots and pans within reach (not deep under the sink or cabinets) may help reduce falls. Home screens for risk factors (e.g., rugs, clutter, cords) and subsequently making environmental adaptations to reduce hazards as well as behavioral strategies to safely negotiate the environment (such as stairs/steps replacement with ramps) have been found to reduce the risk of falls in older adults (Clemson et al. 2008). This intervention has been shown to be effective when delivered by an occupational therapist. Further, studies have demonstrated that the best investment is when it is provided for older people who are at risk, such as those who had a recent hospitalization and previous fall or have a vision impairment (Pighills et al. 2011).

Future Directions of Research and Practice

Falls reduction relies on the removal, reversal, or compensation for the risk factors. Older adults with a history of falls and/or disabilities should undergo comprehensive physical, functional, and cognitive evaluation and treatment to prevent subsequent falls and related injuries (Colon-Emeric et al. 2013) (See ▶ "Comprehensive Geriatric Assessment"). Targeted interventions including exercise and home safety improvements are effective in reducing the number of falls among older adults by 20–30% (Gillespie et al. 2012). However, in the USA, Medicare does not cover preventative evaluation and treatments, and falls remain a significant problem in both magnitude and costs. The direct medical costs of fall-related injuries in the USA will reach $68 billion by 2020 (CDC 2014); a 20% reduction would represent $13.5 billion in savings.

While much is known about effective interventions and strategies to reduce falls, the persistent high prevalence of falls, related injuries, and death indicates that further advances in research and practice are needed. As with any solution, efforts are needed to ensure what works get into the hands of the people who need it most. As such, additional dissemination and implementation research is needed to better understand the science of diffusing innovation and the factors that foster or impede adoption at the organizational and individual level. Further, assessing organizational capacity to host a single intervention relative to multiple interventions over time could improve our understanding about embedding effective interventions in diverse settings. Better understanding the incremental impact of coordinated sequential evidence-based program enrollment can help define appropriate sequences (order) and cadences (timing) to optimize impact on fall-related risk.

While community-based falls reduction programs are extremely beneficial, and can be offered in a variety of settings (e.g., residential facilities, faith-based organizations, senior centers), they also need to be integrated into health-care systems. Therefore, it is important to develop and integrate fall a prevention framework to identify risks, address the issues that pose immediate risk for falls, refer older adults at risk to ongoing services to address the risks and potential consequences (i.e., falls and related injuries), and follow-up to monitor progress (See ▶ "Geriatric Rehabilitation, Instability, and Falls"). Communication between clinical and community settings is essential when developing prevention frameworks because community programs need to educate clinicians about the value of evidence-based fall prevention programs and who they are appropriate for and inform them when and where they will be occurring in their community (leave



Falls, Fig. 2 Clinical/community fall prevention collaboration example

behind flyers and other materials, websites, and shared community calendars are often helpful). Clinicians can then recommend and refer older adults to attend an evidence-based program adequate to address their limitations. When older adults arrive at the program, they should share and tell the program deliverer they were referred to attend by a health-care provider. This will help the deliverer coordinate an appropriate channel for feedback. After participating in the program, the participant can return to their health-care provider and inform them about their progress in the program, which should activate assessments, referrals, and plans of care.

Figure 2 illustrates a clinical/community fall prevention collaboration, which links and integrates fall prevention efforts across these sectors. These relationships exist within the context of social determinants of health where not all social or physical environments are similar (nor are those who live within them) and therefore the services offered differ (in availability, access, affordability, and quality). While these social determinants and policies that influence health-care delivery can be protective or harmful, they must be considered in the context of creating and influencing systems change for fall prevention in a given area (Schneider et al. 2015; Smith et al. 2017).

In this example, an older adult goes to their physician who uses the Stopping Elderly Accidents, Deaths, and Injuries (STEADI) toolkit (Stevens and Phelan 2013). This toolkit is based on an algorithm for fall-related decision-making in clinical settings about screening, treatment, referral, and follow-up. The STEADI toolkit and algorithm have been adopted as a basis for implementing fall prevention in Australia (Clemson et al. 2017). Such systems and approaches enable a broader perspective engaging a whole of primary care approach as well as processes to support efficient practices and facilitate referral pathways. As part of patient care, the clinician refers older adults at risk for falls to health-care specialists, like a physical therapist, to improve their lower limb strength and flexibility, for example. After seeing the patient for about 6 weeks, the physical therapist believes she/he is ready to start the Otago Program. After successfully progressing through the exercises over time, the older adult's mobility improves, and the physical therapist recommends that they enroll in

another evidence-based program such as Stepping On. After completing the 7-week Stepping On workshop, the program deliverer recommends that the client enroll in a longer intervention like Tai Chi: Moving for Better Balance, which meets three times per week for 24+ weeks and can help them maintain their strength, mobility, and functioning. Throughout this older adult's journey, there has been timely feedback (directly or indirectly) between the clinician, the physical therapist, the program deliverer, and the older adult.

In addition to emerging frameworks for falls prevention program delivery and integration into health-care systems, technological advances and translations are becoming readily available. Many Internet-based exercise programs exist to facilitate convenience and overcome obstacles associated with going to an exercise facility. However, these self-driven efforts require older adults to actively participate in the program (See ▶ "Exercise Adherence"); thus, efforts are needed to understand the intrinsic motivators that drive utilization. Similarly, many evidence-based programs have been translated for Internet-based delivery (e.g., OEP). These translated interventions have great promise to overcome traditional barriers to participation such as time, transportation, and geographical locale (Smith et al. 2018).

Technologies are also emerging that screen for risk, monitor safety, and detect occurrences (See ▶ "Managing Long-Term Conditions: Wearable Sensors and IoT-Based Monitoring Applications"). Many of these advances are in the forms of sensors that can be worn or stationed around the home. Wearables outfitted with accelerometers and gyroscopes can identify falls based on sudden movements and changes in trajectory. Wearables can also be used to detect fall-related risk factors such as hand tremors associated with low blood sugar (diabetes and malnutrition are both risks for falling) and frailty (Vieira et al. 2019) (See ▶ "Nutrition and Aging: Nutrition Balance and Dietary Protein Needs"). Telehealth capabilities can be useful to provide medical-related counseling or assistance for medication adherence, physical activity, diet, or mental health, which can detect and offset fall-related risk. Further, in the instance of a fall, telehealth can be used to assess the situation, and other wearables and sensors can contact authorities, emergency medical personnel, and loved ones as needed.

Summary

Falls are common among community-dwelling older adults. Falls are one of the leading causes of injuries and injury-related deaths among older adults. Falls are not "natural/normal/expected" as people get older; they are the result of aging-related changes and behavioral factors (e.g., low physical activity levels) (See ▶ "Health Literacy and Health Behaviors"). Falls are multifactorial; risk factors include physical and cognitive impairments, environmental risks, health conditions, and medications. Many falls can be prevented; effective measures to reduce falls include exercise programs, home safety checks, and medication reviews.

Cross-References

- ▶ Aerobic Exercise Training and Healthy Aging
- ▶ Ageing and Dance
- ▶ Age-Related Cognitive Impairment
- ▶ Benzodiazepines
- ▶ Biology of Frailty
- ▶ Changes in Body Composition and Energy Expenditure
- ▶ Chronic Disease Self-Management
- ▶ Comprehensive Geriatric Assessment
- ▶ Disability Measurement
- ▶ Exercise Adherence
- ▶ Frailty Screening
- ▶ Functional Limitation
- ▶ Geriatric Rehabilitation, Instability, and Falls
- ▶ Health Literacy and Health Behaviors
- ▶ Healthy Aging
- ▶ Healthy Lifestyle
- ▶ Hip Fracture
- ▶ Home Modifications
- ▶ Managing Long-Term Conditions: Wearable Sensors and IoT-Based Monitoring Applications

- Mobility and Frailty
- Nutrition and Aging: Nutrition Balance and Dietary Protein Needs
- Parkinson's Disease
- Physical Activities
- Physical Activity, Sedentary Behaviors, and Frailty
- Physical Disability
- Sarcopenia
- Sport and Healthy Aging
- Stroke
- Yoga Practice and Health Among Older Adults

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