21

Geriatric Rehabilitation

Kuldeep Deka, K Vijaya Kumar

LEARNING OBJECTIVES

After the completion of the chapter, the readers will be able to:

- Define the scope and importance of geriatric rehabilitation in healthcare systems.
- Describe the physiological and functional changes associated with aging across major body systems.
- Identify common geriatric syndromes and understand their multifactorial causes and consequences.
- Explain the components and benefits of comprehensive geriatric assessment (CGA).
- Understand the interrelationship between frailty, sarcopenia, and aging-related disability.
- Recognize evidence-based rehabilitation interventions for institutionalized and community-dwelling older adults.
- Outline fall prevention strategies and fall risk assessment protocols in older adults.
- Discuss the concept of successful aging and its relevance to rehabilitation practice.

CHAPTER OUTLINE

- Introduction
- Aging Process
- Comprehensive Geriatric Assessment
- Geriatric Syndromes
- Frailty
- Prevention of Falls in Elderly
- Successful Aging
- Institutionalized Elderly
- Rehabilitation Interventions

KEY TERMS

Comprehensive geriatric assessment (CGA): A multidimensional, interdisciplinary diagnostic process to determine the medical, psychological, and functional capabilities of older adults.

Frailty: A clinical syndrome characterized by reduced strength, endurance, and physiological function, increasing vulnerability to health stressors.

Functional capacity: The ability to perform daily living tasks and engage in social roles independently.

Geriatric rehabilitation: A multidisciplinary approach aimed at improving the functional ability and quality of life of older adults.

Geriatric syndrome: A set of multifactorial health conditions (e.g., falls, delirium, frailty, incontinence) that commonly affect older adults.

Institutionalization: The placement of older adults into care facilities due to health, cognitive or social factors requiring long-term support.

Multicomponent exercise: A type of intervention combining aerobic, strength, balance, and flexibility training to improve physical function in the elderly.

Sarcopenia: The age-related loss of skeletal muscle mass and function, contributing to physical decline and increased fall risk.

STEADI Toolkit: A fall-prevention resource developed by the CDC to assess and reduce fall risk in older adults.

Successful aging: A multidimensional concept encompassing physical health, mental function, and social engagement in older age.

INTRODUCTION

With the aging process, many changes occur at the molecular and cellular level which directly or indirectly result in decline in physical and mental capacity of the older adults and risk of inflammatory and noninflammatory diseases also increases. However, aging is an inevitable phenomenon. The rising global aging population is linked to a higher prevalence of multimorbidity and geriatric syndromes[1], which consequently heighten the risk of adverse health effects, including functional deterioration, hospitalization, and mortality[2]. After being hospitalized, many older adults require rehabilitation assistance to address functional decline or specific healthcare needs[3-5]. As a result, there has been a growing demand for rehabilitation services tailored for elderly individuals, commonly referred to as geriatric rehabilitation[4,6,7]. These services can be provided through various modalities, including home-based care, community-based programs or institutional care settings.

Geriatric rehabilitation (GR) is characterized as a comprehensive approach encompassing diagnostic and therapeutic interventions aimed at optimizing functional abilities, encouraging activity, and maintaining functional capacity and social engagement in older adults with disabling conditions[8]. The primary objectives of GR typically include improving activities of daily living (ADL), fostering social interaction, and enhancing participation, all while promoting a higher quality of life and overall well-being for patients[4,9,10]. However, rehabilitating elderly individuals presents distinct challenges, as the physiological effects of aging can be further influenced by various psychological, social, and genetic factors[11]. Consequently, older adults often require multifaceted rehabilitation that accounts for aging-related changes, underlying health conditions, and psychosocial elements. This population also tends to necessitate lower medication doses, prolonged rehabilitation duration, and meticulous monitoring of cognitive and physical impairments[11].

The purpose of geriatric rehabilitation is basically to restore functional ability or to enhance the residual functionality in elderly with the goal of improving the quality of life. Therefore, the focus of rehabilitation lies in comprehensive evaluation, accurate diagnosis, and targeted therapeutic interventions. For evidence-based therapeutic interventions, a thorough clinical assessment process is required. With a better understanding of physiological changes of the aging process, and how those changes affect the functionality of the elderly person will provide the keys to deciding which clinical assessments are relevant to planning for an effective rehabilitation goal. Age-related changes can be categorized into several key domains, including normal aging processes, prevalent diseases, and alterations in functional capacity, cognitive and psychiatric conditions, as well as social dynamics[12]. Each of these domains contributes to the overall complexity of aging, requiring a nuanced approach to healthcare and support for older adults.

AGING PROCESS

In normal aging, although changes can be described in every organ system, this chapter will address only the changes concerning the clinical decision-making implications. The following are the summarized views of the age-related changes in different systems of the body in the elderly (Table 21.1).

Maintaining adequate physical function (PF) is crucial for older adults to safely carry out daily activities and retain both physical and motor independence[13]. Among the elderly population, the decline in functional capacity is one of the most prevalent indicators of deteriorating health status[13,14]. Consequently, aging individuals with diminished physical function—whether in terms of cardiorespiratory endurance, muscle strength, flexibility, speed or balance—face a reduced likelihood of achieving optimal health and overall well-being[13,15]. These factors collectively contribute to lower levels of physical activity, and when coupled with sedentary lifestyle patterns, further exacerbate declines in mobility and functional capacity. Normal age-related changes and accumulated pathology (noncommunicable diseases) contribute to functional changes seen with the aging process[12] and these can usually be noticed as impaired mobility, dependency in self-care activities, slow walking speed, falls, frailty and many more. Other domains such as psychological and cognitive changes with mild short-term memory loss, word-finding difficulty, and slower processing speed also affect their general well-being. Various social determinants influence the aging process, including low lifetime socioeconomic status, characterized by limited educational opportunities and financial instability[16]. Additionally, experiences of adversity in both childhood and adulthood—such as trauma and other hardships—can contribute to disparities in aging outcomes[16]. Belonging to a minority group further intersects with these challenges, often exacerbating health risks[16]. Moreover, adverse health behaviors, including smoking, obesity, and excessive alcohol consumption, also play a significant role in shaping the trajectory of aging and overall well-being[16].

TABLE 21.1: Age-related changes in various body structures/systems

Body structures/systems	Changes
Neuromuscular	
Motor unit	↓ Number and ↑ size
Contractile properties	↑ Contraction and ½ relaxation time
Peripheral nerves	↓ Motor nerve conduction velocity
Neuromuscular junction	↓ More complex and irregular
Muscle strength	↓ Upper and lower extremities
Mass	↓ Segmental and whole body
Fiber number	↓ Types I and II
Fiber area	↓ Type II fiber area
Fiber type	↔ ; Increased co-expression of myosin isoforms
Muscular endurance	↓ Endurance, earlier onset of fatigue
Central nervous system	↓ Brain mass
	Decline number/efficiency of neurons
	↓ in brain weight and gyral thickness and ↑ in ventricular size
	↓ Neurotransmitters
	Loss of conduction velocity in sensory and motor neurons
	Loss of myelin sheath and large myelinated fibers occur with advancing age
Peripheral nervous system	↓ Nerve cells
	↓ Blood flow to the nerves
Intersystem homeostasis	Hypothermic thermostat declines
	Basal metabolic rate ↓
	Reactivity of autonomic nervous declines
	Vasomotor system less responsive to warm and cool
	↓ Hormonal balance
	↓ Blood flow to the brain
Sensory	
Touch	Receptor and nerve fibers decline with age
	Skin changes such as dermal thinning, ↓ elasticity and vascularity
	Number and size of sweat glands diminish
Vision	Loss of elasticity and orbital fat around the eye
	Diminished tear production
	Tendency toward increased intraocular pressure
	Increased density of the lens
	Loss of visual receptors in the retina or macula
Hearing	Sclerotic changes in tympanic membrane
	Cochlear osteosclerosis
	↓ Receptors in the Corti
	Degeneration of the auditory nerve
Vestibular	Degeneration in the sensory receptors in the otoliths and semicircular canals
Proprioception and Kinesthesia	Less cellular availability for sensory interpretation, less position and movement sense
Taste and smell	80% of taste buds atrophy
	↓ Saliva
	↓ Cells in olfactory bulb
	Chemosensory decrements
Cardiovascular	
Cardiac	↓ Number of myocytes (myofibrils and pacemaker cells)
	↑ Size of myocytes
	↑ Lipid deposition in myocytes
	↑ Lipofuscin deposition in myocytes
	↓ Mitochondrial oxidative phosphorylation
	↑Amyloid deposition in heart
	↓ Rate of protein synthesis in internodal tract
	↑ Fibrosis and calcification of valves (especially the mitral annulus and aortic valve)
Vascular	↑ Endothelial cell heterogenicity
	↑ Nondistensible collagen, fibrous tissue and calcium in media
	↑ Thickness of smooth muscle cells in media
Airways	↑ Rigidity of trachea and bronchi
	↓ Elasticity of bronchiolar walls
	↓ Cilia

Contd...

Contd...

Body structures/systems	Changes
Lungs	↑ Mucus layer thickening and mucus gland
	↑ Thickening of alveolar walls
	↓ Functional respiratory surface
	↑ Alveolar diameter with a ↓ in alveolar surface area
	↓ Alveolar-capillary interface
	↑ Lung compliance
	↓ Lung parenchymal weight
Respiratory muscles	↓ Contractile protein
	↑ Noncontractile protein
	↑ Connective tissue
	↓ Capillary numbers relative to muscle fibers
	↑ Contraction and relaxation times
	Alteration in diaphragm position and efficiency
Bone	↓ Bone strength
	↓ Calcium
	↓ Circulating levels of vitamin D
	↓ Reserve to quickly accelerate the production of red blood cells when needed
Articular cartilage	↓ Water content Glycosaminoglycans—normal or slightly ↓ (content), link protein fragmented, proteoglycans extractability ↓ and ↑ fibrous growth around bony prominences
Thorax	↓ Loss of bone mineralization
	↓ Disk spaces
	↓ Costal movements resulting from reduced sternal and costovertebral motion
	↑ Anterior-posterior thorax diameter
	↑ Kyphosis
Gastrointestinal	
	↓ Motility of the esophagus
	Lower esophageal resting pressure and hesitance of the sphincter
	↓ Motility in the stomach and intestine
	↓ Blood supply to the gut
Renal	
	↓ Mass and weight
	Protein binding of medication is ↓
	Liver mass and blood perfusion decline
	↓ Vascularity
	Decline in excretory and reabsorptive capacities
	↓ Urine-concentrating abilities
Urinary	
	↑ Residual urine
	↑ Reflux into ureters

↑, increase; ↓, decrease

Adapted from: Kauffman TL, Barr JO, Moran ML, editors. Geriatric rehabilitation manual. Elsevier Health Sciences; 2007.

Aging is a natural biological phenomenon characterized by a gradual and irreversible deterioration of physical function across all organ systems[17]. This decline is driven by the cumulative effects of cellular and molecular damage that accumulate over time in response to various stressors[18]. As a result, aging is accompanied by functional impairments that impact overall health and well-being. Extensive research has indicated a significant, though often underrecognized, relationship between aging and numerous chronic conditions in humans[19-27]. Aging itself has been identified as a major risk factor for various prevalent diseases, including diabetes, Alzheimer's disease, Parkinson's disease, cardiovascular disorders, chronic obstructive pulmonary disease, osteoporosis, and osteoarthritis[19-27]. Consequently, managing these conditions often necessitates a combination of therapeutic approaches to achieve sustained health benefits over time[28]. Furthermore, as aging remains a primary contributor to chronic disease development, gaining a deeper understanding of the aging process is expected to facilitate the identification of effective rehabilitative strategies for age-related illnesses and their impact on the overall functionality of older adults.

COMPREHENSIVE GERIATRIC ASSESSMENT

Identifying specific geriatric conditions by performing a detailed evaluation will assist the healthcare professionals in managing these conditions at its incipient stage and prevent further complication. Traditionally, geriatric assessment requires a coordinated approach for the physical, functional, and psychosocial assessment of the elderly to plan for an effective therapeutic program. Moreover, understanding special need-based assessments is likely the key to geriatric rehabilitation. However, portion of this vulnerable elder's population suffer from some health conditions such as

'Geriatric syndrome', whose causes are multifactorial. This syndrome encompasses a range of conditions, including cognitive impairment, delirium, incontinence, malnutrition, falls, gait disturbances, pressure ulcers, sleep disorders, sensory deficits, fatigue, and dizziness, all of which significantly affect the quality of life of older adults[29]. Consequently, conducting a thorough and comprehensive geriatric assessment is essential for gaining a clearer understanding of the challenges faced by the elderly and for developing appropriate interventions to address their needs.

Comprehensive geriatric assessment (CGA) is a multidisciplinary process designed to diagnose and treat medical, psychosocial, and functional challenges faced by frail older adults, aiming to develop a coordinated strategy to optimize health during aging[30,31]. This approach requires an extensive evaluation of various factors, including physical, mental, functional, emotional, psychological, social, spiritual, and environmental influences on an older individual's well-being. By examining each of these domains, a holistic assessment can be conducted, allowing for the identification of the full bio-psycho-social complexity of the individual's health concerns (Table 21.2)[32]. The effectiveness of CGA is enhanced when carried out by a multidisciplinary team specializing in geriatric care. Assessment can have the following benefits[33,34]:

- Increased identification of conditions
- Improved functional and mental status
- Reduced mortality
- Decreased use of nursing homes and acute care hospitals
- Greater satisfaction with care

TABLE 21.2: Geriatric assessment with relation to biopsychosocial model

Domains of health	Components to be assessed
Physical medical conditions	• Comorbid conditions and disease severity • Medication review • Nutritional status • Problem list
Mental health conditions	• Cognition • Mood and anxiety • Fears
Functioning	• Core functions such as mobility and balance • Activities of daily living • Life roles that are important to the patient
Social circumstances	• Social networks: Informal support available from family, the wider network of friends and contacts, and statutory care • Poverty
Environments	• Housing: Comfort, facilities and safety • Use or potential use of 'telehealth' technology • Transport facilities • Accessibility to local resources

Contd...

Adapted from: Welsh TJ, Gordon AL, Gladman JR. Comprehensive geriatric assessment – a guide for the non-specialist. Int J Clin Pract. 2014 Mar;68(3):290–293.

GERIATRIC SYNDROMES

Geriatric syndromes are defined as multifactorial health conditions that arise when cumulative impairments across multiple bodily systems leave older individuals particularly susceptible to situational challenges[35]. These syndromes present distinct clinical considerations, as they often involve multiple risk factors and organ systems, making diagnosis complex and sometimes ineffective or burdensome[29]. Despite challenges in pinpointing the precise underlying causes, therapeutic management of symptoms can still provide significant benefits, even when a definitive diagnosis remains elusive[29]. Multiple risk factor (modifiable and nonmodifiable) can contribute to the development of geriatric syndrome and because of its associated impairment it may lead to the development of a frail state among the elderly. This frailty on them may affect their functionality in self-care activities.

The occurrence of geriatric syndromes signifies a deterioration in health and is linked to an increased risk of disability, institutionalization, hospitalization, and mortality[36-42]. These syndromes are closely associated with various chronic health conditions, particularly cardiovascular diseases and diabetes, even after accounting for sociodemographic factors, social interactions, health-related variables, and behavioral influences[42]. Consequently, enhanced awareness among healthcare professionals, coupled with comprehensive geriatric assessments, may facilitate the development of effective therapeutic strategies aimed at preventing chronic illnesses and maintaining functional independence in older adults.

Comprehensive geriatric assessment is a multidisciplinary approach designed to identify the medical, functional, and psychosocial challenges faced by frail older patients, enabling the development of a holistic treatment plan with long-term follow-up[43]. This process evaluates multiple health domains, including physical conditions, mental well-being, functional abilities, and social circumstances, ensuring a broad therapeutic strategy that facilitates recovery and promotes patient independence[44]. CGA is implemented through two primary models:

1. **Acute care for elders (ACE) model:** In this approach, patients are admitted to a specialized ward where a coordinated multidisciplinary team conducts both assessment and rehabilitation[45,46].
2. **Mobile team model:** A mobile team visits frail patients in nongeriatric wards, conduct assessments and provides recommendations to the attending physician for appropriate care[47].

By integrating these models, CGA enhances tailored healthcare interventions, thereby improving outcomes for older adults. CGA utilizes standardized assessment scales and assessment tools across multiple health domains to formulate a broad therapeutic strategy, aiding recovery and promoting patient independence. Additionally, the World Health Organization (WHO) has recently introduced guidelines supporting integrated care for older individuals in the community, known as ICOPE[44,48]. ICOPE provides resources and guidance for community health workers to identify declines in intrinsic capacities—such as impaired mobility, malnutrition, visual and hearing loss, cognitive dysfunction, and depressive symptoms—and to implement suitable interventions for their management[44,48-51].

Through a comprehensive evaluation, a detailed care plan can be established. The fundamental principle of rehabilitation involves identifying the primary impairment and addressing it effectively. Furthermore, assessing frailty in older adults is crucial, as frailty serves as a core concept in geriatric medicine, representing a biological vulnerability that predisposes individuals to various geriatric syndromes and adverse health effects[52]. The study of frailty gained prominence in medical literature during the 1990s, reflecting the unexplained vulnerability observed in elderly patients by healthcare professionals[53]. Understanding frailty is instrumental in shaping appropriate interventions for older individuals, ensuring better quality of life and healthcare outcomes.

FRAILTY

Fried and colleagues defined frailty "as a biological syndrome of decreased reserve and resistance to stressors, resulting from cumulative declines across multiple physiological systems, and causing vulnerability to adverse outcomes", and operationalized it using the frailty phenotype[54]. In 2013, members of a consensus group reached agreement on the following definition of frailty: "A medical syndrome with multiple causes and contributors that is characterized by diminished strength, endurance, and reduced physiological function that increases an individual's vulnerability for developing increased dependency and/or death"[55]. Frailty, therefore, may be useful for risk prediction and decision-making in clinical settings[53]. Risk factors of frailty are older age, history of cancer, hospitalization events, chronic obstructive pulmonary disease, cerebrovascular disease, and osteoarthritis[56]. The following are the lists of screening tools for frailty in elderly (Table 21.3)[53,56-63]:

TABLE 21.3: Screening tools—frailty in elderly

Instruments	Components and scoring
Clinical frailty scale	Clinical judgment, ranging from very fit to severely frail: 1 = Very fit; 2 = Well; 3 = Well, with treated comorbid disease; 4 = Apparently vulnerable; 5 = Mildly frail (some dependence on others for instrumental activities of daily living); 6 = Moderately frail (help needed with instrumental and noninstrumental activities of daily living); 7 = Severely frail (total dependence on others for activities of daily living or terminally ill).
FRAIL scale	Self-reported fatigue; resistance (ability to climb a single flight of stairs); ambulation (ability to walk one block); illnesses (>5); loss of weight (>5%) Score: Range 0 to 5. No frailty = 0 deficits. Intermediate frailty = 1 or 2 deficits. Frailty = 3 or more deficits.
Frailty phenotype	Five criteria: 1. Weight loss; 2. Measured weakness; 3. Self-report exhaustion; 4. Measured slowness; 5. Low activity questionnaire Score: Range 0 to 5. Frail: ≥3 criteria present; Intermediate or prefrail: 1 or 2 criteria present. Robust or nonfrail: 0 criteria present.
Gait speed (as a single measure)	Measured gait speed over 4 meters Gait speed <0.8 m/s is cut point for increased risk of adverse health outcomes. Gait speed <0.2 m/s is cut point for extreme frailty.
Gérontopôle Frailty Screening Tool	6 questions to be answered by the practitioner/clinician about: 1. Whether the patient lives along; 2. Whether the patient has lost weight; 3. Whether the patient has felt more tired; 4. Whether the patient has memory problems; 5. Whether the patient has found it difficult to get around; and 6. Whether the patient has a slow gait (<1 m/s) If the practitioner/clinician answer yes to any one of the 6 questions, the screening questionnaire asks for their clinical judgment on whether the patient is frail.

Contd...

Instruments	Components and scoring
Program of Research to Integrate Services for the Maintenance of Autonomy (PRISMA-7) Questionnaire	Seven yes or no self-reported questions about: 1. Age; 2. Sex; 3. Health problems that require a limit on activities; 4. Help needed from someone regularly; 5. Health problems that require one to stay at home; 6. Having someone to count on if needed; and 7. Regular use of an assistive device for walking. Answering yes to three of more of the seven questions = potential disabilities/frailty
Timed-Up-and-Go Test	Measures of functional mobility (chair stair, 10-foot walk, and return the chair) Frail = taking >10 seconds to complete the test.

Adapted from: Walston J, Buta B, Xue QL. Frailty Screening and Interventions: Considerations for Clinical Practice. Clin Geriatr Med. 2018 Feb;34(1):25–38.

Frailty is not classified as a disease but rather as a syndrome, necessitating a multidisciplinary and multi-domain approach for effective management. Management of frailty requires transitioning from a single-disease care model to a holistic patient-centered approach[64,65].

- A comprehensive care plan for frailty should include polypharmacy management, the management of sarcopenia, treatable causes of weight loss, and causes of exhaustion (such as depression, sleep apnea, anemia, hypothyroidism, and vitamin B_{12} deficiency)[65].
- A multicomponent physical activity program. For example, exercises for 20–25 minutes, 4–5 days per week, comprising aerobic exercise, strengthening exercises for major muscle group of upper and lower extremity, balance and coordination exercise.
- Nutrition and oral health consideration
- Active social support and engagement

Sarcopenia and Frailty

Sarcopenia and frailty are significant conditions that become increasingly prevalent with age. Sarcopenia refers to the progressive loss of muscle mass and function, while frailty is characterized by multisystem impairment, leading to greater vulnerability to stressors[66]. Sarcopenia is usually associated with health risk factors such as low levels of physical activity, chronic illness, falls, fractures, and advanced age. Sarcopenia may lead to frailty, but not all elderly people with sarcopenia are frail. Early screening and diagnosis of sarcopenia are important to prevent many health impairments. Sarcopenia can be screened/diagnosed by the following methods:

- Body mass index (BMI), limb anthropometry—such as triceps skinfold (TSF), mid-upper-arm circumference (MUAC), and calf circumference (CC)—along with various derived equations, including mid-upper-arm muscle circumference, serve as objective clinical variables that are widely utilized across different healthcare settings[67].
- Muscle strength and performance can be assessed using various tests, including hand grip strength, chair stand test (chair rise test), gait speed, timed-up-and-go test, and the short physical performance battery (SPPB)[68]. These objective measures help evaluate functional capacity and mobility in older adults.
- Screening tools, such as the Strength, Assistance with walking, Rise from a chair, Climb stairs, and Falls (SARC-F) questionnaire, consist of five key components: strength, assistance with walking, ability to rise from a chair, ability to climb stairs, and history of falls. These items were specifically chosen to capture health status changes associated with the effects of sarcopenia[69,70].
- Techniques for assessing muscle quantity include bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DEXA), computed tomography (CT), and magnetic resonance imaging (MRI)[71]. These methods provide valuable insights into muscle composition and overall physical health.

Although the relationship between sarcopenia and frailty has not been fully characterized, both conditions share numerous similarities in their proposed underlying mechanisms, involving a complex interaction between multiple systems and pathophysiological processes, including aging, immunosenescence, hormonal imbalance, sedentary behavior, poor nutritional status, and other comorbidities. Treatment for sarcopenia includes nutritional therapy and exercise therapy[72-74]. An intervention that integrates nutritional therapy with a structured exercise regimen, particularly resistance training, has been shown to be more effective than a single intervention in addressing sarcopenia[75]. Physical exercise, especially resistance training, has demonstrated effectiveness in enhancing skeletal muscle mass, knee extension strength, normal walking speed, and maximum walking speed in older adults living in the community[75,76].

PREVENTION OF FALLS IN ELDERLY

Age is a significant risk factor for falls, and older adults have the highest likelihood of death or serious injury resulting from a fall, with the risk increasing as they age. Fall-related injuries may be fatal or non-fatal, and various studies have indicated that falling restricts physical activity, impairs social engagement, and elevates the fear of falling, increasing the risk of recurrent falls, depression, and diminished quality of life[77-80].

Most of the causes of falls in elderly individuals originate from neurological diseases, including stroke, vestibular disorders, Parkinson's disease, multiple sclerosis, and dementia; musculoskeletal conditions, such as osteoporosis, arthritis, and lower extremity deformities; cardiovascular disorders, including orthostatic hypotension, arrhythmias,

TABLE 21.4: Risk factors for falls in elderly

Independent risk factors[84]	
Previous falls	Balance impairment
Visual impairment	Polypharmacy (>4 medications)
Decreased muscle strength	Psychoactive drugs
Gait impairment and walking difficulties	Depression
Dizziness or orthostasis	Functional limitations
Age above 80 years	Female gender
Cognitive impairment	Arthritis
Diabetes	Pain
The risk of falling increases with the number of risk factors: 1-year risk of falling doubles with each additional factor.	

Adapted from: Tinetti ME, Kumar C. The patient who falls: "It's always a trade-off." JAMA. 2010;303(3):258–66.

and syncope; and other contributing factors, such as diabetes, depression, sleep disorders, urinary incontinence, pneumonia, and lung infections[81]. Table 21.4 depicts the independent risk factor-related to the falls in elderly[82].

Due to the diversity in causes and risk factors for falls, they have been classified into four categories, following a framework similar to the one adopted by the World Health Organization (WHO) Global Report on Falls Prevention in Older Age[81,83]:

1. **Behavioral:** Characteristics of human actions, emotions or daily choices
   - Medication overdose
   - Fear of fall (after the first fall)
   - Reduction of physical activity
   - Alcohol use
   - Inappropriate footwear
   - Difficulties in dressing
   - Direction of fall (sideways/forward)
2. **Biological:** These are an individual's physical attributes and physiological traits relevant to the human body.
   - Age
   - Cognitive impairment
   - Gender (higher incidence in females)
   - Lack of vision
   - Chronic diseases
   - Dizziness/vertigo
   - Pains
   - Decrease in body mass index
   - Decreased bone density
   - Musculoskeletal and sensory degradation
3. **Environmental:** Interactions between the individual's physical condition and the surrounding environment.
   - Unsafe home environment
   - Unsafe outdoors
   - Mobility aids
   - Falls from hospital bed
4. **Socioeconomic:** These are an individual's social and financial circumstances, influencing their overall well-being and access to resources.
   - Lack of social interaction
   - Lack of education and income
   - Limited access to social services and healthcare

Falls Risk Assessment

A risk assessment involves evaluating a fall history, medication review, physical examination, and functional and environmental assessments. A fall history includes identifying the number of falls within the past 6 months and year, along with their circumstances, such as physical symptoms, location, activity at the time, footwear, use of assistive devices (if prescribed), use of glasses (if typically worn), ability to rise after the fall, time of day, any injuries sustained, and any medical treatment received[82]. The drug review which is usually equally important as there were certain drugs which may increase fall risks such as psychoactive medications such as antidepressant, antipsychotic, benzodiazepine, sedative hypnotics and other medications like antihypertensive, diuretics and nonopioid analgesics. In general, the clinical assessment for multifactorial fall risk assessment includes the following along with the fall subjective history (Table 21.5).

The American Geriatrics Society (AGS) and British Geriatrics Society (BGS) have established clinical practice guidelines for fall risk screening, assessment, and management[84]. The AGS/BGS guideline[85] advises annual

TABLE 21.5: Multifactorial falls risk—clinical assessment

Domains	Components
Falls	• Higher mental function and cognitive screening • Cranial nerve—e.g., Visual acuity, body balance and eye movement • Evaluation of sensation including proprioception • Muscle bulk, tone, strength, reflexes, and range of motion • Balance and coordination assessment
Musculoskeletal examination	Back and lower extremity—range of motion/muscle strength/gait evaluation
Cardiopulmonary examination	• Rate/rhythm/murmur-heart • Auscultation/chest expansion/dyspnea/cough/dyspnea
Others	Orthostatic vital signs
Specific recommended test	Timed up and go test/4-staged balance test
Functional assessment	Self-care (activities of daily living)/Instrumental activities of daily living

screening for all adults aged 65 and older to evaluate fall risk. This screening involves asking whether patients have fallen two or more times in the past year, sought medical attention for a fall or, if they have not fallen, whether they experience unsteadiness while walking[84]. This assessment is incorporated into a toolkit known as Stopping Elderly Accidents, Deaths, and Injuries (STEADI)[85]. Based on the AGS/BGS clinical practice guideline[84], STEADI was developed to assist healthcare professionals in incorporating falls assessment and management into their routine practice. The algorithm emphasizes that even individuals at low risk (no prior falls, no gait or balance issues) can still benefit from a primary prevention strategy, which includes education on fall risk factors, strength and balance exercises, and vitamin D supplementation[86]. The Figures 21.1A and B depict the STEADI algorithm for fall prevention and intervention.

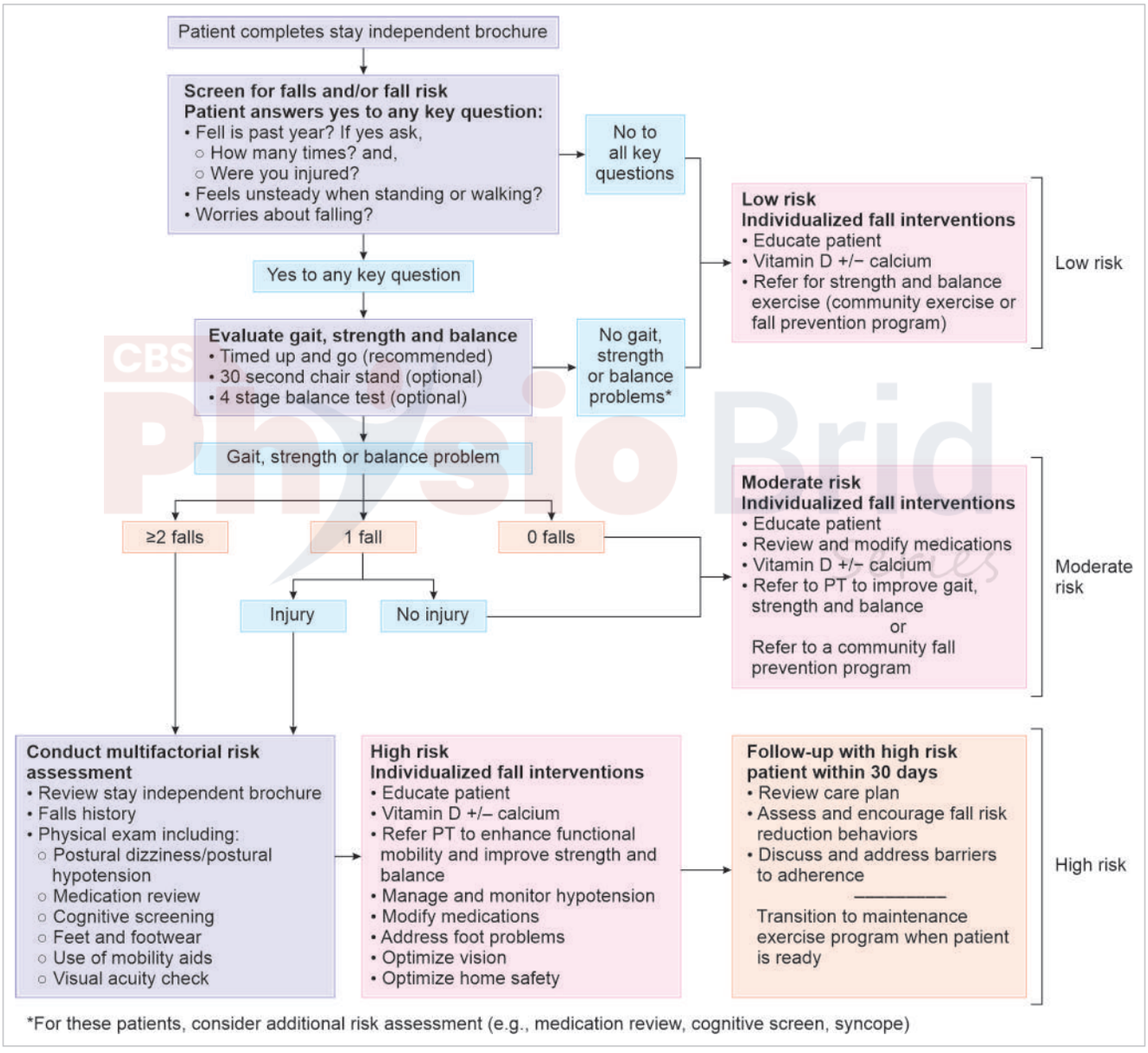

Fig. 21.1A: STEADI-algorithm—risk categorization for fall and its management approaches

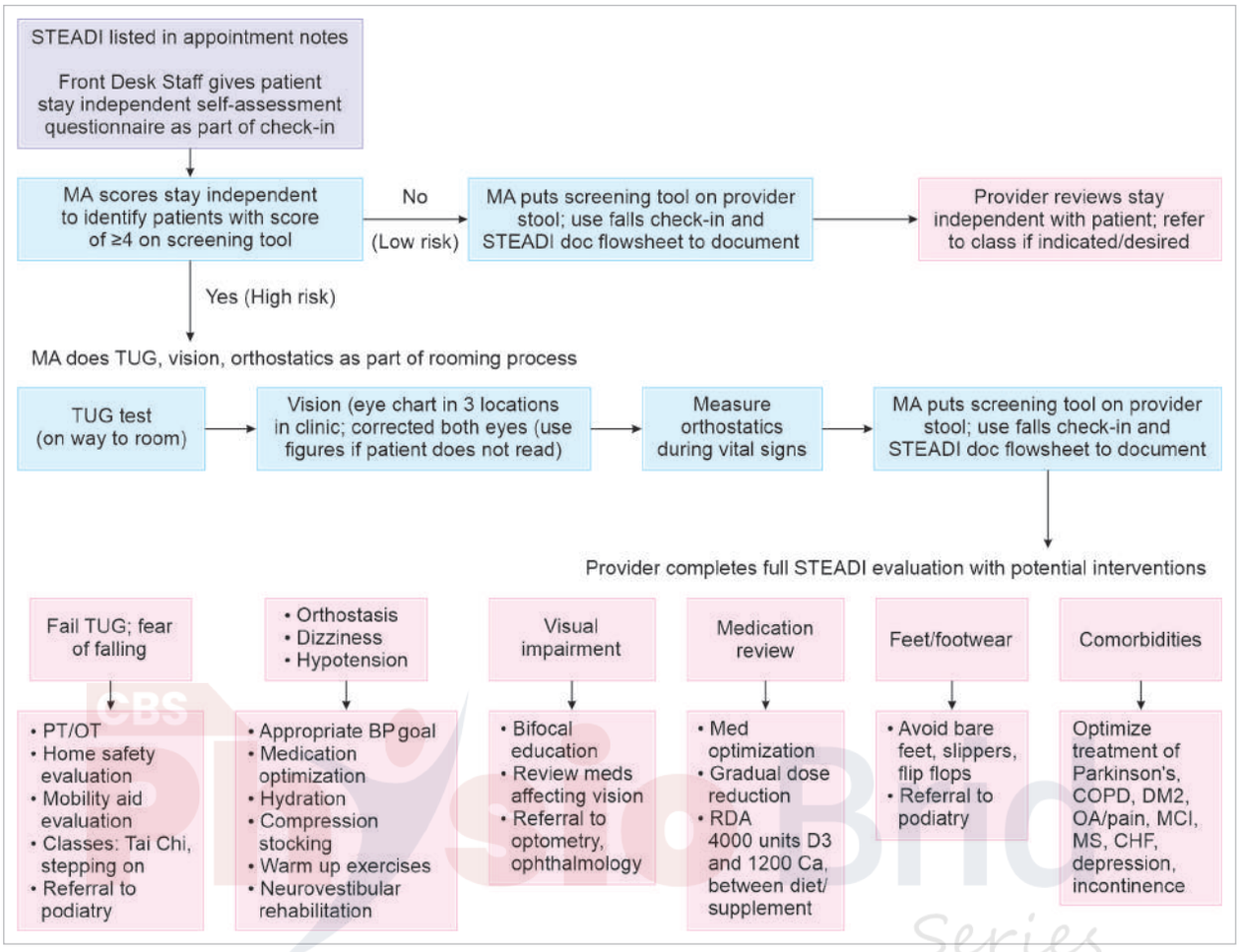

Fig. 21.1B: STEADI-Fall prevention and intervention

Abbreviations: BP, blood pressure; Ca, calcium; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; DM2, diabetes mellitus type 2; MA, medical assistant; MCI, mild cognitive impairment; MS, multiple sclerosis; OA, osteoarthritis; OT, occupational therapist; PT, physiotherapist; RDA, recommendatory dietary allowance; TUG, timed up and Go.

Good to Know

Ethical and Psychosocial Considerations

Geriatric rehabilitation must account for not only physical health but also the psychosocial and ethical challenges that older adults face. Social isolation, elder neglect, and ageism are prevalent and can negatively impact mental health and rehabilitation outcomes. Decision-making capacity and informed consent must be respected, especially in cases involving cognitive impairment.

Ethical care involves promoting dignity, autonomy, and active participation in goal-setting. Rehabilitation professionals must also engage with family caregivers, who often face emotional and physical burdens. Training caregivers in safe transfer techniques, fall prevention, and daily care routines improves outcomes for both older adults and their caregivers.

Recognizing the interplay between physical function, emotional well-being, and social support is essential for holistic geriatric rehabilitation.

SUCCESSFUL AGING

Successful aging is a complex concept influenced by physical, social, and environmental factors, and is defined by optimal physical and mental health, the absence of chronic diseases, and meaningful social connections[87]. Cultural, social, economic, and political determinants shape and influence lifestyle choices[71].

Components

Rowe and Kahn (1998) proposed that successful aging comprises the following three key components[88]:

1. **Optimal health with minimal risk of illness and disability:** Maintaining good health involves consistent physical activity, a balanced diet, and routine medical check-ups.

2. **Strong cognitive and physical capabilities:** In the process of healthy aging, individuals remain mentally engaged and intellectually stimulated.
3. **Active participation in life with a supportive social network:** A fulfilling aging experience includes maintaining social connections and engaging in meaningful activities.

Morley D. Glicken DSW (2009) outlines the following examples of effective health practices for older adults[89]:

- Physical activity is fundamental to successful aging and includes aerobic exercises, such as walking, dancing, and gardening, as well as more intense activities like weight training.
- Diet and exercise contribute to weight management, lower the risk of heart disease, colon and rectal cancer, and help mitigate the effects of diabetes, arthritis, and osteoporosis, while also improving strength and balance to reduce falls.
- Regular fitness activity decreases mortality risk, with older women who exercise being 20% less likely to die compared to those who remain sedentary.
- Smoking cessation leads to an immediate decline in heart disease risk, with ex-smokers having a comparable risk to nonsmokers after five years.
- Quitting smoking enhances heart health, lung capacity, and reduces blood pressure, significantly improving overall well-being.
- Mental stimulation and social interaction with friends and family play a crucial role in maintaining physical health and cognitive function.
- Older adults can preserve or even enhance their mental abilities through reading, word games, mental exercises, and engaging conversations[88].

Therefore, successful aging is not a one-dimensional concept centered solely on physical health; instead, it encompasses social, psychological, spiritual/transcendent, economic, and environmental factors[90]. Additionally, defining successful aging for individuals with long-term physical disabilities is based on the following domains[91]:

a. Autonomy and/or maximized independence
b. Living arrangement
c. Health and well-being and
d. Social connection and meaningful community engagement.

Rehabilitation process through organization can add or adjust services and programs to ensure that they are providing resources that help to facilitate successful aging across these domains of successful aging[91].

Recommendations

The inevitable age-related changes affecting various anatomical and physiological systems, along with the presence of pathological conditions and physical activity levels, are key factors influencing alertness and activity levels, thereby contributing to functional decline and disabilities in these vulnerable age groups. Despite the well-documented benefits of physical activity on health and physical function in aging, the proportion of older adults meeting recommended guidelines remains low. Adults aged 65 and older require[92]:

- At least 150 minutes per week (such as 30 min/day, 5 days a week) of moderate-intensity exercise, including brisk walking or 75 minutes per week of vigorous-intensity activities, such as hiking, jogging or running.
- At least two days per week of muscle-strengthening activities.
- Exercises to enhance balance, such as standing on one foot.

The physical activity guidelines for older adult Americans specify that[93]:

- Multicomponent physical activity should be included in their weekly routine, encompassing balance training, aerobic exercises, and muscle-strengthening activities.
- Older adults should assess their physical activity intensity based on their fitness level.
- If unable to complete 150 minutes of moderate-intensity aerobic activity per week due to chronic conditions, older adults should engage in physical activity aligned with their capabilities and health status.

Research has shown that structured physical exercise programs can enhance physical function, cognition, and hemodynamic parameters in older adults[94]. However, certain barriers, such as the high cost of acquiring and maintaining equipment, space requirements for distribution, and the need for specialized health professionals, can limit their implementation in public health programs[95].

Multicomponent exercise programs, which integrate different exercise modalities (e.g., resistance, balance, gait, aerobics, and flexibility) within a single session, present a viable approach to maintaining or improving physical and cognitive function in community-dwelling older adults[96,97]. The term 'multicomponent' activity refers to physical activity interventions that incorporate multiple modes of exercise, with common components including aerobic, muscle-strengthening, and balance training.

The most conclusive evidence supports the superior benefits of multicomponent exercises over single-component activities in preventing fall-related injuries and enhancing physical function in older adults. Additionally, multicomponent and multi-task activities (i.e., combining physical tasks with cognitive challenges) embedded in daily routines may serve as a promising alternative to structured, single-task exercise programs for older adults.

INSTITUTIONALIZED ELDERLY

An elderly individual who, due to an active disease state or residual physical and mental disabilities, is partially or entirely dependent on their daily living activities may voluntarily or

involuntarily reside in a hospital, medical treatment facility, nursing home, acute care center or community-assisted living facility. Advanced age, low educational attainment, sedentary behavior, poor self-rated health, polypharmacy, and functional or cognitive impairments are the primary factors predicting institutionalization[98,99].

India Insights

National Programme for Healthcare of the Elderly

India's aging population is growing rapidly, leading to increased demand for age-appropriate health and rehabilitation services. The Government of India launched the National Programme for Healthcare of the Elderly (NPHCE) to provide dedicated geriatric care at primary, secondary, and tertiary levels. This includes services through district hospitals, community health centers, and mobile medical units, with an emphasis on active aging and community-based interventions.

Physiotherapists play a crucial role in the NPHCE framework by delivering rehabilitation services to older adults in home and community settings, particularly in rural and underserved areas. Many state-level geriatric clinics also incorporate physiotherapy consultations as part of their multidisciplinary approach.

Integrating these national programs into geriatric rehabilitation planning ensures greater accessibility, cultural relevance, and sustainability of services.

Research indicates that higher age, living alone, functional and cognitive impairment, falls, low body mass index, reduced specialist visits, limited social interactions, reliance on domestic help, multimorbidity, and various chronic conditions, such as depression, mental health disorders, Parkinson's disease, stroke, and heart disease, are significant predictors of institutionalization among older adults[100-103].

Conversely, institutionalization can negatively impact an elderly individual's quality of life, serving as a risk factor for loneliness, anxiety, and depression[104-106].

A thorough careful evaluation comprising each dimension/aspect of the institutionalized elder is necessary to promote active aging and better quality of life. Comprehensive geriatric evaluation and addressing individualistic morbidity will only help to ensure the uniform standards of rehabilitation needs. Therefore, the assessment of disability of institutionalized elderly should follow the standardized approach:

- Characterize the disability
- Identify impairment
- Identify health conditions
- Identify contextual factors
- Listing the potential impairments
- Framing therapeutic goals

Secondly, the assistance of multidisciplinary approaches to rehabilitation and the most common rehabilitation interventions included assessing person-centered goals and delivering therapeutic exercises as well as education and training/advice on self-care.

REHABILITATION INTERVENTIONS

Rehabilitation needs of the elderly care varies from the level of specialized care for the diseased to primary care to the multiple levels of care. The rehabilitation delivery type described as the approaches by rehabilitation intervention are provided to the elderly and are given in Table 21.6[107]. Those interventions specifically from assessment, restorative and compensatory approaches, education and counseling, coordination and management of rehabilitation process, training and provision in the use of assistive technology, and environmental adaptations are required in different areas from home, community, out-patient and in-patient hospitalization and assisted living centers for an appropriate and evidence-based rehabilitation program for this special population of elderly in order to promote healthy aging.

Role of Physiotherapists in Geriatric Care Settings

Physiotherapists are integral to maintaining and restoring functional independence in older adults. Their role varies across settings:

- **In the home:** Physiotherapists assess home safety, teach caregiver-supported mobility exercises, and help older adults manage chronic conditions like osteoarthritis or stroke-related disabilities.
- **In outpatient clinics:** They design individualized therapeutic exercise plans targeting balance, gait, strength, and flexibility to reduce fall risk and enhance mobility.
- **In institutions and long-term care facilities:** Physiotherapists focus on preventing deconditioning, managing pain, and assisting in recovery from surgery or prolonged illness.
- **In community settings:** They lead group exercise programs, conduct screenings (e.g., for fall risk), and support health promotion activities for active aging.

Physiotherapists also educate caregivers and collaborate with occupational therapists, nurses, and physicians to ensure a multidisciplinary approach to elderly care.

Elderly people are particularly vulnerable to poor quality of life (QOL) because of changes and events in their physical health, psychological state, social circumstances and relationship to their environment[108-110]. Task-oriented training related to self-care activities involves the active practice of task-specific motor activities which assist the elderly to gain more confidence toward their functionality, which is the primary focus of geriatric rehabilitation. Rehabilitation interventions to facilitate goal setting together with patients and professionals have positive effects on the quality of geriatric rehabilitation[111,112] and this itself will indirectly improve their QoL.

TABLE 21.6: Types and approaches of rehabilitation delivery

Categories	Interventions
Assessment	• Person-centered goals—functioning/ functional ability (overall) • Environment • Health status • Fall risk • Emotional functions in comprehensive geriatric assessment • Medication used • Cognitive functions • Exercise capacity • Nutritional status—Independence on activities of daily living • Family and caregiver support network
Restorative and compensatory approaches	• Therapeutic exercise • Multicomponent care or rehabilitation program • ADL training • Motivational interventions • Psychological interventions • Cognitive rehabilitation • Occupational therapy • Behavioral interventions • Therapeutic recreation • Physical therapy • Problem-solving skills training • Speech and language therapy • Management of incontinence • Manual therapy • Social skills training • Thermal modalities • Others
Education and counseling	• Education and skills training for self-care and self-management • Education and skills training for caregivers • Education and counseling for physical activity and therapeutic exercise • Education and counseling about healthy diet and nutritional requirements • Education and counseling to modify harmful lifestyle behaviors • Education and counseling for weight management
Coordination and management of the rehabilitation process	• Follow-up visits • Case management • Health status monitoring, rehabilitation process coordination, and management • Discharge planning • Monitoring of functional ability
Provision and training in the use of assistive technology	Selecting suitable devices (e.g., walkers, canes, hearing aids) and providing hands-on training
Environmental adaptations	Modifying living spaces with features like grab bars, non-slip floors, ramps, and improved lighting

Adapted from: Seijas V, Maritz R, Fernandes P, Bernard RM, Lugo LH, Bickenbach J, Uabariego C. Rehabilitation delivery models to foster healthy aging—a scoping review. Front Rehabil Sci. 2024;5:1307536.

SUMMARY

- Geriatric rehabilitation (GR) is described as a comprehensive diagnostic and therapeutic approach aimed at optimizing functional abilities, promoting activity, and maintaining social engagement in older adults with disabling conditions.
- The primary objectives of GR are to enhance performance in activities of daily living, support meaningful social interaction, and improve the overall quality of life for elderly individuals.
- Aging is explained as a natural, irreversible biological process marked by gradual decline in physical function across all major organ systems due to cumulative cellular and molecular damage.
- Age-related deterioration leads to reduced functional capacity, reflected in changes such as decreased muscle strength, slower motor nerve conduction, reduced brain mass, diminished tear production, decreased eye elasticity, and lowered lung compliance.
- Comprehensive Geriatric Assessment (CGA) is highlighted as a multidisciplinary process that evaluates medical, psychosocial, functional, and environmental domains to identify challenges faced by frail older adults.
- CGA supports better identification of health conditions, improved mental and physical functioning, reduced mortality rates, and lower dependence on long-term institutional care.
- Geriatric syndromes are described as multifactorial conditions that increase vulnerability, disability, hospitalization, and mortality in older adults.
- Frailty is defined as a syndrome involving reduced strength, endurance, and physiological reserve that heightens susceptibility to adverse health outcomes.
- Screening for frailty uses tools such as the Clinical Frailty Scale, the FRAIL scale, and the Timed-Up-and-Go Test, while management requires multidisciplinary strategies including polypharmacy review, sarcopenia management, and tailored physical activity programs.

- Sarcopenia is characterized as the progressive age-related loss of skeletal muscle mass and function, contributing to physical decline, fall risk, and the development of frailty.
- Diagnosis of sarcopenia involves body measurements, muscle strength and performance tests such as hand grip dynamometry, chair stand test, and gait speed, as well as imaging techniques; treatment focuses on nutritional interventions and resistance exercise.
- Falls are recognized as a major health concern in older adults, arising from biological, behavioral, environmental, and socioeconomic factors.
- Fall risk assessment includes reviewing fall history, medications, and conducting physical and functional evaluations, with the CDC's STEADI toolkit guiding clinicians on risk stratification and evidence-based interventions.
- Rehabilitation interventions for older adults include assessment, restorative and compensatory strategies such as therapeutic exercise and ADL training, patient and caregiver education, and environmental modifications.
- Physiotherapists play a central role in geriatric rehabilitation by designing individualized exercise programs targeting balance, gait, strength, and flexibility, and by performing home safety assessments to reduce fall risks.
- Successful aging is presented as a multidimensional concept characterized by optimal physical and mental health, minimal chronic disease burden, meaningful social connections, and sustained engagement in physical, cognitive, and social activities.

REFERENCES

1. Chatterji S, Byles J, Cutler D, Seeman T, Verdes E. Health, functioning, and disability in older adults—present status and future implications. Lancet. 2015 Feb 7;385(9967):563-75. doi: 10.1016/S0140-6736(14)61462-8.
2. Covinsky KE, Pierluissi E, Johnston CB. Hospitalization-associated disability: "she was probably able to ambulate, but I'm not sure''. JAMA. 2011 Oct 26;306(16):1782-93.
3. Everink IH, van Haastregt JC, van Hoof SJ, Schols JM, Kempen GI. Factors influencing home discharge after inpatient rehabilitation of older patients: a systematic review. BMC Geriatr. 2016 Jan 12;16:5.
4. Lubbe AL, van Rijn M, Groen WG, Hilhorst S, Burchell GL, Hertogh CMPM, Pol MC. The quality of geriatric rehabilitation from the patients' perspective: a scoping review. Age Ageing. 2023 Mar 1;52(3):afad032.
5. Achterberg WP, Cameron ID, Bauer JM, Schols JM. Geriatric rehabilitation-state of the art and future priorities. J Am Med Dir Assoc. 2019 Apr;20(4):396-398.
6. Parker MG, Thorslund M. Health trends in the elderly population: getting better and getting worse. Gerontologist. 2007 Apr;47(2): 150-8.
7. Grund S, Gordon AL, Bauer JM, Achterberg WP, Schols J. The COVID rehabilitation paradox: why we need to protect and develop geriatric rehabilitation services in the face of the pandemic. Age Ageing. 2021 May 5;50(3):605-607.
8. Grund S, Gordon AL, van Balen R, Bachmann S, Cherubini A, Landi F, Stuck AE, Becker C, Achterberg WP, Bauer JM, Schols JMGA. European consensus on core principles and future priorities for geriatric rehabilitation: consensus statement. Eur Geriatr Med. 2020 Apr;11(2):233-238.
9. Buijck BI, Bushnik T. Therapeutic climate. In: Buijck B, Ribbers G, editors. The Challenges of Nursing Stroke Management in Rehabilitation Centres. Cham (Switzerland): Springer International Publishing; 2018. Chapter 4. doi: 10.1007/978-3-319-76391-0_4.
10. Tijsen LM, Derksen EW, Achterberg WP, Buijck BI. Challenging rehabilitation environment for older patients. Clin Interv Aging. 2019; 14: 1451–60.
11. Robbins GT, Yih E, Chou R, Gundersen AI, Schnieder JC, Bean JF, Zafonte RD. Geriatric rehabilitation. Handbook Clin Neurol. 2019;167:531-43.
12. Jaul E, Barron J. Age-Related Diseases and Clinical and Public Health Implications for the 85 Years Old and Over Population. Front Public Health. 2017 Dec 11;5:335. doi: 10.3389/fpubh.2017.00335.
13. Nascimento MM, Gouveia ÉR, Marques A, Gouveia BR, Marconcin P, França C, Ihle A. The Role of Physical Function in the Association between Physical Activity and Gait Speed in Older Adults: A Mediation Analysis. Int J Environ Res Public Health. 2022 Oct 1;19(19):12581.
14. Patrizio E., Calvani R., Marzetti E., Cesari M. Physical functional assessment in older adults. J Frailty Aging. 2021;10(2):141-149.
15. McPhee J.S., French D.P., Jackson D., Nazroo J., Pendleton N., Degens H. Physical activity in older age: Perspectives for healthy aging and frailty. Biogerontology. 2016 Jun;17(3):567-80.
16. Crimmins EM. Social hallmarks of aging: Suggestions for geroscience research. Ageing Res Rev. 2020 Nov;63:101136.
17. Kauffman TL, Barr JO, Moran ML, editors. Geriatric rehabilitation manual. 2nd ed. Philadelphia: Elsevier Health Sciences; 2007.
18. Guo J, Huang X, Dou L, Yan M, Shen T, Tang W, Li J. Aging and aging-related diseases: from molecular mechanisms to interventions and treatments. Signal Transduct Target Ther. 2022 Dec 16;7(1):391.
19. Niccoli T, Partridge L. Ageing as a risk factor for disease. Curr Biol. 2012 Sep 11;22(17):R741-52 doi: 10.1016/j.cub.2012.07.024.
20. Wilkerson HL. Problems of an aging population: public health aspects of diabetes. Am J Public Health Nations Health. 1947 Feb;37(2): 177-88.
21. Cortes-Canteli M, Iadecola C. Alzheimer's Disease and Vascular Aging: JACC Focus Seminar. J Am Coll Cardiol. 2020 Mar 3;75(8): 942-951.

22. Hoehn MM, Yahr MD. Parkinsonism: onset, progression and mortality. Neurology. 1967;17:427–42.
23. Kaufman P, Poliakoff H. Studies on the aging heart; the pattern of rheumatic heart disease in old age (a clinical pathological study) Ann Intern Med. 1950 May;32(5):889-904.
24. Yan M, Sun S, Xu K, Huang X, Dou L, Pang J, Tang W, Shen T, Li J. Cardiac Aging: From Basic Research to Therapeutics. Oxid Med Cell Longev. 2021 Mar 9;2021:9570325. doi: 10.1155/2021/9570325.
25. Hernández Cordero AI, Yang CX, Yang J, Horvath S, Shaipanich T, MacIsaac J, Lin DTS, Kobor MS, Guillemi S, Harris M, Lam W, Lam S, Montaner J, Man SFP, Sin DD, Leung JM. Airway Aging and Methylation Disruptions in HIV-associated Chronic Obstructive Pulmonary Disease. Am J Respir Crit Care Med. 2022 Jul 15;206(2):150-160. doi: 10.1164/rccm.202106-1440OC.
26. Grunewald M, Kumar S, Sharife H, Volinsky E, Gileles-Hillel A, Licht T, Permyakova A, Hinden L, Azar S, Friedmann Y, Kupetz P, Tzuberi R, Anisimov A, Alitalo K, Horwitz M, Leebhoff S, Khoma OZ, Hlushchuk R, Djonov V, Abramovitch R, Tam J, Keshet E. Counteracting age-related VEGF signaling insufficiency promotes healthy aging and extends life span. Science. 2021 Jul 30;373(6554):eabc8479.
27. Chen X, Gong W, Shao X, Shi T, Zhang L, Dong J, Shi Y, Shen S, Qin J, Jiang Q, Guo B. METTL3-mediated m6A modification of ATG7 regulates autophagy-GATA4 axis to promote cellular senescence and osteoarthritis progression. Ann Rheum Dis. 2022 Jan;81(1):87-99.
28. Ding J, Lohman K, Molina A, Delbono O, Bertoni A, Shea S, Post W, Guo X, Barr RG, Manichaikul AW, Pankow JS, Rotter JI, Hoeschele I, Kritchevsky SB, Liu Y. The association between aging-related monocyte transcriptional networks and comorbidity burden: the Multi-Ethnic Study of Atherosclerosis (MESA). Geroscience. 2023 Feb;45(1):197-207.
29. Inouye SK, Studenski S, Tinetti ME, Kuchel GA. Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. J Am Geriatr Soc. 2007 May;55(5):780-91.
30. Stuck AE, Siu AL, Wieland GD, Adams J, Rubenstein LZ. Comprehensive geriatric assessment: a meta-analysis of controlled trials. Lancet. 1993;342(8878):1032.
31. Devons CA. Comprehensive geriatric assessment: making the most of the aging years. Curr Opin Clin Nutr Metab Care. 2002;5(1):19-22.
32. Welsh TJ, Gordon AL, Gladman JR. Comprehensive geriatric assessment--a guide for the nonspecialist. Int J Clin Pract. 2014; 68(3):290-93.
33. Huss A, Stuck AE, Rubenstein LZ, Egger M, Clough-Gorr KM Multidimensional preventive home visit programs for community-dwelling older adults: A systematic review and meta-analysis of randomized controlled trials. J Gerontol A Biol Sci Med Sci.2008; 63 (3):298–307.
34. Ellis G, Gardner M, Tsiachristas A, Langhorne P, Burke O, Harwood RH, Conroy SP, Kircher T, Somme D, Saltvedt I, Wald H, O'Neill D, Robinson D, Shepperd S. Comprehensive geriatric assessment for older adults admitted to hospital. Cochrane Database Syst Rev. 2017 Sep 12;9(9):CD006211.
35. Tinetti ME, Inouye SK, Gill TM, Doucette JT. Shared risk factors for falls, incontinence, and functional dependence: unifying the approach to geriatric syndromes. JAMA. 1995;273(17):1348–53.
36. Wang SY, Shamliyan TA, Talley KMC, Ramakrishnan R, Kane RL. Not just specific diseases: systematic review of the association of geriatric syndromes with hospitalization or nursing home admission. Arch Gerontol Geriatr. 2013;57(1):16–26.
37. Chiu CJ, Cheng YY. Utility of geriatric syndrome indicators for predicting subsequent health care utilization in older adults in Taiwan. Int J Environ Res Public Health. 2019;16(3):456–9.
38. Huang CC, Lee JD, Yang DC, Hsu HC, Wang YW, Lin CH, et al. Associations between geriatric syndromes and mortality in community-dwelling elderly: results of a national longitudinal study in Taiwan. J Am Med Dir Assoc. 2017;18(3):246–51.
39. Rikkert MG, Rigaud AS, van Hoeyweghen RJ. Geriatric syndromes: medical misnomer or progress in geriatrics? Neth J Med. 2003;61(3):83–7.
40. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. Lancet. 2013;381(9868):752–62.
41. Wierenga PC, Buurman BM, Parlevliet JL, van Munster BC, Smorenburg SM, Inouye SK, de Rooij SE Association between acute geriatric syndromes and medication-related hospital admissions. Drugs Aging. 2012;29(8):691–9.
42. Rausch C, van Zon SKR, Liang Y, Laflamme L, Möller J, de Rooij SE, Bültmann U. Geriatric syndromes and incident chronic health conditions among 9094 older community-dwellers: findings from the Lifelines Cohort Study. J Am Med Dir Assoc. 2022;23(1):54–9.
43. Rubenstein LZ, Stuck AE, Siu AL, Wieland D. Impacts of geriatric evaluation and management programs on defined outcomes: overview of the evidence. J Am Geriatr Soc. 1991;39(S1):8S–16S.
44. Ntsama Essomba MJ, Esson Mapoko BS, Metogo Mbengono JA, Simo-Tabue N, Kengne AP, Choukem SP, Sobngwi E, Ze Minkande J, Tabue Teguo M. Pre-therapeutic assessment of older people in Sub-Saharan Africa: introduction to the comprehensive geriatric assessment. J Clin Med. 2024;13(5):1801–10.
45. Palmer RM, Landefeld CS, Kresevic D, Kowal J. A medical unit for the acute care of the elderly. J Am Geriatr Soc. 1994;42(5):545–52.
46. Palmer RM. The acute care for elders unit model of care. Geriatrics. 2018;3(2):59–61.
47. Deschodt M, Flamaing J, Haentjens P, Boonen S, Milisen K. Impact of geriatric consultation teams on clinical outcome in acute hospitals: a systematic review and meta-analysis. BMC Med. 2013;11:48–58.
48. World Health Organization. Integrated care for older people (ICOPE): guidance for person-centred assessment and pathways in primary care. Geneva: WHO; 2019.
49. Meng LC, Hsiao FY, Huang ST, Lu WH, Peng LN, Chen LK. Intrinsic capacity impairment patterns and their associations with unfavorable medication utilization: a nationwide population-based study of 37,993 community-dwelling older adults. J Nutr Health Aging. 2022;26(8):918–25.

50. Tavassoli N, de Souto Barreto P, Berbon C, Mathieu C, de Kerimel J, Lafont C, Takeda C, Carrie I, Piau A, Jouffrey T, Andrieu S, Nourhashemi F, Beard JR, Soto Martin ME, Vellas B. Implementation of the WHO integrated care for older people (ICOPE) programme in clinical practice: a prospective study. Lancet Healthy Longev. 2022;3(6):e394–e404.
51. Cesari M, Araujo de Carvalho I, Amuthavalli Thiyagarajan J, Cooper C, Martin FC, Reginster JY, Vellas B, Beard JR. Evidence for the domains supporting the construct of intrinsic capacity. J Gerontol A Biol Sci Med Sci. 2018;73(12):1653–60.
52. Fried LP, Walston J. Frailty and failure to thrive. In: Hazzard WR, Blass JP, Ettinger WH Jr, Halter JB, Ouslander J, editors. Principles of Geriatric Medicine and Gerontology. 4th ed. New York: McGraw Hill; 1998. p. 1387–1402.
53. Walston J, Buta B, Xue QL. Frailty Screening and Interventions: Considerations for Clinical Practice. Clin Geriatr Med. 2018 Feb;34(1):25-38.
54. Fried LP, Walston J. Frailty and failure to thrive. In: Hazzard WR, Blass JP, Ettinger WH Jr, Halter JB, Ouslander J, editors. Principles of Geriatric Medicine and Gerontology. 4th ed. New York: McGraw Hill; 1998. p. 1387–1402.
55. Morley JE, Vellas B, van Kan GA, Anker SD, Bauer JM, Bernabei R, Cesari M, Chumlea WC, Doehner W, Evans J, Fried LP, Guralnik JM, Katz PR, Malmstrom TK, McCarter RJ, Gutierrez Robledo LM, Rockwood K, von Haehling S, Vandewoude MF, Walston J. Frailty consensus: a call to action. J Am Med Dir Assoc. 2013 Jun;14(6):392-7.
56. Satake S, Arai H. Implications of frailty screening in clinical practice. Curr Opin Clin Nutr Metab Care. 2017 Jan;20(1):4-10.
57. Rockwood K, Song X, MacKnight C, Bergman H, Hogan DB, McDowell I, Mitnitski A. A global clinical measure of fitness and frailty in elderly people. CMAJ. 2005;173: 489–95.
58. Abellan van Kan G, Rolland Y, Bergman H, Morley JE, Kritchevsky SB, Vellas B. The I.A.N.A Task Force on frailty assessment of older people in clinical practice. J Nutr Health Aging. 2008; 12:29–37.
59. Abellan van Kan G, Rolland Y, Andrieu S, Bauer J, Beauchet O, Bonnefoy M, Cesari M, Donini LM, Gillette Guyonnet S, Inzitari M, Nourhashemi F, Onder G, Ritz P, Salva A, Visser M, Vellas B. Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people: an International Academy on Nutrition and Aging (IANA) Task Force. J Nutr Health Aging.2009;13:881–89.
60. Turner G, Clegg A. Best practice guidelines for the management of frailty: a British Geriatrics Society, Age UK and Royal College of General Practitioners report. Age Ageing. 2014;43: 744–47.
61. Subra J, Gillette-Guyonnet S, Cesari M, Oustric S, Vellas B. The integration of frailty into clinical practice: preliminary results from the Gerontopole. J Nutr Health Aging. 2012;16:714–20.
62. Raîche M, Hébert R, Dubois MF. PRISMA-7: a case-finding tool to identify older adults with moderate to severe disabilities. Arch Gerontol Geriatr. 2008 Jul-Aug;47(1):9-18.
63. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39:142–48.
64. Won CW. Diagnosis and Management of Frailty in Primary Health Care. Korean J Fam Med. 2020 Jul;41(4):207-13.
65. Dent E, Morley JE, Cruz-Jentoft AJ, Woodhouse L, Rodríguez-Mañas L, Fried LP, Woo J, Aprahamian I, Sanford A, Lundy J, Landi F, Beilby J, Martin FC, Bauer JM, Ferrucci L, Merchant RA, Dong B, Arai H, Hoogendijk EO, Won CW, Abbatecola A, Cederholm T, Strandberg T, Gutiérrez Robledo LM, Flicker L, Bhasin S, Aubertin-Leheudre M, Bischoff-Ferrari HA, Guralnik JM, Muscedere J, Pahor M, Ruiz J, Negm AM, Reginster JY, Waters DL, Vellas B. Physical frailty: ICFSR international clinical practice guidelines for identification and management. J Nutr Health Aging. 2019;23:771–87.
66. Dodds R, Sayer AA. Sarcopenia and frailty: new challenges for clinical practice. Clin Med (Lond). 2016 Oct;16(5):455-58.
67. Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, Muscaritoli M, Nyulasi I, Ockenga J, Schneider SM, de van der Schueren MA, Singer P. Diagnostic criteria for malnutritionean ESPEN consensus statement. Clin Nutr 2015;34(3):335-40.
68. Ackermans LLGC, Rabou J, Basrai M, Schweinlin A, Bischoff SC, Cussenot O, Cancel-Tassin G, Renken RJ, Gómez E, Sánchez-González P, Rainoldi A, Boccia G, Reisinger KW, Ten Bosch JA, Blokhuis TJ. Screening, diagnosis and monitoring of sarcopenia: When to use which tool? Clin Nutr ESPEN. 2022;48:36–44.
69. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, Martin FC, Michel JP, Rolland Y, Schneider SM, Topinková E, Vandewoude M, Zamboni M; European Working Group on Sarcopenia in Older People. Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age Ageing. 2010 Jul;39(4):412-23.
70. Fielding RA, Vellas B, Evans WJ, Bhasin S, Morley JE, Newman AB, Abellan van Kan G, Andrieu S, Bauer J, Breuille D, Cederholm T, Chandler J, De Meynard C, Donini L, Harris T, Kannt A, Keime Guibert F, Onder G, Papanicolaou D, Rolland Y, Rooks D, Sieber C, Souhami E, Verlaan S, Zamboni M. Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International working group on sarcopenia. J Am Med Dir Assoc. 2011 May;12(4):249-56.
71. Mobasseri, K, Doshmangir, P, Khodayari-Zarnaq R, Goharinezhad, S, Sergeevich Gordeev, V, Ghiassipoor, M, Doshmangir, L. Factors Influencing Healthy Lifestyle Among Older Adults: A Qualitative Study. Activities, Adaptation & Aging.2024; 1–25.
72. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, Cooper C, Landi F, Rolland Y, Sayer AA, Schneider SM, Sieber CC, Topinkova E, Vandewoude M, Visser M, Zamboni M; Writing Group for the European Working Group on Sarcopenia in Older People 2 (EWGSOP2), and the Extended Group for EWGSOP2. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019 Jan 1;48(1):16-31. doi: 10.1093/ageing/afy169. Erratum in: Age Ageing. 2019 Jul 1;48(4):601.
73. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, Jang HC, Kang L, Kim M, Kim S, Kojima T, Kuzuya M, Lee JSW, Lee SY, Lee WJ, Lee Y, Liang CK, Lim JY, Lim WS, Peng LN, Sugimoto K, Tanaka T, Won CW, Yamada M, Zhang T, Akishita M, Arai H. Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. J Am Med Dir Assoc. 2020 Mar;21(3):300-307.e2.

74. Dent E, Morley JE, Cruz-Jentoft AJ, Arai H, Kritchevsky SB, Guralnik J, Bauer JM, Pahor M, Clark BC, Cesari M, Ruiz J, Sieber CC, Aubertin-Leheudre M, Waters DL, Visvanathan R, Landi F, Villareal DT, Fielding R, Won CW, Theou O, Martin FC, Dong B, Woo J, Flicker L, Ferrucci L, Merchant RA, Cao L, Cederholm T, Ribeiro SML, Rodríguez-Mañas L, Anker SD, Lundy J, Gutiérrez Robledo LM, Bautmans I, Aprahamian I, Schols JMGA, Izquierdo M, Vellas B. International Clinical Practice Guidelines for Sarcopenia (ICFSR): Screening, Diagnosis and Management. J Nutr Health Aging. 2018;22(10):1148-1161.
75. Kakehi S, Wakabayashi H, Inuma H, Inose T, Shioya M, Aoyama Y, Hara T, Uchimura K, Tomita K, Okamoto M, Yoshida M, Yokota S, Suzuki H. Rehabilitation Nutrition and Exercise Therapy for Sarcopenia. World J Mens Health. 2022 Jan;40(1):1-10.
76. Liao Y, Peng Z, Chen L, Zhang Y, Cheng Q, Nüssler AK, Bao W, Liu L, Yang W. Prospective Views for Whey Protein and/or Resistance Training Against Age-related Sarcopenia. Aging Dis. 2019 Feb 1;10(1):157-173.
77. Gill TM, Murphy TE, Gahbauer EA, Allore HG. Association of injurious falls with disability outcomes and nursing home admissions in community-living older persons. Am J Epidemiol. 2013 Aug 1;178(3):418-25.
78. Öztürk ZA, Özdemir S, Türkbeyler İH, Demir Z. Quality of life and fall risk in frail hospitalized elderly patients. Turk J Med Sci. 201 7;47: 1377–83.
79. Vieira ER, Palmer RC, Chaves PHM. Prevention of falls in older people living in the community. BMJ Online. 2016;353:1419.
80. Srivastava S, Muhammad T. Prevalence and risk factors of fall-related injury among older adults in India: evidence from a cross-sectional observational study. BMC Public Health.2022; 22: 550-60.
81. Terroso M, Rosa N, Marques AT, Simoes R. Physical consequences of falls in the elderly: a literature review from 1995 to 2010. Eur Rev Aging Phys Act. 2014; 11: 51–59.
82. Tinetti ME, Kumar C. The patient who falls: "It's always a trade-off." JAMA. 2010;303(3):258–66.
83. World Health Organization. WHO global report on falls prevention in older age. Geneva: World Health Organization; 2007.
84. Panel on Prevention of Falls in Older Persons. Summary of the Updated American Geriatrics Society/British Geriatrics Society clinical practice guideline for prevention of falls in older persons. J Am Geriatr Soc. 2011;59:148–57.
85. Stevens JA, Phelan EA. Development of STEADI: a fall prevention resource for health care providers. Health Promot Pract. 2013;14: 706–14.
86. Moyer VA. Prevention of falls in community-dwelling older adults: U.S. Preventive Services Task Force recommendation statement. Ann Intern Med. 2012; 157:197–204.
87. Rowe JW, Kahn RL. Human aging: usual and successful. Science. 1987;237(4811):143–49.
88. Rowe JW, Kahn RL. Successful aging. Gerontologist. 1997 Aug;37(4):433-40.
89. Glicken MD. Successful aging. In: Evidence-based counseling and psychotherapy for an aging population. San Diego: Academic Press; 2009. p. 23–40.
90. Zanjari N, Sharifian Sani M, Chavoshi MH, Rafiey H, Mohammadi Shahboulaghi F. Successful aging as a multidimensional concept: An integrative review. Med J Islam Repub Iran. 2017 Dec 17;31:100-10.
91. Rurka MM, Riba ML. Organizations' Perspectives on Successful Aging with Long-Term Physical Disability. Disabilities. 2023: 3(2): 217-34.
92. Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, Minson CT, Nigg CR, Salem GJ, Skinner JS. American College of Sports Medicine position stand. Exercise and physical activity for older adults. Med Sci Sports Exerc. 2009 Jul;41(7):1510-30.
93. U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans. 2nd ed. Washington, DC: U.S. Department of Health and Human Services; 2018.
94. Oliveira Gonçalves I, Bandeira AN, Coelho-Júnior HJ, Silva Aguiar SD, Minucci Camargo S, Yukio Asano R, Batista Júnior ML. Multicomponent Exercise on Physical Function, Cognition and Hemodynamic Parameters of Community-Dwelling Older Adults: A Quasi-Experimental Study. Int J Environ Res Public Health. 2019 Jun 20;16(12):2184-92.
95. Coelho HJ, Asano RY, Oliveira Gonçalves I, Brietzke C, Pires FO, Silva Aguiar S, et al. Multicomponent exercise decreases blood pressure, heart rate and double product in normotensive and hypertensive older patients with high blood pressure. Arch Cardiol Mex. 2018;88:413–22.
96. Cadore EL, Rodriguez-Manas L, Sinclair A, Izquierdo M. Effects of different exercise interventions on risk of falls, gait ability, and balance in physically frail older adults: A systematic review. Rejuvenation Res. 2013; 16:105–14.
97. Tarazona-Santabalbina FJ, Gomez-Cabrera MC, Perez-Ros P, Martinez-Arnau FM, Cabo H, Tsaparas K, et al. A Multicomponent Exercise Intervention that Reverses Frailty and Improves Cognition, Emotion, and Social Networking in the Community-Dwelling Frail Elderly: A Randomized Clinical Trial. J. Am. Med. Dir. Assoc. 2016; 17:426–33.
98. Luppa M, Luck T, Weyerer S, König HH, Brähler E, Riedel-Heller SG. Prediction of institutionalization in the elderly. A systematic review. Age Ageing. 2010;39(1):31–38.
99. Del Duca GF, Silva SG, Thumé E, Santos IS, Halla PC. Predictive factors for institutionalization of the elderly: a case-control study. Rev Saúde Pública. 2012;46(1):147–53.
100. Nihtilä EK, Martikainen PT, Koskinen SV, Reunanen AR, Noro AM, Häkkinen UT. Chronic conditions and the risk of long-term institutionalization among older people. Eur J Public Health. 2008; 18:77–84.
101. Gnijidic D, Stanaway F, Cumming R, Waite L, Blyth F, Naganathan V, Handelsman DJ, Le Couter DG. Mild cognitive impairment predicts institutionalization among older men: a population-based cohort study. PLoS One. 2012;5:6-12.

102. Luppa M, Riedel-Heller SG, Luck T, Wiese B, van den Bussche H, Haller F, Sauder M, Mösch E, Pentzek M, Wollny A, Eisele M, Zimmermann T, König HH, Maier W, Bickel H, Werle J, Weyerer S; AgeCoDe study group. Age-related predictors of institutionalization: results of the German study on aging, cognition and dementia in primary care patients (AgeCoDe) Soc Psychiatry Psychiatr Epidemiol. 2012; 47:263–70.
103. Salminen M, Laine J, Vahlberg T, Viikari P, Wuorela M, Viitanen M, Viikari L. Factors associated with institutionalization among home-dwelling patients of Urgent Geriatric Outpatient Clinic: a 3-year follow-up study. Eur Geriatr Med. 2020 Oct;11(5):745-51.
104. Karakaya MG, Bilgin S, Ekici G, Köse N, Otman AS, Functional Mobility D, Symptoms Level of Independence, and Quality of Life of the Elderly Living at Home and in the Nursing Home. J Am Med Dir Assoc. 2009;10(9):662–6.
105. Santiago LM, Mattos IE. Depressive symptoms in institutionalized older adults. Rev Saude Publica. 2014;48(2):216–24.
106. Syed Elias SM, Neville C, Scott T. The effectiveness of group reminiscence therapy for loneliness, anxiety and depression in older adults in long-term care: A systematic review. Geriatric Nursing. 2015;36(5):372–80.
107. Seijas V, Maritz R, Fernandes P, Bernard RM, Lugo LH, Bickenbach J and Sabariego C (2024) Rehabilitation delivery models to foster healthy aging—a scoping review. Front. Rehabil. Sci. 5:1307536.
108. Brett CE, Dykiert D, Starr JM, Deary IJ. Predicting change in quality of life from age 79 to 90 in the Lothian Birth Cohort 1921. Qual Life Res. 2019 Mar;28(3):737-749.
109. Haider S, Luger E, Kapan A, Titze S, Lackinger C, Schindler KE, Dorner TE. Associations between daily physical activity, handgrip strength, muscle mass, physical performance and quality of life in prefrail and frail community-dwelling older adults. Qual Life Res. 2016 Dec;25(12):3129-3138.
110. Attafuah PYA, Everink I, Abuosi AA, Lohrmann C, Schols JMGA. Quality of life of older adults and associated factors in Ghanaian urban slums: a cross-sectional study. BMJ Open. 2022 Feb 11;12(2):e057264.
111. Buijck BI, Bushnik T. Therapeutic climate. In: Buijck B, Ribbers G (eds). The Challenges of Nursing Stroke Management in Rehabilitation Centres. Cham, Switzerland: Springer International Publishing; 2018. p. 35–40.
112. Tijsen LM, Derksen EW, Achterberg WP, Buijck BI. Challenging rehabilitation environment for older patients. Clin Interv Aging 2019; 14: 1451–60.

STUDENT ASSIGNMENT

LONG ANSWER QUESTIONS

1. Explain in detail the physiological changes associated with aging in the musculoskeletal, cardiovascular, and nervous systems. Discuss how these changes influence rehabilitation planning for older adults.
2. Define comprehensive geriatric assessment (CGA). Describe its key components and elaborate how it guides physiotherapy management in geriatric rehabilitation.
3. What are frailty and sarcopenia? Explain their clinical features, causes, and impact on functional independence. Discuss physiotherapy interventions to prevent or manage these conditions in both institutional and community settings.

SHORT ANSWER QUESTIONS

1. List any five common geriatric syndromes encountered in older adults.
2. What is the STEADI Toolkit? How it is used in fall risk screening and prevention in geriatric practice?
3. Compare the rehabilitation needs of institutionalized versus community-dwelling older adults, citing two examples for each.

MULTIPLE CHOICE QUESTIONS

1. Which of the following is a core component of comprehensive geriatric assessment (CGA)?

a. Vital capacity measurement
b. Liver function test
c. Functional status evaluation
d. Total cholesterol level

2. Frailty in older adults is best described as:

a. A type of arthritis
b. A reversible cardiovascular condition
c. A syndrome of decreased physiological reserve and increased vulnerability
d. A fixed neurological disorder

3. The age-related loss of skeletal muscle mass and strength is known as:

a. Osteopenia
b. Sarcopenia
c. Kyphosis
d. Cachexia

4. The STEADI Toolkit is primarily used to:

a. Measure oxygen saturation in elderly patients
b. Diagnose dementia
c. Screen and prevent falls in older adults
d. Treat urinary incontinence

5. Successful aging includes all of the following; except:

a. Maintenance of physical health
b. Active social engagement
c. Severe dependence on institutional care
d. Retained cognitive function

ANSWER KEY

1. c **2.** c **3.** b **4.** c **5.** c