



# MODULE 2

AGEING PROCESS AND DESIGN

## UNIT

# 2

OVERVIEW OF THE MOST COMMON DISEASES  
IN THE OLDER POPULATION

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# DESIRE

## DESIGN FOR ALL METHODS TO CREATE AGE-FRIENDLY HOUSING

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DESIRE will provide professionals in the building industry and home furnishings sector with the tools and skills to apply Design4All methods as an integral part of the design process, with the aim to create or adapt age friendly housing as a solution for the wellbeing, comfort and autonomy of the older adults or dependents at home.

The DESIRE training platform consists of six modules and 21 units.



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## UNIT 2 – OVERVIEW OF THE MOST COMMON DISEASES IN THE OLDER POPULATION

### IN A NUTSHELL

The most common pathologies related to musculoskeletal, cardio-vascular, pulmonary, and neurological systems among older adults are described in this unit. Their impact on

limitations and needs of older adults in built environment is severe and therefore the professionals in building industry should address it when designing living environment.

## 2.1 MUSCULOSKELETAL DISORDERS

### 2.1.1 Structural changes of neurons, nerves and brain

Osteopenia is a skeletal disease characterized by lowered bone mass. Osteopenia is also called a pre-stage of osteoporosis, which is described as a progressive systemic skeletal disease characterized by low bone mass and impairment of bone tissue. Osteoporosis leads to increased bone fragility and susceptibility to fracture (Raisz & Gideon, 2003) Risk factors for osteoporosis are multifactorial and may include older age, female sex, genetics, low levels of physical activity, and smoking (Föger-Samwald et al., 2020).

Osteoporosis may affect both sexes, but the brunt of the disease is in menopausal women. It is estimated that approximately 30 % of postmenopausal women have osteoporosis (Bijelic et al., 2017). The major determinants of postmenopausal osteoporosis are suspected to be endocrine deficits due to decreased ovarian function (decreased estrogen levels), reduced dietary intake, and vitamin D deficiency (Karaguzel & Holick, 2010). As a result, there is an imbalance in bone resorption and bone formation. The most common consequence of osteopenia and osteoporosis is therefore reduced bone mass. Aggravation of osteoporosis significantly increases the risk of bone fractures. The most common fractures occur in the hip, spine, followed by arms and lower legs. It is estimated that approximately 50 % of women and 20 % of men will experience a fragility fracture after age 50 (Lorentzon, 2019).

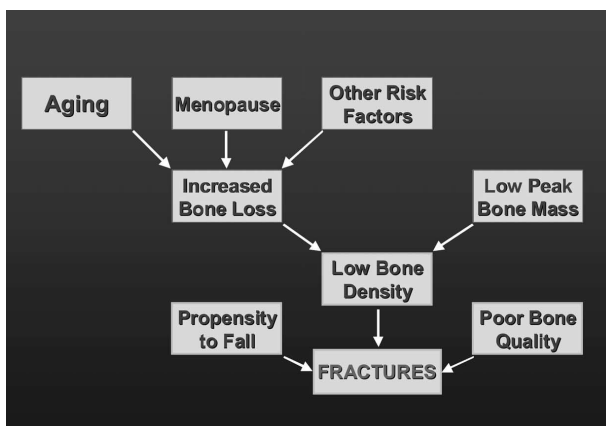


Figure 2.2.1 Bone fracture risk factors

Effective fracture prevention has a major impact on individual morbidity and a significant impact on mortality. Because of the morbid consequences of osteoporosis, prevention

of this disease and its associated fractures is considered essential for maintaining the health, quality of life, and independence of the elderly population.

## 2.1.2 Sarcopenia

One of the changes associated with human ageing is the progressive decline of skeletal muscle mass. This pathological condition is called sarcopenia, and is defined as a progressive and generalized skeletal muscle disorder characterized by low levels of measures for three parameters: **i)** muscle strength, **ii)** muscle quantity/quality, and **iii)** physical performance (Cruz-Jentoft & Sayer, 2019). Recently, low muscle strength overtook the role of low muscle mass as a principal determinant in sarcopenic individuals.

The cause of sarcopenia is multifactorial. Several factors contribute to the onset of disease such as physical inactivity, loss of neurons due to central nervous system decline, loss of muscle contractile function, decreased endocrine function (decreased levels of growth hormone, testosterone and estrogen, and reduced rate of skeletal muscle protein synthesis). Other possible risk factors for sarcopenia include female gender, low birth weight, genetic predisposition, malnutrition, alcohol and cigarette consumption, and chronic diseases.

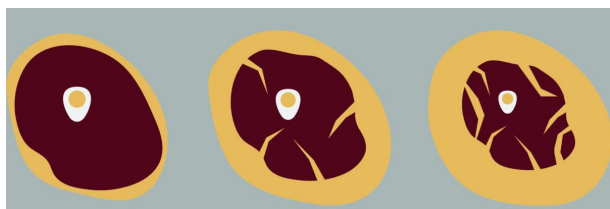


Figure 2.2.2 Change in muscle mass due to sarcopenia

Sarcopenia can occur in adults over the age of 45 years, increases with age, and is the most prevalent after the age of 70. However, the decrease in muscle mass is now recognized to begin even earlier in life, soon after 30 years of age. The prevalence of sarcopenia varies among age groups and other demographic characteristics and is estimated to be between 1–29 % in individuals aged (Beaudart et al., 2014). Individuals with sarcopenia have increased likelihood of adverse outcomes including falls, fractures, physical disability, cardiac disease, respiratory disease, cognitive impairment, and mortality. In long term sarcopenia leads to lowered quality of life, loss of independence and need for long-term care placement.

Sarcopenia is associated with numerous diseases. One of them is sarcopenic obesity as a new class of obesity in older adults in which low skeletal muscle mass is coupled with high levels of adiposity. Older adults with sarcopenic obesity may have higher levels of cardiovascular risk factors and an increased risk of mortality (Moon, 2016).

If sarcopenia progresses beyond a certain threshold of functional requirements, it leads to disability and frailty. Hence, it should be important to prevent or at least postpone the onset of the disease as much as possible to enhance survival and to reduce the demand for long-term care.

## 2.1.3 Rheumatoid arthritis

Rheumatoid arthritis is a chronic, autoimmune (immune system attacks healthy cells in the body by mistake) disease affecting the joints (Lin et al., 2020). It is characterized by a progressive inflammation of affected joints bilaterally, resulting in cartilage destruction, bone erosion, and disability (McAllister et al., 2011). Joints in the hands, wrists, and knees are most affected. Other tissues in the body can as well be affected and cause problems in organs such as the lungs, heart, and eyes.

Rheumatoid arthritis affects approximately 1 % of the population in Europe and North America (van der Woude & van der Helm-van Mil, 2018). It affects at least twice as many women as men, and although it can occur at any age, the peak incidence is around the age of 50 years. Other risk factors, beside age, are family history of rheumatoid arthritis, are the genetic factors and exposure to tobacco smoke. Typical articular symptoms are joint pain, stiffness, and swelling. Individuals with rheumatoid arthritis may also experience tender, warm,

swollen joints, fatigue, and loss of appetite. Joint stiffness is usually worse in the mornings and after inactivity while pain may be reduced with movement or activity.

Individuals with severe rheumatoid arthritis may have problems with participation in everyday activities due to pain, limited range of motion in affected joints, loss of selective movements especially in hands which can lead to decreased quality of life.

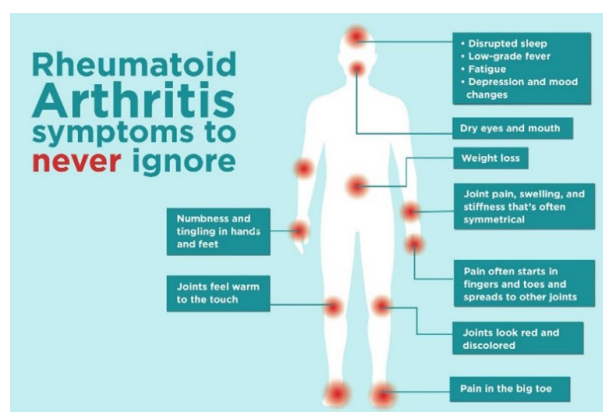


Figure 2.2.3 How rheumatoid arthritis affects the body

## 2.1.4 Osteoarthritis

Osteoarthritis is the most common form of arthritis (joint inflammation) and a leading cause of pain and disability in older adults. It can be defined as a degenerative disease characterized by focal areas of loss of articular cartilage within the joints, associated with hypertrophy of the bone and thickening of the capsule (Loeser et al., 2012).

Although osteoarthritis can damage any joint, the disease most commonly affects joints in the hands, knees, hips, and spine.

Osteoarthritis symptoms often develop slowly and worsen over time. The disease is most common after age 50 and affects more women than men (Palazzo et al., 2016). The prevalence of the disease ranges from 12 % to 22 % and is generally higher in developed countries (Palazzo et al., 2016). The WHO Scientific Group on Rheumatic Diseases estimates that 10 % of the world's population 60 years or older have significant clinical problems attributable to osteoarthritis.

The risk factors for osteoarthritis are multifactorial and usually include a combination of:

- Age: the risk of the disease increases with age,
- Gender: women are at higher risk,
- Obesity: higher body weight can put more stress on joints. Obesity may also have metabolic effects that increase the risk of osteoarthritis,
- Genetics,
- Joint injury or overuse: especially repetitive stress on a joint.

Signs and symptoms of osteoarthritis include pain (affected joints may ache during or after movement), stiffness (especially upon waking or after inactivity), tenderness (after light pressure on or near the joint), limited joint mobility, a cracking sensation, bone spurs (extra pieces of bone that feel like hard lumps may form around the affected joint), and swelling due to inflammation. The symptoms of osteoarthritis can usually be relieved, although the damage to the joints cannot be reversed.

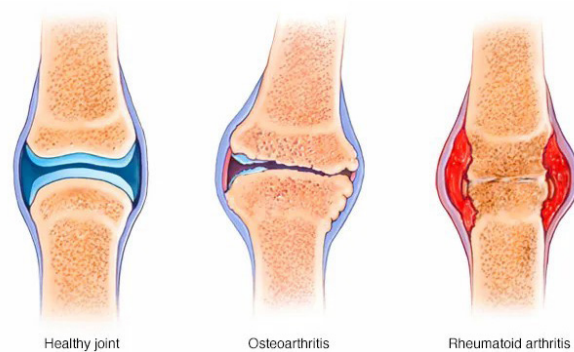


Figure 2.2.4 Joint changes due to osteoarthritis and rheumatoid arthritis

Osteoarthritis can lead to functional limitations and disability. Depression and sleep disturbances can result from the pain and disability caused by osteoarthritis. As the disease worsens over time it often leads to chronic pain which lowers the quality of life. Joint pain and stiffness can become so severe that it makes difficult to perform everyday tasks or work.

## 2.1.5 How musculoskeletal disorders affect everyday life of older adults

Musculoskeletal disorders are among the most common problems affecting older adults. They are a serious condition that can lead to loss of functionality, mobility, and physical independence. Loss of mobility and physical independence due to joint disease and fractures can be particularly devastating in this population, not only physically and psychologically, but also in terms of increased mortality rates. One of the most serious consequences of musculoskeletal conditions are falls, which are a one of the leading cause of disability and mortality in older adults.

Falls most often occur at home, where older people tend to feel safest and are most familiar with their surroundings. Therefore, fall prevention begins with creating a safe living environment that is tailored to the needs

and limitations of older adults. In addition to designing indoor spaces to prevent falls (e.g., avoiding carpets, slippery floors, having poles and handrails), it is also important to think about other limitations older adults may have due to musculoskeletal conditions. In previous chapters, we wrote about rheumatoid arthritis and osteoarthritis, which cause painful, swollen joints with limited range of motion. These diseases often affect the joints in the wrist, resulting in limited, selective movement. When this happens, older adults have difficulty holding small objects or even opening a cabinet if a handle is too small. They may have trouble opening their mailbox or performing kitchen tasks such as holding a knife and cutting. When the disease affects the hip and knee joints, all tasks that involve bending are limited. Typically, they cannot use (kitchen) drawers below knee

level. In addition, after total hip replacement, people need to avoid bending their hips more than 90° – so they need a higher chair, sofa, bed, toilet, etc. People with shoulder pain usually have difficulty reaching objects placed higher than shoulder height. In particular kitchen design should take into account the limitations of older people who can no longer easily reach for the top shelves.

Interior design should take into account the limitations of older people, both in the layout of rooms and in the design of interior spaces and products. The built environment should be designed to provide safe living conditions while promoting the right level of active lifestyle for older adults, adapted to their specific conditions.

## 2.2 CARDIOVASCULAR DISORDERS

### 2.2.1 Hypertension

Blood pressure is the pressure or force with which the blood presses against the vessel walls of the arteries as the heart carries the blood through the body. Blood pressure is measured by two numbers. Systolic pressure (the higher number) is the force with which your heart pumps blood through your body. Diastolic pressure (the lower number) is the pressure in arteries when the heart rest between to beats. In Europe, hypertension is usually diagnosed when blood pressure is above 140/80 mmHg (Williams et al., 2018).

The main risk factors for hypertension are genetics, obesity (abdominal obesity, body mass index above 30), inadequate diet, smoking, and older age. An unhealthy lifestyle is thus one of the most important factors that can contribute to the development of the disease. The symptoms and signs of arterial hypertension are often uncharacteristic and unnoticed, which is why it is often called the “silent killer”. Headaches, dizziness, shortness of breath on exertion, chest tightness, palpitations, and fatigue can occur.

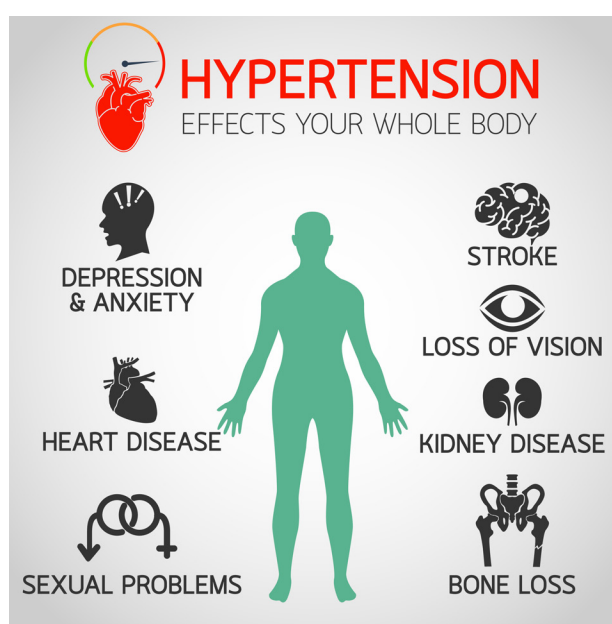


Figure 2.2.5 Hypertension affects whole body

High blood pressure is one of the most important risk factors for chronic non-communicable diseases such as cardiovascular disease, which is the leading cause of death and premature mortality worldwide (Roth et al., 2020). Among other complications, high blood pressure can cause damage to the heart. Excessive pressure can harden the arteries and reduce the flow of blood and oxygen to the heart. This increased pressure and decreased blood flow can cause the following:

- Chest pain, also called angina pectoris,
- Heart attack, which occurs when the blood supply to the heart is blocked and the heart muscle cells die due to lack of oxygen,
- Heart failure, when the heart can no longer pump enough blood and oxygen to other



- vital organs of the body,
- Stroke, by blockage of the arteries that supply blood and oxygen to the brain,
- Kidney damage, leading to kidney failure.

High blood pressure is a serious condition that can lead to various cardiovascular and other diseases. As cardiovascular disease is the leading cause of death worldwide, preventing high blood pressure can have a huge impact on health and improve the quality of life of older adults.

## 2.2.2 Heart failure

Heart failure is defined as a condition in which the heart is unable to provide sufficient cardiac output per minute to meet the current metabolic needs of the body, or can only do so with increased filling pressure/heart rate (Bozkurt et al., 2021). It can affect the pumping function of the heart (systolic heart failure) or the filling of the heart (diastolic heart failure). Chronic heart failure develops gradually and therefore has less severe clinical signs compared to acute heart failure. The prevalence of heart failure is 2–5 % of the general population and the incidence increases with age.

The most common risk factors for heart failure are coronary artery disease and hypertension. Other risk factors include pericardial disease, metabolic disorders, and arrhythmias. The New York Heart Association (NYHA) classifies heart failure into four stages, from Class 1, where patients have no limitation of physical activity, to Class 4, where breathing problems occur at rest and worsen with the slightest physical exertion.

The symptoms and signs of heart failure are due to decreased blood supply to the organs and include shortness of breath, fatigue, decreased exercise capacity, swelling, increased heart rate, swelling of the legs, cold extremities, peripheral cyanosis, enlarged liver, and ascites.

In patients with chronic heart failure, widening of blood vessels, which would ensure adequate blood supply and thus muscle activity during exertion, is impaired. The reduced blood supply to the skeletal muscles and physical inactivity in patients with chronic heart failure leads to atrophy of the skeletal muscles.

Heart failure is one of the cardiovascular diseases that mainly affects older people. People diagnosed with heart failure have reduced physical fitness, which significantly limits their ability to perform everyday tasks, especially in the later stages of the disease

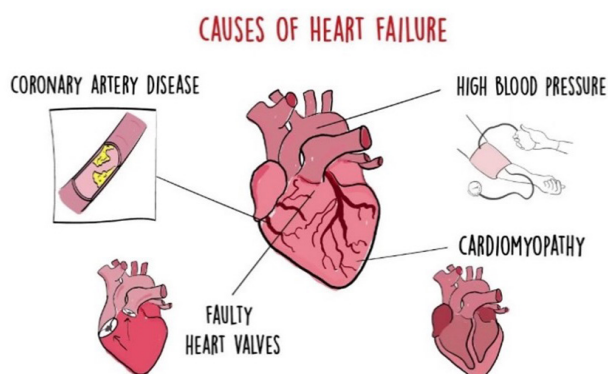


Figure 2.2.6 Causes of heart failure

## 2.2.3 Peripheral artery disease

Peripheral artery disease (PAD) is a chronic narrowing or blockage of the vessels that carry blood from the heart to the legs, resulting in reduced arterial blood flow in the limbs. The disease develops slowly, is asymptomatic for a long time and causes increasingly severe limb ischaemia in advanced stages. The prevalence of PAD increases with age, affecting more than 20 % of the elderly population over 80 years of age (Shu & Santulli, 2018).

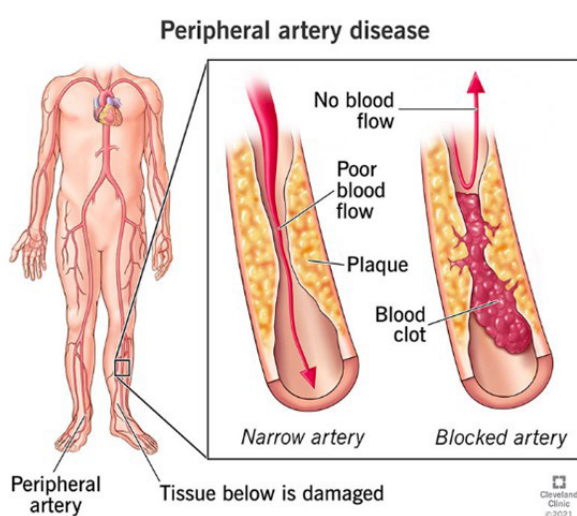


Figure 2.2.7 Blockage of blood flow in arteries

Plaques consisting of fats and other substances in and on the artery walls (also called atherosclerosis) contribute most to the development of the disease. Individuals with advanced atherosclerosis have at least 10 times the risk of PAD than the general population. Diabetes mellitus is also an important risk factor for increasing the risk of developing PAD and accelerates the development of the disease by about 5 times. The most common symptoms of PAD is cramping pain in the muscles supplied by the affected artery that occurs when walking, also called intermittent claudication. Ischaemic rest pain may also occur in the distal parts of the extremities (toes) and diminishes or disappears when the person sits down.

PAD affects the arteries in the lower limbs and severely limits the person's ability to walk longer distances. In advanced stages, it can even lead to limb amputation. Individuals with PAD often suffer from pain and therefore also have a higher risk of social and emotional deficits and participate less often in social activities.

## 2.2.4 How cardiovascular disorders affect everyday life of older adults

Ageing can lead to changes in the heart and blood vessels, increasing the risk of various diseases such as hypertension, coronary heart disease, heart failure, and others. One of the main causes of most cardiovascular diseases is the accumulation of fat deposits in the walls of the arteries over many years. In the past 30 years, it has been shown that a healthy lifestyle, including regular physical activity, reduced sedentary behaviour, a balanced diet, good quality sleep, absence of smoking and alcohol consumption, and low stress, contributes significantly to a lower incidence

of cardiovascular disease. Physical activity and sleep, in particular, can be influenced to some extent by the built environment in which we live.

To help prevent cardio-vascular diseases, indoor spaces should be designed to promote physical activity in older adults, at least to some extent. An example of a very simple measure is to use the stairs instead of the lift. Of course, all safety rules should be observed when doing so. Further on, older adults should also have the possibility to perform some kind of exercise

indoors. This can be achieved by designing one part of the space for exercise and placing some simple equipment there.

In addition to indoor spaces, outdoor areas also play an important role in increasing physical activity among older adults. A variety of neighbourhood features are related to physical activity of older adults. For example, if the paths are safe and wide enough, older people are more likely to go for a walk. And if there are several benches along the paths, older adults are more likely to spend time outdoors because they feel safer knowing they can rest if needed.

In fact, living in walkable neighbourhoods has been shown to be associated with a lower prevalence of high body mass index, diabetes mellitus and metabolic syndrome.

Both indoor and outdoor environments should aim to promote and enhance physical activity among older adults by providing safe and walkable environments. Designing indoor and outdoor spaces that promote active ageing by incorporating pathways, parks and other green spaces can improve both the physical and mental health of older adults.

## 2.3 PULMONARY DISORDERS

### 2.3.1 Obstructive and restrictive pulmonary diseases

Ageing is a multisystem process which leads to alterations of many diseases, including pulmonary disorders. The prevalence of pulmonary disorders increases with age and contributes to morbidity and mortality in older adults. The most common pulmonary disorders among older adults are respiratory infections, chronic obstructive pulmonary disease and bronchial asthma (Akgün et al., 2012).

In general, we can divide pulmonary diseases into two types: obstructive and restrictive. Obstruction refers to increased airway resistance, i.e. obstructed airflow through the airways. It is usually caused by a narrowing of the airways. Obstruction can be reversible (e.g. in asthma) or irreversible (e.g. in chronic obstructive pulmonary disease). In contrast to obstructive diseases, restriction leads to a reduction in lung volume without narrowing of the airways. Typical restrictive pulmonary diseases include fibrosis, diseases of the respiratory muscles, chest wall and pleura, and systemic diseases that also affect the lungs. In certain diseases, such as cystic fibrosis, there

can be both obstruction and restriction of the lungs. In this case, we speak of a restrictive-obstructive ventilation disorder.

Chronic obstructive pulmonary disease (COPD) is a common condition that is preventable and treatable. It is characterised by a permanent reduction in airflow through the airways, which is usually progressive and associated with chronic inflammation of the airways and lungs by harmful particles or gases (Global Initiative for Chronic Obstructive Lung Disease, 2022). According to the World Health Organisation, COPD is the third leading cause of death worldwide.

COPD is most commonly caused by smoking, but can also occur in non-smokers. Long-term occupational exposure to dust and chemicals, older age, lower socioeconomic status and an urban environment are associated with a higher incidence of the disease. There is a clear dose-response relationship with smoking, so the more years you smoke, the higher your risk of developing the disease. COPD is a systemic

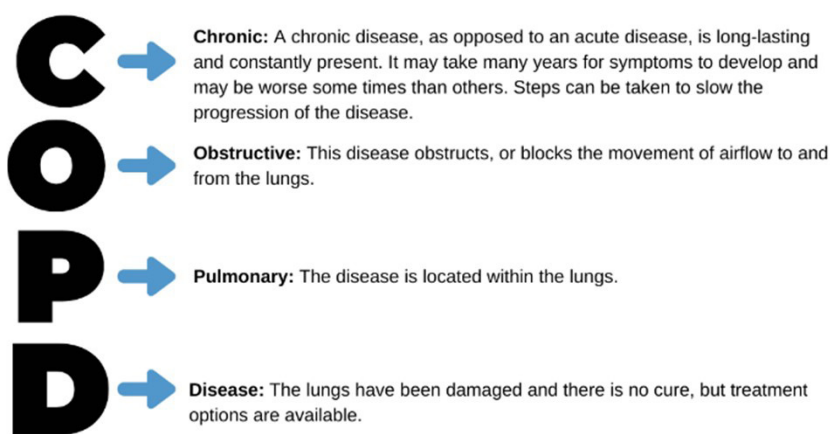


Figure 2.2.8 Explanation of the acronym COPD

disease that affects not only the lung tissue but also other organs in the body. People with COPD often have reduced cardiovascular capacity, impaired peripheral skeletal muscle strength, hormonal changes, systemic inflammation, and increased resting energy expenditure (Andersson, 2016). People with COPD typically suffer from cough, shortness of breath (initially on exertion, and in later stages

at rest), prolonged expiration, skeletal muscle weakness, hypoxaemia, and hypercapnia.

COPD, like other lung diseases, significantly affects quality of life and it worsens considerably with increasing severity of the disease. Older adults with COPD suffer from reduced physical fitness and are often unable to participate in various social activities.

## 2.3.2 Limitations and risks for older adults due to pulmonary diseases

The prevalence of pulmonary disease increases with age and contributes to morbidity and mortality in older adults. In addition, quality of life is also reduced as the most basic human function – breathing – is impaired.

As lung disease progresses, activities of daily living, from the simplest tasks to more demanding activities, are limited and quality of life declines. Shortness of breath, the most distressing symptom of COPD, worsens over time and reduces exercise tolerance, further limiting daily activities and worsening health. Older patients with pulmonary diseases such as COPD are also at increased risk for other conditions that contribute to functional limitations. COPD is associated with both osteoporosis and falls, which significantly

increase the risk of hip fractures, one of the leading causes of disability in older adults. In addition, older adults with lung disease are more likely to have poor sleep quality and more likely to report symptoms of anxiety and depression.

Built environment may have a role in preventing or worsening pulmonary disorders. For older adults with or without pulmonary disorders it is important to avoid inhaling chemical irritants, allergens, or toxins in the built environment. This can be achieved by using natural building materials such as wood, which can also have positive psychological effects, contributing to a better well-being of older people in the built environment.

## 2.4 NEUROLOGICAL DISORDERS

### 2.4.1 Parkinson disease

Parkinson's disease is a brain disorder that causes involuntary or uncontrollable movements such as tremors, stiffness, and difficulties with balance and coordination. Symptoms usually start gradually and get worse over time. As the disease progresses, individuals may have difficulty walking and talking. They may also have sleep problems, behavioural changes, depression, memory problems, and fatigue.

The most noticeable signs and symptoms of Parkinson's disease occur when the dopaminergic neurons in the area of the brain that controls movement become impaired or die (Hawkes, 2008). Normally, these nerve cells produce an important brain chemical known as dopamine. When the neurons die or become impaired, they produce less dopamine, which leads to the movement problems. So far, the cause of the onset of the disease is still unknown.

Parkinson's disease has four main symptoms (Heavenaver & Bradshaw, 2022):

- Tremor in the hands, arms, legs, jaw, or head,
- Muscle rigidity, where muscles remain tense for long periods of time,
- Slowness of movements,
- Impaired balance and coordination.

Some people with Parkinson's may experience changes in cognitive function, including problems with memory, attention, and the ability to plan and carry out tasks. Over time, as the disease progresses, some people may even develop dementia and be diagnosed with Parkinson's dementia, also called Lewy body dementia. People with Parkinson's dementia can have severe memory and thinking problems that interfere with daily life (Blanc & Bousiges, 2022).

#### PARKINSON DISEASE SYMPTOMS

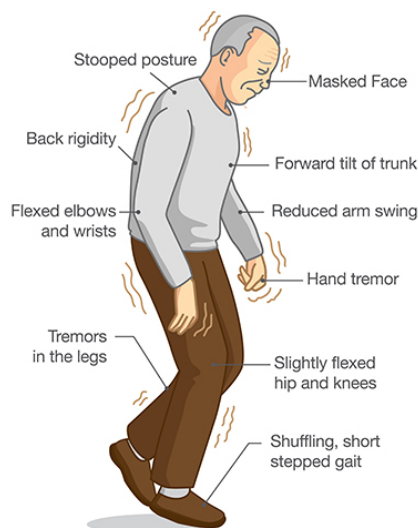


Figure 2.2.9 Symptoms of Parkinson's disease

Although the progression of Parkinson's disease is usually slow, a person's daily life may eventually be affected. Parkinson's disease cannot be cured, but medication can significantly improve symptoms. However, activities such as working, taking care of a home and participating in social activities with friends can become challenging.

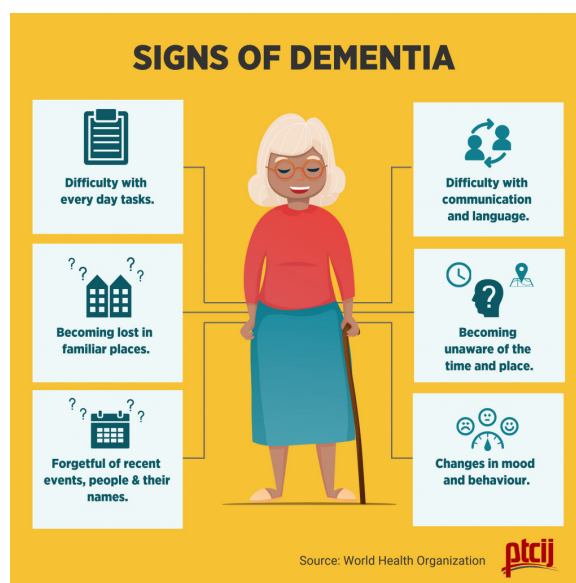


Figure 2.2.10 Symptoms and signs of dementia

## 2.2.4 Dementia

Dementia is not a specific disease, but rather a general term for the impairment of the ability to remember, think, or make decisions that interferes with the performance of everyday activities. Alzheimer's disease is the most common form of dementia. Although dementia mostly affects older adults, it is not part of normal ageing process. The prevalence and incidence of dementia increase exponentially after the age of 65. The estimated prevalence of dementia in Europe among older adults is 4.7 % (Lopez & Kuller, 2019).

As dementia is a general term, symptoms can vary greatly from person to person. People with dementia have problems with memory, attention, communication, reasoning, judgement and problem solving, and visual perception beyond the typical age-related changes in vision. Risk factors for developing dementia include older age, genetic factors, poor cardiovascular health (e. g. high blood pressure), and traumatic brain injury. There are several types of dementia, but the most common are Alzheimer's disease, vascular dementia, Lewy body dementia, and mixed dementia (Raz et al., 2016).

Signs that may indicate dementia include:

- Getting lost in a familiar environment,
- Using unusual words for familiar objects,
- Forgetting old memories,
- Not being able to do tasks independently.

Dementia is not curable. However, a healthy lifestyle with a healthy diet, absence of smoking, regular exercise, and cognitive stimulation can reduce the risk of cognitive decline and dementia.

Alzheimer's disease is a neurological disorder that slowly destroys memory and thinking ability, and eventually the ability to perform the simplest tasks. For most people who develop Alzheimer's disease, the first symptoms appear later in life. Alzheimer's disease is the

most common form of dementia and accounts for 60–80 % of all cases (Garre-Olmo, 2018). Alzheimer's disease is a progressive disease, meaning that symptoms develop gradually over many years and eventually become more severe.

Memory loss is the main symptom of Alzheimer's disease. Early signs include difficulty remembering recent events or conversations. As the disease progresses, memory problems worsen and other symptoms appear, such as insomnia, wandering, restlessness, anxiety, and aggression. Some people with memory problems have what is called mild cognitive impairment. In this case, they have more memory problems than normal for their age, but their symptoms do not interfere with their daily life. Older people with mild cognitive impairment have a higher risk of developing Alzheimer's disease, but not all of them develop it (Sanford, 2017).

The exact cause of Alzheimer's disease is not yet fully understood, although several factors are thought to increase the risk of developing the disease. The causes of Alzheimer's disease are likely to be a combination of genetic, environmental, and lifestyle factors (e.g. poor cardiovascular health). It is known that the risk of Alzheimer's disease increases with age and that people with untreated depression are more likely to develop the disease, although depression can also be one of the symptoms of Alzheimer's disease.

Alzheimer's disease is a complex disease for which there is no cure to successfully treat it. Current approaches to treating Alzheimer's disease focus on helping people maintain mental function, treating the underlying disease process and controlling behavioural symptoms.

## 2.4.3 Peripheral neuropathies and tremor

Peripheral neuropathy is a term used to describe conditions in which the muscles and sensory organs are weakened or injured due to damage to the nerves that supply them. Symptoms of peripheral neuropathies include numbness and paraesthesia, which may be accompanied by weakness and pain.

Most peripheral neuropathies develop slowly over months or years, but some are rapidly progressive. Carpal tunnel syndrome is the most common mononeuropathy, with a prevalence of 5 %. In general, peripheral neuropathies are more common in male older adults (Hanewinkel et al., 2016). There are several risk factors for developing peripheral neuropathies, but diabetes is a common cause.

Peripheral neuropathies can cause tremor, which refers to involuntary rhythmic oscillations of a body part, most commonly hand (Anouti & Koller, 1995). Tremor varies in frequency and amplitude and can be influenced by physiological and psychological factors and also by medication. There are different types of tremors with different pathophysiological backgrounds. We generally associate tremor with Parkinson's disease, but other types of tremors can also occur.

In general, tremor can be the only physical abnormality (isolated tremor), or it can be combined with other neurological or systemic signs (combined tremor). Essential tremor is the most common example of an isolated tremor syndrome, and resting tremor with parkinsonism is the most common combined tremor syndrome. However, there are many other isolated and combined tremor syndromes that can occur in older adults (e. g. dystonic tremor, action tremor with ataxia, focal and task-specific tremor) (Elble, 2017). Tremor in the hands is the most common and has a major impact on quality of life and the ability to perform everyday tasks.

The hand is a very complex structure consisting of many different bones, muscles and ligaments that allow for a high degree of movement and dexterity. There are three main types of bones in the hand itself, including:

- Phalanges. The bones found in the fingers of each hand. Each finger has 3 phalanges while the thumb has 2,
- Metacarpal bones. The bones that make up the middle part of the hand,
- Carpals bones. The bones that make up the wrist. The 2 rows of carpal bones are connected to the bones of the arm.

There are numerous muscles, ligaments, tendons, and sheaths in the hand. The muscles are the structures that can contract to allow the bones in the hand to move. The ligaments are fibrous tissues that hold the joints of the hand together. The sheaths are tubular structures that surround part of the fingers. The tendons connect the muscles to the bones to allow movement. In addition, there are arteries, veins and nerves in the hand that provide blood flow and sensation to the hand and fingers. The skin normally covers and protects the deep structures of the hand and wrist. The fingernails are essentially a specialised part of the skin that protects the fingertips.

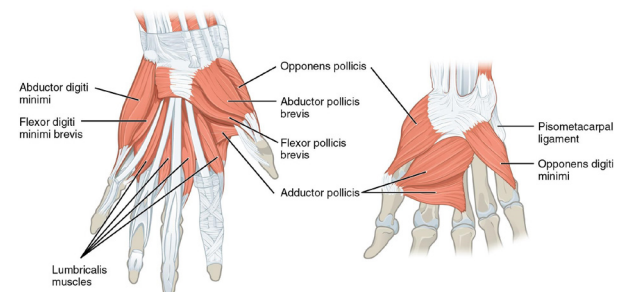


Figure 2.2.11 Hand anatomy

Peripheral neuropathies and tremor are common in older adults. The hand is the most commonly affected by tremor. We know of different types of tremors that are triggered by different background mechanisms. So far, there

is no general cure for tremor, but treatments can relieve the symptoms and improve quality of life. Certain lifestyle changes and specific treatment can help reduce tremor.

## 2.4.4 Gait disorders

Human gait is based on a complex interaction between the nervous system, the musculo-skeletal system and the cardiorespiratory system (Pirker & Katzenschlager, 2017). Each gait pattern is influenced by an individual's age, personality, mood, and socio-cultural factors. To ensure safe walking, intact cognition and executive control are required.

Gait disorders are common in the older adult population and increase with age. Gait disorders result in a loss of personal freedom, increase the risk of falls and injuries, and lead to a reduction in quality of life. Older adults with gait disorders often suffer from imbalance, shuffling, staggering, and stiffening. We know several causes of gait disorders, from orthopaedic to neurological conditions such as Parkinsonism. There are several types of gait disorders, including:

- Impulsive gait. This type of gait is observed in patients with parkinsonism. It is characterised by a stooped, rigid posture, with the head and neck bent forward. Steps tend to become faster and shorter.
- Scissor gait. This type of gait is common in patients with spastic cerebral palsy. The knees and thighs meet or cross each other

in a scissor-like fashion when walking. The legs, hips and pelvis are bent, giving the impression that the person is squatting. The steps are slow and small.

- Spastic gait. This type of gait is observed in patients with cerebral palsy or multiple sclerosis. Spastic gait is a type of walking in which one leg is stiff and drags in a semicircular motion on the side most affected by long-term muscle contraction.
- Stepping gait. A “high-stepping” gait in which the leg is raised high, the foot drops and the toes point down and scrape the ground as the person walks. Atrophy of the peroneal muscle or injury to the peroneal nerve can cause this type of gait.

Although the different types of gait disorders have different pathophysiological backgrounds and require different types of treatment and rehabilitation, they result in similar limitations in older adults. Older adults with a gait disorder often have weaker muscles, delayed reaction, and less muscle coordination. Consequently, they have reduced balance and coordination and a higher risk for falls.



## 2.4.5 Limitations and risks for older adults due to neurological disorders

Neurological disorders are conditions that result from damage to part of the brain or nervous system. Neurological disorders are common in older adults and are associated with a high risk of adverse health outcomes, including mortality, disability, and hospitalisation.

It is well known that patients with neurological disorders have a lower quality of life. One of the most common neurological disorders in older adults is dementia, which leads to impaired memory, attention, and communication. Nowadays it is known that the built environment can influence human emotions, behaviour and physiological responses as well as social relationships. Personalised (hospital) rooms, the right choice of colours of walls and furniture, the use of simple and functional equipment, appropriate aesthetics of the environment, customisation of objects are just some of the possible solutions we can incorporate into the built environment to improve well-being of neurological patients. Special attention should be paid to the location of equipment such as mirrors and TV, as well as protection against falls and other injuries (avoid sharp edges on furniture) or the possibility of a suicide attempt (safe windows). Special attention should be paid to safe restraints, such as the use of a safe cooker.

Older adults with peripheral neuropathies often suffer from numbness and pain in the body, which significantly affects their ability to perform everyday tasks. People with carpal tunnel often have a weaker grip in their hand, so that in the worst cases they even find it difficult to hold a glass of water. Older adults with peripheral neuropathies or parkinsonism may also suffer from tremor. Although there are different types of tremors, all older adults with tremor have difficulty with hand accuracy. Therefore, objects in their living environment should be larger and designed so that they can be easily grasped and manipulated (e. g. cutlery or cups with a larger opening for the fingers). Older adults with neurological disorders may also have problems walking. Impaired walking increases the risk of falls and related injuries. Therefore, special care should be taken in the design of the built environment to ensure that there are level floors without carpets and doorsteps. Walls should be equipped with safety handles to help them keep balance when needed.

Proper design of the built environment can help with therapy and rehabilitation and positively influence the patient's behaviour. Above all, it is important that the built environment ensures a safe and comfortable living environment for people with neurological disorders.

## 2.5 AGE FRAILITY

Frailty is a common clinical geriatric syndrome associated with a high risk of decline in health and function in older adults. Frailty has been defined as meeting three of the five criteria: low grip strength, low energy, slowed rate of waking, low physical activity, and/or unwanted weight loss (Fried et al., 2001). About 10 % of people over the age of 65 live with frailty. As frailty increases with age, the prevalence of frailty among those over 85 ranges from 25 % to 50 % .

Frailty in old age includes unwanted weight loss, weakness, and fatigue. There is often reduced food intake and gait problems (Guinan, 2016). Older adults with frailty often also suffer from sarcopenia and osteoporosis. Older adults with frailty have a higher risk of falls, disability,

hospitalisation, and mortality. It should be noted that frailty is a multidimensional concept that relates not only to physical domains, but also to psychological and social domains. Social frailty is defined as a condition in which there is a risk of losing resources that are essential for meeting one or more basic social needs (Bunt et al., 2017). Due to the multidimensional nature of frailty, the combination of physical, psychological, and social frailty is more likely to contribute to disability and mortality than physical, psychological, or social frailty alone.

Frailty is a serious geriatric syndrome. Frail older adults suffer from various symptoms and signs that lead to reduced muscle performance, physical fitness, and psychological well-being.

### 2.5.1 Limitations and risks for older adults due to age frailty pathologies

Frailty is defined as a state of increased vulnerability to adverse health effects resulting from multiple deficits in physiological, physical, and mental functioning. Frail older adults are at higher risk for falls and consequently for hospitalisation and mortality.

When designing the built environment for frail older adults, special care should be taken to prevent falls. Carpets, uneven floors (e. g. in the shower) should be avoided. If possible, frail older adults should live on the ground floor to avoid using stairs. The bathroom should be specially designed and equipped with non-slip tiles. The toilet, shower, and other elements in the bathroom should be equipped with holders to facilitate the completion of tasks in the bathroom (e. g. transitioning from the toilet to standing up).

When designing the built environment for frail older adults, we want to make the environment as safe and comfortable as possible. On the other hand, we should include elements to promote physical activity, as this is an important goal in the prevention of frailty. In fact, lower levels of physical activity are associated with worsening frailty syndrome. It is important that frail older adults engage in regular physical activity, but always in a safe and controlled environment. Taking all these limitations into account, the built environment should have indoor elements that promote physical activity among frail older people.

As frailty is a common syndrome in older adults that increases the risk of hospitalisation and morbidity, the built environment should be designed to meet the needs and limitations of frail older people to provide a safe and

comfortable living environment. Frail older adults require special care and treatment, as well as a living environment that takes into account their physical and mental limitations

and consists of individually adapted furnishing solutions to enable them to live safely and independently.

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Figure 2.2.1 Bone fracture risk factors. Adapted from Riggs, B. L., & Melton, L. J., 3rd (1992). The prevention and treatment of osteoporosis. *The New England journal of medicine*, 327(9), 620–627. <https://doi.org/10.1056/NEJM199208273270908>

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