

# **THE AGING PROCESS**

## **Abstract**

As a person ages there are many physiological changes that occur. These changes start when the person reaches the teen years, and involve all body organs. Often the first body organ affected is the musculoskeletal system. The sensory organs of the eyes and ears tend to change mid-life. As a person becomes elderly many of the internal body organs decline and begin to fail. There are risks associated with aging related to falling and other complicating factors. As a person ages the body's reserves are less. This is part of normal aging. At the same time, aging doesn't necessarily refer to an old person or to someone who is unable to participate in strenuous physical activity or who can tolerate environmental stressors. Body changes are a normal part of aging, and there are numerous expert studies on how these changes affect various individuals based on their individual health states. A case study of elderly involved in endurance activities is discussed.

## **Learning Objectives:**

1. Identify body system changes caused by the aging process.
2. Describe acute and chronic diseases that are common in older adults.
3. Describe health issues that affect the elderly.
4. Identify medication issues that are common to the elderly.

## **Introduction**

Certified nursing assistants and other healthcare professionals often care for people who are elderly. A certified nursing assistant (CNA) who cares for elderly patients needs to understand the aging process and the medical challenges it brings. As people grow older, they eventually enter the aging process, a progressive and inevitable series of bodily changes. The aging process is characterized by a decline in physical and mental abilities. It also involves a decreased resistance to disease, diminished powers of recuperation, and a greater risk of developing acute and/or chronic diseases. Being “elderly” involves more than biological or chronological factors. Psychological and social dimensions are also involved. These added dimensions make defining old age, older adult, or elderly difficult, however in the following sections old age will be considered 65 years or more and will be used interchangeably.

### **The Aging Population**

Life expectancy is generally increasing worldwide resulting in more people entering what is traditionally described as old age. This means that the elderly populations, in the United States and many other countries, are getting older. In the United States, this is referred to as “the graying of America.”

The statistics confirm that the population in the United States is aging. The number of people in the U.S., who are 65 or older has been slowly and steadily increasing, and this older population has grown by over 20% in the last decade and is an increase that is expected to continue. With each passing year more and more of the population will be elderly. There are many reasons why this is happening and will continue to happen. Better access to improved healthcare is partially

responsible. Many diseases and illnesses that could not be treated or that could greatly decrease life span can now be cured.

Lifestyle changes have contributed to this trend as well. The number of people who smoke has decreased significantly, and fitness and nutrition have become a more popular lifestyle trend. Add to these changes the fact that the birth rate of the Baby Boomer generation has been high, and that Baby Boomer's now make up a large part of the population, many of these people will be turning 65 years old during the next decade.

### **Defining "Old" and Elderly People**

The words old, old age, elderly, and older adult are frequently used but they do not have universally accepted definitions. Gerontologists (professionals who study aging) have developed categories such as the young-old (60-69 years) and the middle-old (70-79 years) and others to describe the elderly but these categories have not definitively defined what is old or old age.

There are no universally accepted definitions for a person who is old or belonging to an old age category. Old age or being elderly tends to be defined in context. In a society where many people die in infancy or before reaching age 35, someone who is 50 may be considered old. The context can also depend on the individual referring to a person who is "old". If a teenager were asked if a 67-year-old woman is old, the answer would likely be "yes", however a 67-year-old person may possibly disagree.

The aging process has four dimensions: 1) biological, 2) chronological, 3) psychological, and 4) social. When defining "old," it

is important to delineate which dimension, or combination of dimensions, is being used. Some people may consider a person who is 66 to be old and in the chronological sense that is true since that person is older than most of the population. Other people may not consider this person old if the 66-year-old person is in perfect health, exercises every day, is happy and well-adjusted, and has an active professional and social life. It is questionable whether a 66 year old person who is psychologically and socially youthful is an "old" person.

Although the aging process is usually associated with being old, the biological process of aging actually begins early in life, as discussed in more detail later on. Aging is experienced differently for each person: the aging process can happen slowly or quickly. Each aspect of aging, the biological, chronological, psychological, and social also develops at its own rate.

### **The Aging Process**

The aging process is defined as *the gradual, decreased ability of the body to function and to heal itself*. People think of aging as equivalent to being old but aging actually begins in the late teens. That is the time when a person's physical capabilities are at their maximum. As a person moves past the late teen years, the body begins to decline. The person gradually loses strength, eyesight and hearing becomes weaker. All of the organ systems slowly become less able to function. The heart and lungs are not as strong, the immune system is less able to fight infections, and other parts of the body do not function as well as they previously did.

Further, the aging process occurs over time. The aging process, the gradual decline in a person's health and physical abilities, is very

slow. For most of a person's life, the aging process is not noticeable and does not interfere with daily life.

### **Stress and Repair**

Each minute of every day a person's body must deal with internal and external stress but fortunately it is usually able to handle the stress, to fight off infections, and repair damage. As a person gets older, the body loses the capability for self-healing with two results: 1) damage that cannot be repaired, and 2) susceptibility to disease. The body wears out, it cannot do what it once did, and acute and chronic illnesses may occur.

### **Progression**

Throughout most of life, the aging process is slow and gradual but at a certain point it begins to speed up. When that happens several things occur: 1) the effects of aging begin to be noticeable to the individual, 2) the effects of aging can be measured by a physical examination or testing, 3) the older person becomes more susceptible to disease, 4) the older person is less able to recover from illness, and 5) the older person develops an acute or chronic disease.

### **The Weak Link**

Eventually the balance of stress and repair is tipped in favor of damage and an acute or chronic disease happens. An older person may develop heart failure, chronic kidney disease, or suffer an acute illness such as a stroke or infection where recovery is difficult. Therefore, one or more of the organ systems will be the "weak link" that leads to illness.

Aging begins early and it progresses slowly. It represents a gradual decline in the functional ability of the body and a decrease in the ability of the body to handle stress. All of this makes a person vulnerable to illness and infection and eventually vulnerable to acute or chronic diseases.

### **The Causes of Aging**

The question of why a person ages is a source of constant investigation and there are many theories. Scientists have speculated that aging represents an imbalance between stress and repair. There is also evidence that aging itself seems to cause an increase in internal stress that is separate from the normal external stress, tissue, and organ damage that all human bodies undergo.

Another theory of aging is that the process of homeostasis is disrupted as a person gets older. Homeostasis is defined as the ability of the body to maintain an internal environment that allows for optimal functioning. For example, the brain, the heart, and muscles all work best within a certain range of body temperature and if the body temperature becomes too high or too low, heat can be produced or lost as needed. Homeostatic mechanisms may simply stop working after a certain point.

It could also be that a person's DNA is programmed to age. These bodily changes mean that waste products from metabolism are eliminated less effectively during old age. As waste products accumulate, a person shows signs of aging. Also, if a person's DNA contributes to aging, this would explain, in part, why everyone ages differently. Some people live to be quite old and they have few health problems and minor decreases in functional ability. Longevity and freedom from illness is another part of the aging process but it is not

clear why some people live longer and healthier lives. Regardless of the process, aging happens to everyone.

Since the aging process affects each person differently, descriptions of what happens to a person's body during aging can only be described in general terms. When and how aging affects a person's health on the individual. Age-related changes in the body systems will be discussed here, and the implications and consequences of these changes will be discussed in the next section.

### **Bone Composition and Skin Changes**

A person gains weight in older age. The percentage of body weight that is fat is increased and the person gradually loses muscle mass. The loss of muscle mass begins slowly but increases more quickly as an individual ages. The number of fast twitch muscle fibers - the ones that give us power - decrease so strength is gradually lost. Joints become less flexible because the tendons and ligaments deteriorate, and the bones lose calcium and become thinner and more brittle. The bones and joints in particular are constantly in a balance between breakdown and rebuilding, and as people get older this balance is irreversibly more inclined towards breakdown. The skin gets thinner and dryer as people age and it gets noticeably more fragile. Receptors for touch and pain in the skin do not function as well. In addition, thinning of the skin plus loss of the fat layer immediately below the skin means that body heat is more easily lost.

### **Cardiovascular System and Aging**

The cardiovascular system is comprised of the blood vessels, the blood, and the heart. The purpose of the cardiovascular system is to

deliver oxygen and nutrients to the organs and tissues and to help eliminate metabolic waste products. These functions are done by the heart pumping the blood throughout the body by way of the arteries, capillaries, and veins.

Several important age-related changes occur to the cardiovascular system. The heart muscle becomes thicker and stiffer and much less compliant, as do the arteries and the other blood vessels. In most people the heart muscle does not become weaker with age but it does lose some capacity for response to stress. In addition, the process of atherosclerosis, typically known as hardening of the arteries, increases with age and the majority of elderly people have atherosclerotic plaques in the arteries of the brain, the heart, and major blood vessels. Blood volume is unaffected by age, but the ability of the bone marrow to produce more blood cells during times of stress is definitely decreased. Finally, the blood must be able to form clots to prevent bleeding, but in many older persons blood clotting is suboptimal.

### **Gastrointestinal Tract and Aging**

The gastrointestinal (GI) tract breaks down food, absorbs nutrients and fluids, and eliminates wastes. Each part of the GI tract, from the mouth to the lower GI tract, can be affected by the aging process.

In the mouth, the gums recede as people get older and the teeth become more prone to decay. The esophagus, the muscular tube that connects the oral cavity to the stomach, is less sensitive to pain and the gastroesophageal (GE) valve, which is technically a sphincter that

separates the esophagus from the stomach, begins to leak. This allows acidic stomach contents to splash back into the esophagus, but because pain sensation in the esophagus is diminished the acid reflux may go unnoticed.

Other parts of the GI tract experience age-related changes as well. The stomach becomes more sensitive to the irritating effect of certain drugs such as aspirin and ibuprofen, the small intestine of an older adult does not absorb calcium as efficiently as the small intestine of someone younger, the lower bowel loses muscle tone and is less able to expel feces, and the strength and tone of the anal sphincter are decreased.

### **Genito-Urinary System and Aging**

The urinary bladder of an elderly person has a smaller maximum capacity. The bladder is not emptied completely during urination and the ability to voluntarily delay urination is decreased. The female urethra becomes shorter and may not close completely after every act of urination.

Sexual function for men and women is adversely affected by age and obviously the ability to reproduce is compromised. For men, the prostate gland gradually becomes enlarged with age.

### **Hepatobiliary System and Aging**

The hepatobiliary system is comprised of the gallbladder and the liver. The gallbladder stores bile, a compound made by the liver that is needed to absorb fat, and releases it into the GI tract. The liver has a wide range of important functions, including but not limited to production of blood clotting factors, cholesterol production, metabolism

of drugs, regulation of blood sugar, and assisting with the immune response to infection and stress.

The liver is a very active organ and is constantly faced with the demands of stress and repair. The size and functioning ability of the liver decline with age. Examples of this are the decreased production of clotting factors and perhaps most importantly, the ability to break down and metabolize drugs.

### **Immune System**

The immune system defends against disease and infection. Individuals are constantly exposed to bacteria, viruses, and other harmful pathogens but the immune system recognizes and neutralizes them. The immune system ages along with the rest of the body and as people get old the immune system becomes less strong and less effective. This is one of the primary reasons that older people are more susceptible to autoimmune diseases, cancers, and infections. A diminished immune system also limits the ability to recover from illnesses.

### **The Brain, Nervous System and Aging**

Age-related changes in the nervous system and the brain are very complex and not well understood. Coordination between different areas of the brain decreases with age and the ability to quickly process information is decreased. The brain atrophies (shrinks) as individuals get older. Nerve cells and nerve fibers are lost and the nervous system does not transmit impulses from the brain to the body as quickly or efficiently. Abnormal tissue deposits called plaques and tangles begin to

form in the brain and for some people these will eventually cause Alzheimer's disease.

### **Renal System and Aging**

The renal system is profoundly affected by age. The kidneys become smaller and quite a bit of the functional kidney tissue is lost and replaced with fat or fiber. By the age of 75 approximately one-third of each kidney is no longer viable.

The kidneys also suffer from changes to their blood supply. The kidney is a very active organ and it needs a lot of blood to function properly; slightly more than 20% of the blood pumped by the heart with each beat goes to the kidneys. But aging causes the blood vessels in the kidney to become very narrow. This deprives the kidneys of oxygen and nutrients and this in turn decreases the ability of the kidneys to eliminate toxins, drug metabolites, and waste products.

### **Respiratory System and Aging**

The primary function of the lungs and the respiratory system is gas exchange. Oxygen is delivered to the blood during inhalation and carbon dioxide is eliminated from the blood and out through the lungs during exhalation. Aging affects the lungs and the respiratory system and gas exchange in many ways. These age-related changes include decreased elasticity, decreased functional lung tissue, changes in the chest, diaphragm and rib muscles, and resistance to disease.

### **Decreased Elasticity**

Lung tissue is very elastic. When the lungs are stretched during inhalation, the elastic property of lung tissue creates a powerful impulse for them to recoil and return to their original size. This elasticity and recoil is the primary way that exhalation occurs. But as we people the elasticity of the lungs is significantly diminished and exhalation is less efficient and less complete.

### **Decreased Functional Lung Tissue**

As people get older the amount of functional lung tissue is decreased and less oxygen moves through the lungs into the blood. Carbon dioxide elimination however is not affected by aging.

### **Chest, Diaphragm, and Rib Muscles**

The chest, diaphragm, and rib muscles get weaker and stiffer with age. This limits the ability to inhale and fully expand the lungs.

### **Resistance to Disease**

There are several age-related changes in the respiratory system that decrease resistance to disease. For example, the cough reflex is weakened so mucous and inhaled bacteria and viruses are not effectively cleared from the lungs.

## **Sensory Changes**

Changes in sensory ability are some of the most noticeable effects of aging. Many older adults will report that they cannot hear or see as well as they once could. They also note that their senses of taste and smell are diminished.

### **Vision**

The eyes experience significant changes from aging. The ability to distinguish between colors decreases, the eyes cannot adapt to low light conditions or darkness, and presbyopia, which is commonly called nearsightedness, develops. Presbyopia limits the ability of the eyes to focus on objects that are close at hand. Someone who has presbyopia must use corrective lenses or will have to hold a book or an object at arm's length in order to see it clearly.

## **Hearing**

Hearing is seriously affected by age. Two examples of this are changes in pitch discrimination and sound location. Older people have difficulty in hearing high-pitched sounds, especially high-pitched consonants such as **t** or **k**. Words that contain those letters may not be well understood or heard clearly. A person's ability to distinguish speech from background noise diminishes in old age. This factor may be more responsible for hearing impairment than the volume of another person's speech, or decreased hearing acuity by the hearer. Interference by surrounding noise may be primarily responsible for an elderly person's ability to understand what another person is saying.

## **Taste and Smell**

The ability to discriminate between tastes gets worse as people get older, but much of this is caused by a very sharp decrease in the sense of smell. By the age of 80 most people have lost 50%-80% of their sense of smell. Aging, and the consequences of aging, are inevitable and there are other age-associated changes aside from the one discussed above. As people grow older, their bodies lose strength and health, they cannot adapt to stress, and they cannot recover from

stress. These changes related to aging may be an inconvenience, but they are also the cause of many acute and chronic illnesses.

**Table 1: Body System Changes and Aging**

<p><b>Arterial stiffness</b> <b>Blood clotting dysfunction</b> <b>Bone marrow dysfunction</b> <b>Bone weakness and fragility</b> <b>Brain and nervous system tissue loss and dysfunction</b> <b>Decreased immune system function</b> <b>Dry, thin skin</b> <b>Gastrointestinal dysfunction</b> <b>Joint breakdown and stiffness</b> <b>Loss of blood supply to organs</b> <b>Loss of kidney function</b> <b>Loss of liver function</b> <b>Loss of muscle mass and strength</b> <b>Loss of functional lung tissue, decreased lung elasticity</b> <b>Prostate gland enlargement</b> <b>Vision, hearing, smell, and taste disorders</b></p>
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This section outlined how the body systems are affected by aging. The next section will discuss the acute and chronic illnesses that can result from these changes.

### **Aging and Disease**

Older people are not, as a group, as healthy as people who are young. The U.S. Department of Public Health and Human Services (DPHHS) makes periodic assessments of the health and living conditions of older adults. The 2013 DPHHS report noted that the majority of older Americans have at least one chronic medical condition and many of them have several.

Diseases of virtually every organ system disproportionately affect the elderly population. Arthritis, cancers, cardiac arrhythmias, heart disease, hypertension, diabetes, kidney failure, liver disease, stroke,

and other acute and chronic diseases are far more common in older people than in the younger population. It is not uncommon for someone over the age of 65 to have multiple chronic diseases. Many diseases and medical emergencies such as arthritis, hypertension, myocardial infarction (commonly known as a heart attack) stroke, *etc.*, occur over age 65, and older age is considered to be a risk factor for the development of these problems.

Elderly people are also more susceptible to certain conditions that are not diseases but contribute to poor health. The older population responds less predictably to medications and they suffer more medication side effects. Poor nutrition, certain types of injuries, poor dental health, social isolation, and bowel and bladder problems are all more common in the elderly population.

### **Acute and Chronic Diseases**

Some of the more common acute and chronic diseases that affect the elderly, and especially ones that the Certified Nursing Assistant should be familiar with, are discussed next. These are also summarized in Table 2.

#### **Bone, Joint, and Skin Diseases:**

Osteoarthritis, often simply called arthritis, is very common in older adults. Approximately 50% of all people 65 and older have osteoarthritis to a degree that affects their lives and approximately 80% - 90% of that population has osteoarthritis that can be seen on X-ray. Joint pain and swelling are caused by osteoarthritis, and can affect walking and activities of daily living.

Osteoporosis is a disease that causes the bones to become thin, brittle, and likely to fracture. Osteoporosis and low bone mass affect millions of older Americans and women are particularly at risk. One in two women over the age of 50 will eventually suffer a fracture that is caused by osteoporosis. Skin cancers such as basal cell carcinoma and squamous cell carcinoma typically have their onset in the later stages of life.

#### Cardiovascular System:

The incidence of atherosclerosis, cardiac arrhythmias, congestive heart failure (CHF) coronary artery disease, hypertension, myocardial infarction, stroke, and transient ischemic attack (TIA), also known as a mini stroke or minor stroke, increases significantly with age. Old age is considered to be a major risk factor for the development of cardiovascular disease.

Stroke is defined as irreversible brain damage caused by a blood clot or bleeding in the brain. Seventy-five percent of all strokes happen to people who are 64 years of age or older.

Hypertension increases the risk of atherosclerosis, chronic kidney disease (CKD), myocardial infarction, and stroke and hypertension becomes more common as people age. Atherosclerosis and coronary artery disease are diseases that typically affect older adults, causing chest pain, decreased exercise tolerance, and myocardial infarction.

Congestive heart failure is also a common disease of the elderly, causing shortness of breath and exercise intolerance.

### Endocrine System:

The incidence of non-insulin dependent diabetes increases with age. Much of this increase is related to modifiable risk factors such as diet, obesity, and a sedentary lifestyle.

### Gastrointestinal Tract:

The GI tract suffers from aging and this is reflected in the increased incidence in older adults of GI tract diseases such as colon cancer and diverticulosis. The incidence of colon cancer increases dramatically after age 65 and approximately 90% of all cases occur in people over the age of 50. Diverticulosis is caused by weaknesses in the intestinal wall. This results in areas of the gut that bulge out and can cause abdominal pain.

### Genitourinary System:

Prostate cancer is the most common cancer affecting older men. Approximately 99% of all cases of prostate cancer occur in men aged 50 or older and by age 70 the majority of men will have prostate cancer.

Urinary tract infections are relatively common in elderly men and women. These infections have many age-related causes that may include changes in the anatomy of the urinary tract, diabetes, enlarged prostate gland, diminished immune system functioning, decreased levels of estrogen in women, and the use of medications that can cause urinary retention.

### Hepatobiliary System:

Perhaps the most important effect that aging has on the liver is the change in drug metabolism. Most medications are metabolized by the liver and many are excreted by the liver, as well. These processes can be significantly changed by the effects of aging on the liver. Medication dosages need to be adjusted based on age and older adults may respond badly to what is considered a normal amount of medication. In addition, the duration of medication effects is likely to be much longer in an older adult because someone who is 65 or older does not metabolize and eliminate drugs as quickly as a younger adult.

#### Immune System:

The decrease in immune system functioning that occurs as people age has profound effects. The older adult is more susceptible to infections. They are less able to recover from infections and the recovery period is often prolonged.

#### Nervous System and Brain:

Many older adults maintain a normal level of intelligence and cognition well into their old age. Although diminished brain function is not an inevitable consequence of getting older, aging is associated with an increased risk for serious neurological diseases such as Alzheimer's disease, dementia, and Parkinson's disease. Depression and suicide are also associated with growing older.

#### Renal System:

Chronic kidney disease is a progressive disease that causes anemia, fatigue, weight loss, and loss of kidney function. It is also associated with the development of hypertension and other

cardiovascular diseases. Chronic kidney disease can also affect the elimination of many drugs.

As with many chronic medical conditions, chronic kidney disease is more common in older adults and age is considered to be a risk factor for chronic kidney disease.

#### Respiratory System:

Chronic obstructive pulmonary disease (COPD) is a common respiratory disease that is primarily caused by cigarette smoking. Chronic obstructive pulmonary disease severely decreases gas exchange and people who have COPD have chronic coughing, difficulty breathing, and decreased exercise tolerance. These symptoms often progress to the point where simple activities of daily living can seem impossible.

Chronic obstructive pulmonary disease begins at an early age but the clinical signs and symptoms begin in late adulthood and early old age. Pneumonias are also more likely to happen in the older population and older adults are more likely to die from pneumonia than children or younger adults.

#### Diseases of the Sensory Organs:

Cataracts and glaucoma are diseases of the eyes that become very common as people age. A cataract is a thickening of the lens of the eye that causes difficulty focusing and myopia (commonly known as nearsightedness) and cataracts are one of the leading causes of blindness.

Glaucoma is characterized by increased pressure in the eyeball. The increased pressure can irreversibly damage the ocular blood vessels and nerves. Glaucoma, as with cataracts, is one of the leading causes of blindness.

Acute and chronic physical changes that affect the elderly involve many body systems, and are outlined in Table 2.

**Table 2: Acute and Chronic Diseases that Affect the Elderly**

<p><b>Alzheimer's disease</b></p> <p><b>Anemia</b></p> <p><b>Angina pectoris</b></p> <p><b>Arthritis</b></p> <p><b>Atherosclerosis</b></p> <p><b>Cancers</b></p> <p><b>Cardiac arrhythmias</b></p> <p><b>Cataracts</b></p> <p><b>CKD</b></p> <p><b>Congestive heart failure</b></p> <p><b>COPD</b></p> <p><b>Coronary artery disease</b></p> <p><b>Dementia</b></p> <p><b>Depression</b></p> <p><b>Diabetes</b></p> <p><b>Diverticulosis</b></p> <p><b>Glaucoma</b></p> <p><b>Hypertension</b></p> <p><b>Myocardial infarction</b></p> <p><b>Osteoporosis</b></p> <p><b>Parkinson's disease</b></p> <p><b>Pneumonia</b></p> <p><b>Sleep disorders</b></p> <p><b>Stroke</b></p> <p><b>Transient ischemic attack</b></p>
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## **Health Issues of the Elderly**

Some of the health issues that confront the elderly are not specific diseases. They are conditions that occur as a result of the age-related changes in body or they are caused by an acute or chronic disease. Examples of key health issues include difficulty with ambulation, falls, incontinence, malnutrition and medical problems.

### **Ambulation Difficulty**

Older people often have muscle and joint pain, stiffness, and weakness. Balance and vision disorders and peripheral neuropathy also become more prevalent with advancing age. All of these problems combine to make ambulating difficult for older adults

### **Fall Risk**

Falls are relatively frequent in older adults. Approximately one out of three adults 65 years or older has a fall, or several falls, each year. Falls are the leading cause of non-serious and serious injury in this age group, and lacerations, hip fractures, and traumatic brain injury after a fall are not uncommon. Another consequence of falls is the fear of falling. After one or two falls many older adults begin to become less active and they are hesitant to ambulate. While this may in one sense limit the risk of falling, it can also increase the risk of falling as muscles and joints that are not exercised become weak and stiff.

### **Incontinence**

Age is one of the biggest risk factors for bladder and bowel incontinence. The age-related changes in the genito-urinary and GI

systems certainly contribute to these problems, but constipation, diabetes, infections, medications, mobility disorders, and stroke can all be causes of bladder or bowel incontinence.

### **Malnutrition**

Food intake decreases as people age and there are multiple reasons why this happens. The appetite declines and poor dentition makes chewing and eating difficult. The sense of taste and the sense of smell that are so important to the enjoyment of food are not as acute as they once were, and social isolation and depression tend to make people less likely to eat. The end result can be malnutrition and increased susceptibility to disease.

### **Polypharmacy**

Many older adults are taking multiple medications, otherwise known as polypharmacy. When polypharmacy exists there is an increased risk for drug interactions and medication errors.

In some cases, medical insurance pays for some of the cost of a person's needed medications, but the cost of co-payments may cause an older adult to skip doses or to stop taking a medication for a while in order to save money. Not taking medication appropriately or as prescribed can lead to health complications in an older person.

### **Case Study: Elderly and Endurance**

The following case study was obtained from a PubMed search and discusses physical endurance in elderly marathon runners. While the average elderly person does not participate in such activities of

endurance, this interesting small population of older active people reveals how an older person's body can respond to high level exercise and physical endure.

The authors reported in recent years, elderly people up to 100 years of age have been reported to participate in high endurance activities. They present the case of a 95-year old marathon runner during and after a 12-hour ultra-marathon. This older athlete completed a marathon total distance of 52.987 km. The runner's speed was paced to decrease until the middle of the race and then increased later on in the race. The runner's speed decreased and increased during the total run.

During recovery following the race, the runner's blood tests were done that showed changes to his total blood count where the hemoglobin and hematocrit counts (the oxygen capacity of the red blood cells) increased whereas the white blood cells (the cells fighting infection in the body) decreased. Other body enzymes and markers of inflammation were also increased following the race, and then decreased to the standard reference range (normal) during the runner's recovery. Also, the blood creatinine and urea levels (markers of how well the kidneys function) decreased during recovery; however, the runner's creatinine clearance increased during recovery.

The runner's blood sodium level increased during recovery and remained constantly within the reference range. During recovery body fat and visceral fat mass decreased, whereas body water and lean body mass increased. The older runner was able to build some muscle.

In summary, a 95-year-old man was able to run during a 12 hour marathon by pacing himself, and achieving a total distance of nearly 53 km. His blood values for the blood cell count, electrolytes and other inflammatory markers were stable and returned to pre-race values within a recovery phase of 5 days.

## **Discussion**

Age group marathon runners can compete late in their life until the age of 70 years according to multiple researchers, and a few other researchers have also reported that people at the ages of 80 to 90 years can complete a marathon. Not enough is known about how well elderly people at very high ages are able to perform, as well as of the effects of endurance activities on their bodies during and after recovering from a running event.

Currently, it is well accepted that elderly marathoners age 70 years can complete an event, and some push this age up to as high as 85 years to finish an ultra-marathon. By pacing, an important aspect for a successful race finish in any marathon, this older ultra-marathon runner was able to complete a race. The pacing of master marathoners and of master ultra-marathoners has been studied. An ultra-marathoner, such as in this case, could complete successfully by pacing himself in a 12-hour run at the age of 95. Moreover, he tolerated the run with acute changes in his blood laboratory values that showed how well his specific organ systems tolerated the run, such as his skeletal muscles, heart, liver, kidney, immune, and endocrine systems, showed a good response. The elderly runner's acute physiological responses to ultra-endurance exercise were considered normal for his age rather than pathological (or diseased).

Regarding the age group in ultra-marathon running and existing scientific reports, no person at this man's age ever competed in such a race. Although the age-related differences in ultra-marathon running performance have been well-documented in people who are in their 70s and 80s, there are no known studies that scientifically showed the blood level responses of a 95-year-old runner during an ultra-marathon race and recovery.

### **Summary**

The aging process is a profound and life-changing experience. The body slowly begins to weaken, resistance to disease is decreased, and recovery time is prolonged. Acute and chronic medical conditions become more common and life-disrupting conditions such as incontinence and falls can severely affect independence and quality of life.

Many people age 65 or older self-report some sort of disability. These may be minor or they may be significant, requiring the older person to need skilled assistance. The aging process is individual, however age-related changes are inevitable.

People think of aging as equivalent to being old but aging begins in the late teens. That is the time when a person's physical capabilities are at their maximum. The case study presented here showed how physical activity and endurance marathons in older individuals may be done successfully with proper pacing. Aging doesn't necessarily mean that a person is old and will have inevitable age-related acute or chronic health issues, but aging does involve changes to the body that could

lead to a disease state or physical disability based on the individual's life patterns and physical condition. The case study above raised how exercise may be tolerated in an older individual and specifically referenced current research focused on the ability of elderly people to succeed in tests of endurance.