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Review

Does Chronological Age Reduce Working Ability?

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A B S T R A C T

Definitions of so-called older age often are based on a chronological age of 65 years and over, although by some authors aging is the process that starts after the 30th year of life. At the beginning occur changes in the organ functions, followed by anatomical changes as well. Some organs age faster, some slower. For example, kidneys decrease for one third, lungs do not change, liver shrinks a little, prostate increases twice. In some cross-sectional studies, muscle mass in men aged 65 is on average 12 kg less than in the so-called middle age, and in women it is approximately 5 kg less. In the heart the amount of connective tissue increases, lipofuscin is deposited in cardiac muscle, the strength of which is decreasing. In the respiratory tract the number of pathways cilia decreases, along with the alveolar surface, muscles involved in breathing change, lung elasticity is also diminished. But, in regard with the previous body capacity, »physiological aging« can be divided into three types of elderly: the »older« elderly have the highest functional capacity of 2–3 MET (MET – metabolic unit, i.e. the oxygen consumption of 3.5 ml/kg body mass in a minute), the »younger« elderly are the persons of older age having maximal functional capacity of 5–7 MET, while the »sport« elderly have the functional capacity of 9–10 MET, disregarding chronological age. The brain weight diminishes for approximately 7% compared to younger age. In temporal gyrus and area striata even 20–40% of cells are being lost, vacuolar and neuroaxonal degeneration occurs, lipofuscin is being accumulated. The brain blood flow, which is in normal conditions 50–60 ml/ min/100 g of tissue, with the increase of biological age decreases to about 40 ml/min/100 g of tissue. However, this usually is not the consequence of biological age but of disease. A chronological age of 65 for the beginning of »elder hood« is a sociopolitical construct developed by social security systems and government organizations to decide an arbitrary age at which benefits should be paid. Thus, it neither a border nor do changes designating old age occurs exactly with that »age border«. The changes in the organism during the so-called aging are individual. So, the functional capacity of an organism, both physical and intellectual, must be evaluated individually, having in mind biological age.

Key words: *biological age, working ability*

Sensim sine sensu aetas senescit
(Marcus Tullius Cicero, 106-43)

Introduction

In some countries, for example in Croatia at this moment more than 15.6% of inhabitants are aged 65 or more, with the assumption that by the year 2050 AD, more than 30% of inhabitants will belong to those chronological groups. In the city of Zagreb, every sixth inhabitant is aged 65 or over, and in the period 1992–2002 more inhabitants died than were born.

Aging is mostly discussed on the basis of chronological age. Chronological and biological ages are in growing incongruity. A chronological age of 65 for the beginning of »elder hood« is a sociopolitical construct developed by social security systems and government organizations to decide an arbitrary age at which benefits should be paid. But, numerous questions are imposed here. Some of them are: Can we talk about the so-called older age on the basis of the chronological age border of 65 years? Are there substantial proves for that? Do criteria exist at all? Probably, genetic-evolutional and direct environmental factors are responsible for changes observed in humans during centuries.

It is considered that in Paleolithic the man lived approximately 18 years, old Egyptians lived about 29 years.

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Sometimes it is stated that at the time of Christ the average life expectancy was about 30 years, although there were people of pretty advanced age. In the so-called new era, some 500 years ago, the average life span was about 35 years. At the beginning of the 20th century the average life expectancy was about 50 years, and at the end of the century it approached the limit of 80 years. For example, in the USA at the beginning of the 20th century the population aged 65 or older for both genders was 4.1%, in France 8.1%, while at the end of the two thirds of the century in the USA was 8.3% of such persons, in France 12% and in Croatia 10.8%. It was expected that at the turn of the millennium there would be about 11.4% of persons belonging to older age groups, but the actual data is much higher. What definition leads to the so-called older life age? It is the matter of different approaches, but common to all of them has been already said – the citing of chronological age [1–19]. The limit of 65 years has been mostly taken into account for the assessment of the so-called older age. But, a more careful definition of the World Health Organization tells that the older age is a range from 60 to 75 years, old age from 76 to 90 years, and very old age is the chronological age over 90 years. Unfortunately, today the situation is that more people get older than children are born. Croatia has one inhabitant less every 35 minutes. In 2002, 9,000 more died than were born[10].

Numerous changes occur in the human organism with advancing age, from the decrease in the material substrate quantity, making tissues less valuable, and often being replaced by still less valuable tissue. These changes are called atrophic or degenerative (the so-called »tissue wearing out processes«). Already Galen had spoken about them. Some authors claim that the end of an organism's life is the final course of events in increasing entropy of a non-regulated system. In recent times the theory of apoptosis – the programmed cell death, is gaining growing significance.

The highest somatic functional capacity in man is achieved about the 30th year of life. By some authors, the expressive aging of an organism does not start with the age of 65, but after the 30th year[10,12–18]. Some usual criteria of aging are presented in Table 1.

In the beginning happen changes in the organ functions, followed by morphological changes of particular organs. Some organs age faster, some slower. When evaluating the changes starting with advancing age, three types of changes could take place: the changes of organs due to disease, the changes of organs caused by organism aging (the so-called physiological aging), as well as the simultaneous changes in organs due to both disease and aging process. This text deals with the organ changes during physiological aging. The statement often met: *Senectus ipsa morbus est*, is incorrect.

TABLE 1
SOME USUAL CRITERIA OF AGING IN YEARS[10,12–18]

World Health Organization	60–75 elderly 76–90 old >90 very old
Often	>60
Usual	>65
Biological ages (by some authors)	>30

Out of some general changes which happen along with the so-called aging, body mass grows with advancing age on account of the fat tissue increase, but is, as a rule, decreased in a highly advanced age. Thus, for example, in some cross-sectional studies, in the so-called younger age in men fat tissue amounts to about 15% of body mass, at the age of 75 it is 36%, in young women it is about 33%, while at the age of 75 it is 45% on average.

In cross-sectional comparisons (no meaning for change over life span) of the so-called middle and older ages shows that the total amount of water in the body is lessened for about 10–15%, what counts more for water outside than within cells, but also for the plasma volume: the ratio of these parameters in middle age is about 2:1, but is getting lower in older age.

Skin and Epidermal Tissue

The skin is changing with age[10,12,13,16,17]. The germinative epidermal layer diminishes and the number of germination cells is reduced. Also, the number of sebaceous and sweat glands becomes smaller, the skin becomes thin, its elasticity is lost, it wrinkles, especially on the face. The epidermal fat tissue is vanishing, and the skin loses the property of warmth isolator.

The quantity of subcutaneous tissue is decreasing, the skin itself becomes thinner, sweat glands undergo atrophy, and sweating is lower. The blood perfusion of the skin is diminishing, both due to changes in blood vessels and to the decrease in the minute heart output. Thermoregulation changes, due to the mentioned alterations, but also due to the changes in the central nervous system. The result is the decrease in the ability of emitting, maintaining and keeping body temperature. Nails grow more slowly, they become blunt and yellowish, while the content of calcium is declining. Hair is disappearing from the scalp, armpits and other places.

Supportive Tissues

The supportive tissues become more voluminous with advancing age, because a relatively greater amount of extracellular water is distributed within them[3,4,7–9,10–13,16,17]. The supportive basis of the connective tissue changes and the water content reduces, while the amount of solid tissue grows. The latter consist of polymers condensing in old age. Collagen fibers become both larger and more numerous, their fusibility decreases, while their structure becomes more solid. However, their mechanical properties become aggravated. Consequently, more strength is needed for adequate extension, while return to the initial length is slower. But, in very advanced age the collagenase enzyme concentration is increased, what causes less expressed collagen inelasticity. With age, elastin fibers lose water, become intense yellow, hard and stiff, what is especially observable in stress, when they break and become fragmented. They are sometimes replaced by collagen fibers. With advancing age emerges a substance with properties in between collagen and elastin, the so-called pseudo-elastin. Its structure is made of the amorphous substance sheath around collagen. The hyaline cartilage dehydrates through years, and turns into fibro-cartilage. The joint cartilage becomes yellow, loses elastic properties, and in more mechanically loaded sites, as for example, the knee meniscus, it becomes thinner. The cartilage can completely »ossify« due to calcifications. The skin loses elasticity, the joints become stiffer due to fibrous tissue, the rib cartilages lose elasticity and stiffen. The intervertebral discs harden due to the restricted water content.

Muscle Mass

The muscle mass in men in the so-called middle years in some cross-sectional studies, is about 12 kg higher than at the age of about 65 years[10,12,16,17], and in the so-called middle aged women about 5 kg higher than at the age of 65. The pigment lipofuscin is accumulated in muscle cells (called the »aging pigment«), the quantity of fats increases, a part of muscle cells deteriorates, i.e. is replaced by connective tissue. An attempt to regenerate myocytes is the synthesis of proteins in their peripheral parts, lessening the ATP content, decreasing the ratio of ATP and ADP, and diminishing the quantity of glycogen and creatinine phosphates. Simultaneously, but in a lesser degree, motoneurons are being lost. The amount of spontaneous neurotransmitter release is decreased, although membrane potentials do not change with the advancing age. In some studies, working capacity, i.e. use of large muscle groups during longer periods of time, in the so-called older age is approximately one third lower than the capacity of middle aged persons.

Bones

Bones also undergo numerous changes, particularly in women after menopause. The mineral content of bones subsides for about 10% with advancing age[10–13,16,17]. In long bones remodeling occurs. The outer bone diameter is increased, the bone mass becomes thinner, and the resulting space is filled with fat and fibrous tissue. The bone cortex becomes thinner with the increasing inclination towards fractures. This loss of mineral content is particularly pronounced in women after menopause. Consequently, the frequency of bone fractures is several times greater in women than in men. Data show that each fifth woman aged about 80 years experiences the thighbone fracture. Naturally, many factors are responsible for that, from the imbalance of osteoblastic and osteoclastic activities (particularly in post-menopause) to the change in the relation of parathromones and calcitonin. The latter happens due to the changes in the estrogen quantity, because the calcitonin excretion is under direct influence of the estrogen rate in the blood flow. The consequence is the larger quantity of parathormone that directly influences the bones and the increased excretion of minerals through kidneys. Besides, in the elderly the decreased concentration of hydroxylated D_3 vitamin is observed, leading towards reduced calcium absorption through the small intestines membrane that causes an increased calcium release from the bones in order to achieve the adequate calcium level in blood.

Heart and Blood Vessels

The heart is susceptible to changes with the increase of biological age. The quantity of the connective tissue (collagen) in heart muscle is increasing, particularly in endocardium and epicardium, while the pigment lipofuscin is deposited in myocardium (but can not increases or decreases with cross-sectional data). The strength of cardiac muscle is decreasing, as well as the speed of myocardiac fibers shortening, inotropic action also decreases, as well as the pressure of diastolic filling, ventricle extrusion fraction, while systolic load of the heart increases[2–4,7–10,12,13,15–18]. By some authors, from the beginning of the fourth decade of life, the cardiac output decreases about 10% per decade, the stoke volume decreases approximately 7% per decade, the peripheral vascular resistance increases over approximately 12%. This means that, if we compare ages of 30 and 90 years, cardiac output could be decreased for about 60%, beat volume for about 42%, and peripheral vascular resistance increases for about 72%.

The cells of sinoatrial node are replaced by connective tissue, the heart frequency is diminishing, and so the heart significantly slowly reacts by elevating frequency. The capacity of performing physical strains with advancing age could be doubly reduced, both due to the decrease in the cardiac output, in the vital lung capacity, in the amount of auxiliary muscles participating in breathing, increase in the amount of fat tissue, and the loss of mineral bone content.

In persons aged about 70, the ability of performing physical strains could be about 50% lower than in the so-called younger age. Having in mind body efforts, about two half an hour daily walks, i.e. about 5 km daily or 24–32 km weekly (if there are no medical limitations) will elevate heart rate to about 110–120 per minute, what resembles submaximal body strain (the highest heart rate is calculated according to the calculation: 220 – age in years, and is aiming at achieving the so-called submaximal or 85% of maximal heart rate). But, if the so-called elderly person has been practicing physical exercise during life, he/she has a far greater maximal aerobic lung capacity than persons who neither exercise nor walk, but mostly sit. However, persons of the so-called older age, who during life had mostly sedentary jobs, when they start to exercise (under the condition that they are clinically examined, assessed by ECG and ergometry and are without contraindications for exercising), they often achieve higher work capacity and increased glucose tolerance. Regarding lipoproteins, sometimes changes could be fourfold: the concentration of »protective« HDL can increase, the concentration of »dangerous« LDL and VLDL can diminish, both can happen as well and rarely, none of these changes can occur. Time will show whether body load brings to the changes of derivates of amino acid methionine-homocysteine, whose elevated concentration also presents risk for atherosclerosis.

Although by some authors the mentioned changes occur after 30 years of life, it is very often strictly individual, because of the fact that many reductions in organ functions in the so-called older age are less the consequence of aging and more the result of inactivity. In the developed World it is estimated to be 50%.

Thus, according to functional ability, »physiological senescence«, which is the topic of this text, regarding previous physical activity, specially exercising, can be divided into three types of elderly. The »older« elderly have the highest functional capability of 2–3 MET (MET – metabolic unit, i.e. the oxygen consumption of 3.5 ml/kg body mass in a minute), the »younger« older are the persons of older age having maximal functional capacity of 5–7 MET, while the »sport« elderly have the functional capacity of 9–10 MET, independently of chronological age[2,9,12,16–19]. The majority of the above mentioned changes can be confirmed by the so-called non-invasive diagnostics, along with clinical examination, ECG, ergometry and echocardiogram. According to the data from our studies, over one third of people aged 65 and over have no signs of the described changes in regard to the described parameters.

The changes in vascular system can be numerous, and by some authors, could start to happen from the beginning of the fourth decade of life[2,8,9,12,16–19]. Some changes are mentioned in a series: the quantity of collagen in the arterial walls is increasing, calcium is being deposited in collagen. The amount of elastic fibers is diminished, the inner layer-intima becomes more voluminous, permeated by altered smooth muscle cells. Arteries can become hard, elasticity is lost, what is particularly visible in the aorta. In veins the wall also becomes thicker, media fibrosis is present, veins could become twisted, especially those exposed to elevated pressure. Capillaries also change, basal membrane thickens, along with increasingly pronounced endothelial »fenestration«. Due to increased peripheral vascular resistance, the organ perfusion can be reduced, less in skeletal muscles and myocardial muscle, and more in kidneys, mesenteric blood vessels, splanchic vessels and skin. The result of this can be the elevation of arterial blood pressure, mostly systolic, while for diastolic it is less pronounced. Moreover, in the so-called advanced age diastolic pressure can be lower than in middle age. Activity of the autonomous nervous system is reduced, as well as the neurotransmitter synthesis and the amount of receptors, as well as the sensitivity of baroreceptors. The noradrenalin concentration in blood can be increased. Often the process of atherosclerosis is intertwined in this. But atherosclerosis is a disease, and not the consequence of advancing physiological age.

Respiratory System

The respiratory system, by some authors, can be also susceptible to changes with progressing age, again from the fourth decade of life onwards. The number of cilia in respiratory pathways diminishes, alveolar macrophage are less efficient, lung elasticity is decreased, sternocostal joints become inelastic, as well as the spine, which becomes spondylotic, and the consequence is diminished chest expansion while breathing, causing greater work of muscles for removing the air from the lungs. The speed of expiry airflow can be reduced, and alveolar-arterial oxygen difference grows[9,10,12,16–18]. Decreased can be functions that can be evaluated by respirometry testing: forced expiratory volume, vital capacity, and the highest breathing capacity. Functional residual capacity increases to 60%, in comparison to 50% in the so-called middle age. The consumption of energy needed in breathing is growing, and due to the afore mentioned reduced minute heart output and increased peripheral vascular resistance, the possibility of microcirculation spreading can be reduced. The input of oxygen is lessened, arterial oxygen saturation is decreased, and the 2,3-diphosphoglycerate concentration is reduced, causing the change of the dissociation curve to the left. Regarding the acid-base status, the total buffer capacity is reduced in comparison to the so-called middle age, the bicarbonate concentration can be reduced. However, the excretion of carbonic acid does not change.

Kidneys

In kidneys of the elderly both functional and organic changes can develop. Firstly changes in blood vessels occur, leading to the alterations of nephron functions[3,4,7–10,12,13,15–18]. The number of capillaries is thinning, influencing both glomerular and peritubular parts of the kidney. The total kidney weight can be reduced. The connective tissue is increasing and the basal membrane becomes thicker. Glomerular capillaries degenerate, and these parts are bridged by arterioles. Small arteries lose elastic tissue that is replaced by collagen tissue. Arcuate and interlobar arteries become coiled. The basal membrane of renal veins thickens, and this process starts from the fourth decade of age onwards. The amount of connective tissue increases. The hydration of renal medulla abates with ageing, causing the diminished concentration ability of kidneys. The kidney weight from the fourth till the eight decade of life is reduced for about 30%. Renal perfusion can be diminished on average for about 10% per decade, starting with the fourth decade onwards, probably as the result of parenchymal and vascular changes, with simultaneous reduction in the heart minute volume for more than a third. The renal perfusion in the eight decade of life amounts to only about 50% of that in younger people. Partial renal functions weaken

TABLE 2
THE DATA ON THE SERUM CREATININE, CREATININE CLEARANCE AND OTHER CLINICAL AND LABORATORY FINDINGS FROM THE GROUP OF 30 PATIENTS AGED 71–89 YEARS, HOSPITALIZED AS EMERGENCIES NOT SUFFERING OF KIDNEYS DISEASES (OUR STUDY)

Parameter	71–79 years		80–89 years	
	Male (X±SD)	Female (X±SD)	Male (X±SD)	Female (X±SD)
Mean age (years)	74±2	76±3	86±3	84±5
Mean arterial blood pressure (kPa)	13.6±2.9	13.6±1.9	13.7±2.0	14.0±2.1
Serum creatinine (μmol/L)	94.9±24.1	85.6±17.0	99.7±35.2	77.4±29.3
Urine creatinine (μmol/L/24 h)	8.3±3.5	6.7±2.6	8.0±1.3	9.3±5.4
Corrected creatinine clearance (mL/min)	63.9±23.8	56.3±16.8	62.2±25.0	75.8±27.5
Corrected creatinine clearance (mL/s)	1.1±0.4	0.9±0.3	1.0±0.4	0.9±0.5

in senescence due to numerous reasons, for example, because of the loss of nephrons and changes in blood vessels, alterations in filtration and perfusion connected with the advancing age, and partly due to the reversible changes of tonus in glomerular blood vessels.

The creatinine clearance, as the result of glomerular filtration, can be reduced for 8 mL/min per decade on 1.73 m^2 of body surface, starting from the fourth decade onwards. With advancing age, proportionally with the reduction in glomerular filtration, muscle mass diminishes as well, so the reduction in glomerular filtration need not necessarily be accompanied by simultaneous rise of serum creatinine. But this change will be observable in the analysis of the endogenous creatinine clearance. Glomerular filtration at the age of 90 years can be reduced for about 50% in comparison to the age of 40. By some authors, the serum creatinine concentration of 124 μmol/L (1.4 mg/100 mL) is compatible with the reduction of glomerular filtration in the elderly for about one third. The normal values of creatinine clearance in these patients have been recorded in 20% of the cases (Table 2).

These parameters could also serve in the evaluation of biological age. However, by our study, one third of elderly persons have renal function within normal range. The renal plasma flow can be reduced with advancing age. According to some data, in men aged 65 and over it is 420 mL/min (the normal value determined by the para-aminohippurate for men is 645±163 mL/min, and for women 594±102 mL/min), and at the age of 75 it amounts to 350 ml/min.

The kidneys of an elderly person cannot maintain an adequate acid-base balance in blood often. This is partly the consequence of reduced ability of kidneys to excrete ammonium, while phosphates somewhat increase due to the reduction of the proximal tubule reabsorption. Phosphates are capable to create »titrable acidity«. The osmotic urine concentration diminishes with ageing.

Kidneys perform the maintenance of buffer systems within normal limits. All the three kidney functions change in old age: the regulation of bicarbonate quantity, excretion of hydrogen ions and the restoring of the buffer systems by the replacement of urine cation with the ammonium ion.

The regulation of water and salts in the organism depends on the excretion of both water and salts, and vice versa: their retention in the organism, according to the actual need. This depends on the vasopressin secretion (hypothalamic-hypophyseal mechanism), as well as on the aldosterone mechanism of the adrenal gland.

It seems that age has not a particular influence upon the vasopressin secretion, but aldosterone has lower concentration in the elderly compared to younger persons. The distal tubule is less sensitive to vasopressin, and the osmotic capability of kidneys in an elderly person is re-

TABLE 3
SOME PARAMETERS INDICATING FUNCTIONAL CHANGES OF HEART, LUNGS AND KIDNEYS

Parameter	Changes in decade after 30 years
Stroke volume of the heart	–10%
Cardiac output	–7%
Peripheral vascular resistance	+12%
Working ability	–10%
Forced expiratory volume in the first second ($FEV_{1.0}$)	–320 ml
Forced vital capacity (FVC)	–250 ml
Creatinine clearance ml/min/1.73 m^2 body surface	–8

TABLE 4
SOME PARAMETERS INDICATING BIOLOGICAL AGE

Parameter	Correlation with biological age
Skin changes	+0.604
Systolic blood pressure	+0.519
Lung vital capacity	–0.402
Strength of fist	–0.323
Time of reaction	+0.488
Sensitivity on vibrations	–0.537
Quick-sightedness	–0.432
Threshold of hearing at 4,000 Hz	–0.596
Serum cholesterol level	+0.234

duced. The result of both phenomena is the weakened ability of maintaining water and salts in the organism. According to that, the processes of concentration and dilution in the elderly can be less efficacious than in the young. Some parameters of heart, lungs and kidneys indicating biological age are presented in Table 3. Some parameters indicating biological age are presented in Table 4.

Central Nervous System

The central nervous system can be changed with advancing biological age[10,12,13,18]. The brain weight changes on average for about 7% in comparison to younger age, i.e. for about 100 g. The loss of cortical brain tissue is more pronounced, sulci become broader, and gyri shallower. In some parts of the brain even up to 20–40% of cells are lost, particularly in the temporal gyrus and area striata. In some cells, particularly in hippocampus, vacuolar degeneration occurs. Neuroaxonal degeneration is also present, with the loss of myelin. In neuronal cells is accumulated the »aging pigment« lipofuscin. The blood flow through the brain, which is in normal conditions 50–60 ml/min/100 g tissue, with the advancing biological age can be reduced to about 40 ml/min/100 g tissue. By measuring the glucose phases, i.e. the reception of 2-deoxyglucose, by the analysis with positron emission tomography, no differences are observed between a person aged 80 and a person aged 20. Although the described changes do happen, a large number of authors consider that the reduction of the brain function in biologically higher age most often is not the consequence of biological senescence but of illness.

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SMANJUJE LI KRONOLOŠKA DOB RADNU SPOSOBNOST?

SAŽETAK

Iako se definicije tzv. starije dobi života baziraju na kronološkoj dobi 65 i više godina, starenje je proces koji započinje s navršenom tridesetom godinom života. U početku se događaju promjene funkcija nutarnjih organa, a potom i anatomske promjene. Neki organi stare brže, neki sporije: npr. bubrezi se s povisivanjem dobi smanjuju za do jedne trećine, pluća se ne mijenjaju, jetra se malo smanjuje, prostata se dvostruko povećava. Mišićna je masa u muškaraca dobi 65 i više godina prosječno za 12 kg niža nego u tzv. srednjoj dobi, a u žena je prosječno za 5 kg niža. U srcu se povećava količina vezivnog tkiva, u miokard se odlaže pigment lipofuscin. Snaga mišića srca se smanjuje. U dišnim putovima smanjuje se količina trepetljika, površina alveola se smanjuje, mijenjaju se mišići koji pomažu pri disanju, elastičnost se pluća smanjuje. No s obzirom na raniju tjelesnu sposobnost, »fiziološka starost« može se podijeliti u tri skupine: »stariji« stariji imaju najvišu funkcijsku sposobnost 2–3 MET-a (MET – metabolička jedinica, tj. potrošnja kisika od 3,5 l/min na kilogram tjelesne mase u jednoj minuti), »mlađi« stariji su osobe tzv. starije dobi koje imaju najvišu funkcijsku sposobnost 5–7 MET-a, dok »športski« stariji imaju funkcijsku sposobnost 8–10 MET-a, neovisno o kronološkoj dobi. Masa mozga smanjuje se prosječno za oko 7% u odnosu prema mlađoj dobi. U temporalnom girusu i areji strijati gubi se i do 20–40% stanica, zbivaju se vakuolska i neuroaksonska degeneracija, nakuplja se lipofuscin. Protok krvi kroz mozak koji u normalnim uvjetima iznosi 50–60 ml/min/100 g tkiva, s povisivanjem biološke dobi smanjuje se na oko 40 ml/min/100 g

tkiva. No to smanjivanje najčešće nije posljedica povisivanja biološke dobi, već je posljedica bolesti. Proizvoljna granica tzv. starosti s navršenom 65-om godinom života ničim nije označena, nema bioloških mjerljivih dokaza za tu tvrdnju. Dakle niti je to granica, niti se upravo s tom »granicom dobi« događaju promjene koje određuju starost. Promjene organizma tijekom tzv. starenja vrlo su individualne. Stoga treba funkcijsku sposobnost organizma, intelektualnu i tjelesnu, uvijek pojedinačno ocjenjivati, vodeći računa isključivo o biološkoj, a ne kronološkoj dobi. Objektivni kriteriji procjene biološke dobi mogu se bazirati na ocjeni na prvom mjestu kardiovaskularnog, respiratornog i renalnog sustava, a u žena i koštanog sustava u postmenopauzi.