



Derleme

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AGING AND CARDIOVASCULAR DISEASES
YAŞLANMA VE KARDİOVASKÜLER HASTALIKLAR

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ABSTRACT

According to the World Health Organization, the term "elderly" refers to people over the age of 65. Decreases in heart rate, heart function, oxygen consumption and stroke rate occur with aging. Many changes occur in the cardiovascular system with aging, and this predisposes to diseases. The aim of this review article is to examine the physiological relationship between aging and cardiovascular diseases. Depending on genetic differences and age, the heart's ability to pump blood decreases, the myocardium loses flexibility, and the heart valves thicken and increase in diameter. Aging is an inevitable part of life and constitutes the most important risk factor for cardiovascular diseases. Arteriosclerosis increases the thickness of blood vessels while decreasing their elasticity. Functional and structural changes in the cardiovascular system in older ages increase the risk of coronary artery disease, heart diseases, heart failure, venous thrombosis, and hypertension. Cardiac output and stroke volume decreases and the risk of postural hypotension increases. With advancing age, a continuous rise in systolic blood pressure occurs as a result of a hardening of the vessels and their diminished elasticity. After the age of 60, either a slight decrease or no change is seen in diastolic blood pressure.

ÖZ

Dünya Sağlık Örgütü'ne göre yaşlı terimi; 65 yaşın üstündeki kişiler için ifade edilmektedir. Yaşlanmayla birlikte kalp atım hacminde, kalp işlevinde, oksijenin tüketiminde ve atım sayısında düşmeler meydana gelmektedir. Yaşlanma ile birlikte kardiyovasküler sistemde birçok değişiklik meydana gelmekte ve bu durum hastalıklara zemin hazırlamaktadır. Bu derleme makale de yaşlanma ve kardiyovasküler hastalıklar arasındaki fizyolojik ilişkiye değinmek amaçlanmıştır. Genetik zemindeki farklılıklara ve yaşa bağlı olarak kalbin kan pompalama becerisi düşer, miyokard esnekliğini kaybeder, kalp kapaklarının çapında kalınlaşma ve artma meydana gelir. Yaşlanma yaşamın kaçınılmaz bir bölümüdür ve kardiyovasküler hastalıklar için en önemli risk faktörünü oluşturmaktadır. Arterioskleroza bağlı olarak kan damarlarının kalınlığı artarken elastikiyeti düşer. Yaşlılıkta kardiyovasküler sistemdeki işlevsel ve yapısal değişimler koroner arter hastalığı, kalp hastalıkları, kalp yetmezliği, venöz tromboz ve hipertansiyon görülme riskini artırmaktadır. Yaşlanma ile kardiyak debi ve stroke volüme düşüp, postural hipotansiyon riski yükselmektedir. İlerleyen yaşla damarların sertleşip elastikiyetinin düşmesi sonucu sistolik kan basıncında sürekli bir yükseliş meydana gelir. 60 ve sonrasında diyastolik kan basıncında ise ya hafifçe bir düşme görülür ya da değişiklik görülmez.

Keywords: Aging, cardiovascular diseases, chronic diseases.

Anahtar kelimeler: Yaşlanma, kardiyovasküler hastalıklar, kronik hastalıklar.

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INTRODUCTION

According to the World Health Organization (WHO), old age is defined as a period of increasing disability and becoming more dependent on others; the start of old age has been determined to be 65 years. This definition of old age by WHO includes the loss of the ability of an individual to adapt to the environment and declining health, becoming economically dependent, further stating that this period is one that encompasses a series of physiological, social and economic changes.¹ WHO has sub-classified old age as follows:

- Early (Young) Old Age: 65-74 years
- Middle Old Age: 75-84 years old
- Advanced Old Age: 85 years and over.²

Age is an important risk factor for cardiovascular diseases. Studies conducted indicate that the risk of cardiovascular disease increases in older individuals compared to younger persons.³ Cardiovascular disease will continue to be the leading cause of death in older individuals and the costs of treatment will continue to increase.⁴ The aging process is associated with a progressive decline in various physiological processes, resulting in an increased risk of health complications and disease. Because of its function of delivering oxygenated blood to all tissues in the body, a healthy cardiovascular system is of vital importance to the health of every tissue and to the longevity of the organism as a whole.³ Aging has a remarkable effect on the heart and arterial system and brings with it an increase in cardiovascular diseases, including atherosclerosis, hypertension, myocardial infarction, and stroke. Aging cardiovascular tissues may be associated with pathological changes, including hypertrophy, altered left ventricular diastolic function, and decreased left ventricular systolic capacity, increased arterial stiffness, and impaired endothelial function (Figure 1).⁵

From 1960 to 2020, the number of people aged 65 and over was expected to gradually increase all over the world. This number increased from 150 million in 1960 to 722 million worldwide in 2020. European countries are currently experiencing an increase in their aging populations due to increasing life expectancy and falling fertility rates. The share of the 65+ year-old population continues to increase at a higher rate than all other age groups.⁶ In fact, the number of individuals aged 80 and over is expected to triple between 2020 and 2050, reaching 426 million.⁷

Factors that affect the health of older people are gender, their integration with their physical and social environment, which incorporates their home situation, relations with neighbors and community, their ethnic background, and socioeconomic status.⁶ The community and social setting in which children are brought up are important in ensuring their development into healthy individuals. The environment in which an individual lives has an impact on their determination and health behaviors.⁸ Health behaviors comprise eating a balanced diet, smoking cessation, regular physical activity, reducing the risk of contracting incommunicable diseases, improving physical and mental capacities, and preventing any kind of addiction. A supportive physical and social environment leads individuals into focusing on their acquired behaviors, helping them to maintain these behaviors independently and exceed their capacities,

allowing them to improve and better themselves.⁹ High total cholesterol levels are more common in women (28.5%) than in men (20.9%). A low level of HDL cholesterol, often referred to as "good cholesterol," is more common in men (55.6%) than in women (49.1%). High levels of triglycerides are again more common in men (19.9%) than in women (13.6%).¹⁰ At the same time, men are known to engage in physical activity more than women, which is significant when it is considered that physical activity has been identified as a risk factor for many incommunicable diseases. Men, in other words, live more active lives.¹¹ DALY (Disability-adjusted life years) data for 2019, representing total levels of morbidity and mortality, indicate that while there is no difference between men and women in terms of prevalence of communicable and incommunicable diseases, men sustain more injuries than women. It is reported that incommunicable diseases, which include malignant neoplasms, diabetes, circulatory system disorders, and chronic respiratory tract disorders, were the cause of death for more men than women over the period 2013-2021.¹²

Also, the global population aged 65 and over in 2019 was 703 million, with the East and Southeast Asia region hosting the largest number of seniors (261 million). It is predicted that 80% of the elderly will live in middle- and low-income countries by 2050.⁷ The increase in the older adult population in Turkey and around the world and the effect of aging on the heart (e.g., arteriosclerosis, thickening of vessel walls, increases of systolic blood pressure, decreases of diastolic blood pressure) pointed to the need for the conduct of this study.

Physiological Changes Due to Aging

Some changes occur in elderly individuals as they age. These generally consist of psychological, physical, social and economic changes, all of which affect the life of the elderly person.¹³

When we look at physiological changes after the age of 60 in this context, it can be seen that there is an increase in fat ratio and a decrease in muscle weight, factors that differ in men and women. The decrease in joint flexibility and reduced calcium levels in bones and muscle mass in the human body makes it difficult for a person to perform daily life activities. Because of this, the individual's level of physical activity diminishes.¹² Losses in muscles and bones raise the risks of bone fracture, and of developing a shortening of the neck, tooth loss, thinning of the subcutaneous fat layer, hunchback as well as curvatures in the legs. With aging, decreases occur in heart stroke volume, heart function, oxygen consumption and stroke rate.¹⁴ Hardening of the chest wall, the loss of flexibility of the lung tissues and a decrease in respiratory muscle strength cause changes in respiratory functions. The decrease in the effectiveness of insulin, so important in the regulation of blood glucose, leads to "Type 2" diabetes. Insulin resistance occurs as a result of an increase in adipose tissue and a decrease in physical activity.¹⁵ There is also a decrease in the metabolic rate of the brain. As a result of the decrease in basal metabolic rate, calorie requirements and total energy expenditure diminishes. Elderly persons experience falls in unsafe environments, such as slippery floors, due to problems related to the nervous system,

and because of balance and vision issues. Older people may suffer such injuries as fall-related bone fractures, painful soft tissue damage and cerebral hemorrhage. In old age, the proliferation of immune cells decreases and the body's resistance to micro-organisms decreases.¹⁶ Dryness and thinning of the vaginal tissue become noticeable while nipple sensitivity decreases and there is a hardening of the breasts. Such changes women experience do not have a negative effect on sexual relations. Meanwhile, changes also occur in men's reproductive system but their ability to procreate continues for their entire lifetime. On the other hand, men experience changes in the quality and number of sperm, a decrease in seminal fluid, a reduction of the testicles and penis and an enlargement in the prostate as a result of the decrease in hormone production at older ages.¹³

Aging and Cardiovascular Diseases

The cardiovascular system is the most important sys-

tem to affect mortality and morbidity due to cell loss in messaging and muscle systems in old age. Depending on genetic background¹⁸ and age, the heart's ability to pump blood decreases, the myocardium loses its flexibility, and the heart valves thicken and increase in diameter. Arteriosclerosis increases the thickness of blood vessels while decreasing their elasticity.¹⁷ Functional and structural changes in the cardiovascular system in older ages increase the risk of coronary artery disease, heart diseases, heart failure, venous thrombosis, and hypertension. Healthcare professionals should be aware of the physiological changes that affect the quality of life of elderly people.¹⁹ It is striking to see in Figures 2 and 3 that mortality and morbidity increase with age. At the same time, the prevalence of illnesses rises with age (Figure 2 and Figure 3).²⁰ Some changes also occur in the cardiovascular system without the presence of morbidity at older ages. Cardiac

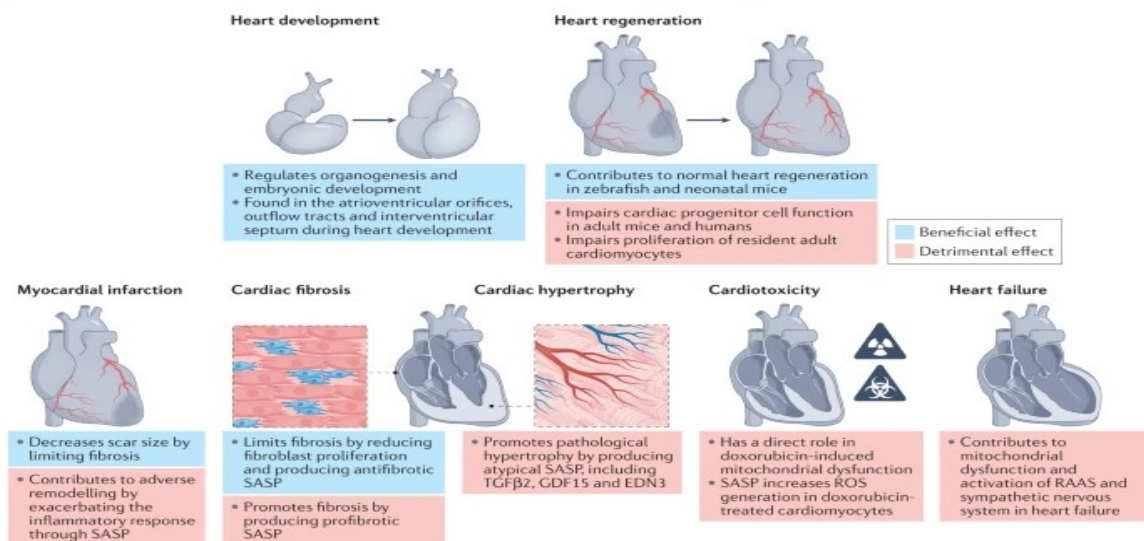
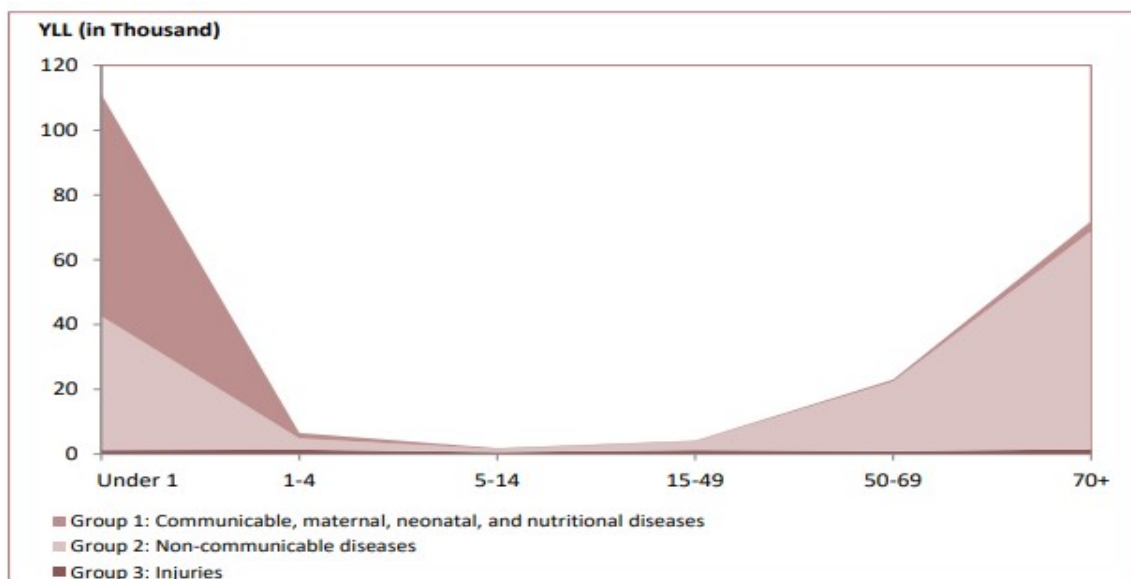
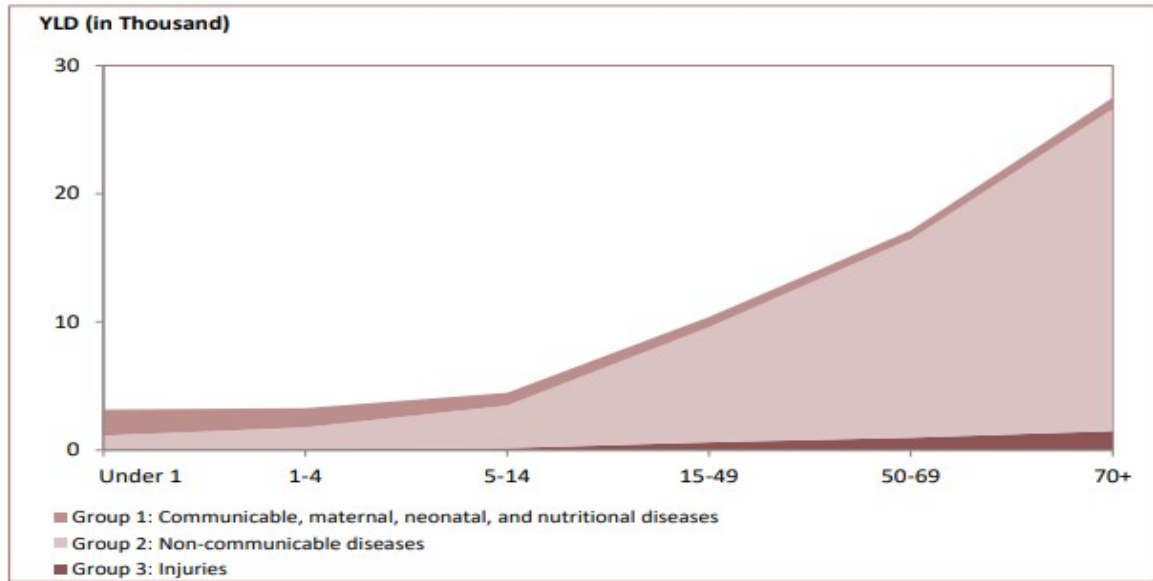


Figure 1: Involvement of cellular senescence in the pathogenesis of cardiac disease



Source: IHME, Global Burden of Disease Study 2019

Figure 2: YLL per 100 000 population by major disease group and age group, (in thousands)



Source: IHME, Global Burden of Disease Study 2019

Figure 3: YLD per 100 000 population by major disease group and age group, (in thousands)

output and stroke volume decreases and the risk of postural hypotension increases.¹⁸ With advancing age, a continuous rise in systolic blood pressure occurs as a result of a hardening of the vessels and their diminished elasticity. After the age of 60, either a slight decrease or no change is seen in diastolic blood pressure. With the accumulation of calcium minerals in the heart, the heart valves thicken and murmurs appear. Cardiac output also decreases during exercise as the response to beta-adrenergic stimuli in smooth muscles decreases.²¹ Important problems that can be seen as a result of physiological changes that occur with aging are heart failure, arrhythmia, and cardiac hypertrophy. In this context, the risk of cardiovascular disease increases with the existence of concomitant conditions such as age-related diabetes, obesity, and hypertension. With increasing age, heart failure, heart valve problems, arrhythmias and coronary artery diseases also increase. There is therefore a need to know the changes that occur with aging.²²

Accompanying the aging process are an increased loss of elasticity of the aorta and main arteries, an increase in interstitial fibrosis and calcification of the vessel media, elastin degradation, a change in collagen amounts and types, causing arterial stiffness. As a result, with aging, there is a steady rise in systolic blood pressure and consequently of pulse pressure.²¹ These increases contribute to hardening of the arteries and endothelial dysfunction. Aging also brings about increased sensitivity in the baroreceptors found in the blood vessel walls. As a result, the increase that should occur in heart rate and total peripheral vascular resistance in response to reduced blood pressure does not materialize. This is the reason why orthostatic hypotension is more commonly seen in the elderly.²³

Cardiovascular diseases are the leading cause of death in people aged 65 and over, and 80% of deaths from cardiovascular diseases occur in this age range. For this reason, it is important that healthcare professionals

interpret and understand the physiological changes that can reduce the quality of life in later life.²⁴ A chest X-ray will indicate an enlargement in the shadow of the heart. Mitral and aortic valves are affected as a result of the various calcifications taking place in the heart, which causes sclerosis and murmurs.²⁵

Aging is also accompanied by apoptosis and necrosis leading to myocyte loss, in which case myocytes are significantly diminished.²⁶ Additionally, more severe cell loss occurs at the sinoatrial and atrioventricular nodes. This in turn may increase the sensitivity of the aging sinoatrial node to calcium channel blockers.²⁷ With advancing age, the resting heart rate may display a negligible reduction, but the maximum heart rate will show a pronounced decrease in response to exercise and other stressors. The internal heart rate (the heart rate that is unaffected by the sympathetic or parasympathetic system) decreases by five to six beats a minute every ten years. In healthy older individuals, the response to both parasympathetic antagonists (atropine) and beta-adrenergic agonists (isoproterenol) decreases.²⁸ The prevalence of premature atrial contractions increases with age, but this is not associated with increased cardiac risk.²⁹ An increase of isolated ventricular ectopic beats can be seen in healthy older individuals; these are normal manifestations of the aging process.³⁰

Systolic blood pressure generally increases with advanced age, whereas diastolic blood pressure either tends to decrease slightly or does not change after 60 years of age. The main reason for this is the hardening of the arteries due to the loss of flexibility of the great arteries. An increase in systolic blood pressure can cause hypotension and impair left ventricular filling.³¹ Arrhythmias and ectopic beats are common, and the activity of baroreceptors decreases, vasoconstriction occurs in the lower extremity veins, with adipose tissue increasing around the heart. The blood flow to all organs decreases, the superficial veins of the skin become

prominent, and the veins dilate.³² A serious decrease in physical activity capacity due to aging, hypertension, atrial fibrillation, atherosclerosis, valve diseases, heart attack, venous thrombosis and heart failure occur. Appropriate exercises should be recommended to elderly people according to their physical capacities, and the elderly should avoid excessive fatigue, stress and situations that cause tachycardia.²¹

The incidence of coronary heart disease rises with aging. The majority of deaths caused by coronary artery disease involve people over the age of 65. The treatment of coronary artery disease in the elderly aims to reduce both mortality and morbidity and to provide a better quality of life.³³ The treatment of coronary artery disease at advanced ages addresses more considerations than in the treatment of younger patients. The effects of age on the coronary arteries should be reviewed in order to examine the increase in the incidence rate of coronary artery disease and the worsening of its prognosis in the elderly.³⁴ With aging, the coronary arteries become more convoluted, and the intima layer thickens. Calcium, phospholipid and cholesterol deposits are responsible for this thickening, independent of atherosclerosis.³⁵ Changes in the morphology of endothelial cells are accompanied by functional changes such as a decreased ability to produce nitric oxide (NO) and increased NO consumption. The most important change in the media layer is calcification and fragmentation of elastin fibers. In addition to the migration of activated smooth muscle cells from the media to the intima layer, increases in angiotensin II, transforming growth factor-beta and adhesion molecules are seen in the matrix metalloproteinases in the elderly.³⁶ This process, which results in intima/media thickening, is an indicator of arterial aging. It is important that these events that are involved in the physiology of aging also play a role in the pathophysiology of atherosclerosis. Coronary heart diseases come to the fore along with these physiological conditions in old age.³⁴

While cardiovascular diseases are commonly the primary cause of deaths in the elderly population, they also lead to significant morbidity and a deterioration in the quality of life. Cardiovascular risk factors play a leading role in the older population, but studies have indicated that effective risk control reduces the development of cardiovascular events.²¹ It is for this reason that risk factor modification is an important and effective way to protect individuals from cardiovascular diseases. Conditions that are commonly encountered in the evaluation of cardiovascular events in the elderly are hypertension, coronary heart disease, atrial fibrillation, valve disease and heart failure.²⁶

With aging, cardiac output and the heart rate decreases, while wall thickness increases, and vessels lose their flexibility. The fat layer surrounding the heart increases. These changes that occur with advancing age significantly affect the function of the heart and create an environment for the development of incommunicable diseases.²¹ Congestive heart failure, hypertension, ischemic heart disease, coronary artery disease are common cardiovascular diseases in older adults. Due to these problems, circulation decreases, weakness, fatigue, edema, oxygen deficiency and adaptation to different states become difficult.³⁷ The physical capacities of individuals

decrease with age, limiting the functional independence of the elderly.³⁸ It is stated that regular physical exercise reduces the risk of major cardiovascular and metabolic diseases, cognitive loss, falls and obesity at advanced ages.³⁹

Dietary recommendations for older adults should be personalized with consideration for any co morbid conditions in order to accommodate the individual's particular needs. Individuals should be encouraged to be as active as possible, starting off with a program of light exercise and gradually increasing the duration of the activity each week (5 minutes of continuous exercise). For a variety of reasons, drugs should be carefully prescribed, especially in the case of the elderly.⁴⁰ Aging causes changes in body composition that tend to cause an increase in the concentrations of hydrophilic drugs and decreases in the plasma concentrations of lipophilic drugs. Side effects of drugs should be considered, particularly in those older individuals who have co morbid conditions. Additionally, polypharmacy increases the risk of drug-drug interaction. The existence of cognitive impairment makes treatment compliance challenging. Social, economic and caregiver burden issues should all be considered when determining a treatment plan.⁴¹

CONCLUSION

Various changes occur in the cardiovascular system with aging, and as a result, the risk of cardiovascular disease increases. Cardiovascular diseases are one of the leading causes of death in the elderly. The necessary precautions should therefore be taken to reduce the risk of developing these diseases. Excess weight, a life without physical activity, an unhealthy diet,⁴²⁻⁴⁴ and other similar conditions increase the risk of cardiovascular disease. Achieving weight control, encouraging physical activity, ensuring that the individual adopts healthy eating habits, maintains adequate fluid intake, refrains from using tobacco and alcohol, avoids stress, and takes medications correctly are some of the critical steps in preventing the risk of cardiovascular disease and the progression of any existing disease.

Unhealthy nutrition and resulting obesity lead to the development of nutrition-related noncommunicable diseases (e.g., cancer, cardiovascular diseases, osteoporosis, diabetes). Studies have shown that regular physical exercise reduces the risk of developing type 2 diabetes or heart attack by 50 percent, also indicating that this significant reduction may also be valid for some types of cancer and hypertension.

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