



## Cardiovascular Diseases: Understanding the Leading Cause of Death Worldwide

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### Article History

Submitted: 05-07-2024

Revised: 26-07-2024

Accepted: 01-08-2024

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### Abstract

This comprehensive review paper thoroughly explains the complex domain of cardiovascular diseases (CVDs), offering a detailed overview of their various aspects. This review effectively explores the role of atherosclerosis as the central factor in the development of cardiovascular diseases (CVD). It highlights the chronic and asymptomatic nature of these diseases, emphasizing their significant impact on worldwide mortality and morbidity. An in-depth examination of risk factors reveals the significant influence of type 2 diabetes, hypertension, and dyslipidemia. The conversation smoothly moves on to coronary artery disease, providing insight into the complex mechanisms of plaque formation and its potentially devastating outcomes, including stroke and myocardial infarction. The review provides significant insights into cerebrovascular illnesses, clarifying the diverse etiologies and highlighting the essential connection between risk factors and atherosclerosis. The pathogenesis of cardiovascular diseases (CVDs) is analyzed meticulously, focusing on endothelial dysfunction and emphasizing the interaction between oxidative stress, inflammation, and apoptosis in the degradation of the heart muscle. The frequency of cardiovascular diseases (CVDs) is examined by considering age and gender, and by doing a detailed investigation into hormone replacement therapy and its effects on the aging heart. This article comprehensively analyzes atherosclerosis as a significant risk to the small blood vessels, with particular emphasis on dyslipidemia and its association with diabetes. This review explores the influence of diabetes on the autonomic nervous system and local metabolism, establishing links to macro vascular disorders. Inflammation has an important role in causing cardiovascular diseases specifically in obese people. The article focuses on the clinical symptoms of cardiovascular diseases caused by diabetes, highlighting the significance of promptly identifying and evaluating autonomic neuropathy. The report finishes by endorsing a comprehensive approach to cardiovascular health, emphasizing the importance of lifestyle variables and patient education in the context of secondary prevention. The article emphasizes the relevance of pharmacotherapies in managing cardiovascular disease (CVD).

### Keywords

Cardiovascular Diseases, Hypertension, Dyslipidemia, Obesity



## Introduction

Cardiovascular diseases (CVDs) comprise a category of diseases related to the heart and blood vessels [1]. They are a group of varying disorders whose leading reason for growth is the hardening of arteries [2]. These diseases stay asymptomatic almost throughout life as they are persistent and chronic. Cardiovascular diseases are also an emerging source of mortality and morbidity among people around the globe. The disease of arteries is the leading cause of cardiovascular-associated fatality [3]. Atherosclerosis is defined as the condensing and stiffening of the arterial border, accompanied by the factor of age, and significantly impacts cardiovascular disease. Elevated plasma level ( $>150\text{mg/DL}$ ) increases the risk of outgrowth of atherosclerosis [4]. High blood pressure and high cholesterol levels are major factors in inducing CVDs and high sugar concentration in the blood (diabetes) is also an independent risk. People suffering from diabetes may exhibit two conditions: Heart failure with preserved ejection fraction (HFpEF) and or Heart failure with reduced ejection fraction (HFrEF). High blood pressure is the primary cause of heart collapse, on the other hand, myocardial infarction (MI) is a significant element of high failure with reduced ejection fraction.

Coronary artery disease elicits a typical heart disease which involves the blockage and shrinking of primary arteries. It involves the emergence of plaque in the intima of the arterial wall. *Plaque* is depicted as the formation of fat substances inside the vessel intima, mainly if inflammation is chronic. Thus, the hardened buildup of fats and cholesterol may break, followed by the development of blood clots (thrombosis) and rupture of blood vessels, which causes stroke, cardiovascular stroke, chronic limb-threatening decreased blood flow, and mortality. Above 7 million, 20 years or elderly people have experienced a cerebrovascular accident. Annually, almost 610,000 people are exposed to their first stroke, and the other 185,000 undergo a reappearance of stroke. Cardiovascular disease is classified as civilized, so it is essential to create practical algorithms to help doctors with their work. *Endothelial dysfunction* is the primary cause of CAD and atherosclerosis [5]. Due to continuous improvement and the introduction of pharmacotherapies solutions, these processes are starting further research and improvement.



A cerebrovascular disease that develops from a variety of causes includes

- Thrombosis (blood clots create blockage in blood vessels),
- Cerebral venous thrombosis (embolism in the blood of a vein) and
- Embolic arterial blood lump (blood clot in an artery of the brain).

Cerebrovascular disease arises from different etiologies, such as blood clots in patients with atrial twitching, triggering rheumatoid fever, thrombotic stroke, and disease of heart valves, highlighting risk hazards related to the occurrence of coronary artery disease because it imparts an essential role in the pathogenesis of CVD. Hypertensive heart illness causes therapeutic issues such as heart loss as well as heart block, which occurs in case of unmanageable hypertension. Heart failure often occurs at the age of 65 or older. Long-term hypertension strains your heart, making it harder to pump [6]. The wall of a blood vessel also thickens due to elevated blood tension, and it becomes risky when high-fat molecules compile in the blood vessels.

The involuntary force, i.e: turbulent flux, is associated with the shape and geometry of arteries and veins and influences the vascular endothelial layer [7]. The endothelial cells experience different kinds of shear pressure, which affects shape, intracellular signaling, and gene expression. In the inactive condition of the endothelium, the production of nitric oxide occurs which fixes with the cysteine group and mitochondria that inhibit cellular processes [8]. The outer endothelial layer permits the flow of compounds including nitric oxide, which causes transcription factors and protease to be activated. Further processes that induce endothelial diseases include the production of less synthase enzyme dissociation, hindrance of prostacyclin development, and endothelial manifestation activation due to a decrease in the activity of the dissolved guanylate cyclase enzyme [9].

Since 1975, cardiovascular diseases have been among the second directing rationales of demise, with 633,842 deaths and 17.7 million deaths, according to WHO in 2015. The burden of this disease is that it is considered very costly in front to Alzheimer's malady or diabetes. The incidence of disease increases with age with some variation in gender. That is, it is more prevalent in men than in women. The American Heart Association shows that the occurrence of cardiovascular diseases in the United States in males and females is 40% from 40 to 59 years, 75% from 60 to 79 years, and 86% in people over 80 years. Sex differences are also frequently observed in aging



adults, leading to the onset of CVD. The prevalence of cardiovascular diseases was documented at 77.2% in men and 78.2% in women ranging from 60 to 79 years of age, and occurrence was around 89.3% in men and 91.8% in women beyond the age of 80. The most substantial threat aspects are masculinity and gender in coronary artery disease. Hormone replacement treatments (HRT), which use estrogen therapy, are highly disputed due to their harsh complications [10].

Functional change in the aging of adult heart has been characterized, including systolic diastolic and electrical dysfunction. The prevalence of CVD has several factors that include redox imbalance, sensitivity, swelling, programmed cell death, and myocardial breakdown. The increase in relative oxidative stress (ROS) occurs with advanced age [11]. The enhancement of erythropoietic components and additional intermediates assists in cellular modification of the heart after inflammation, including extracellular matrix (EMC) recreation provoked by defective extracellular matrix turnover. Fibrotic scarring and gigantism are critical anatomical adaptations leading to ultimate cardiac deterioration in mature patients. Fibrosis is caused by imperfect extracellular matrix turnover, which has been transmitted to enlarge the atria of older patients, and results in the irregular beating of upper chamber the heart (atria) in many patients [12].

## **Risk factors**

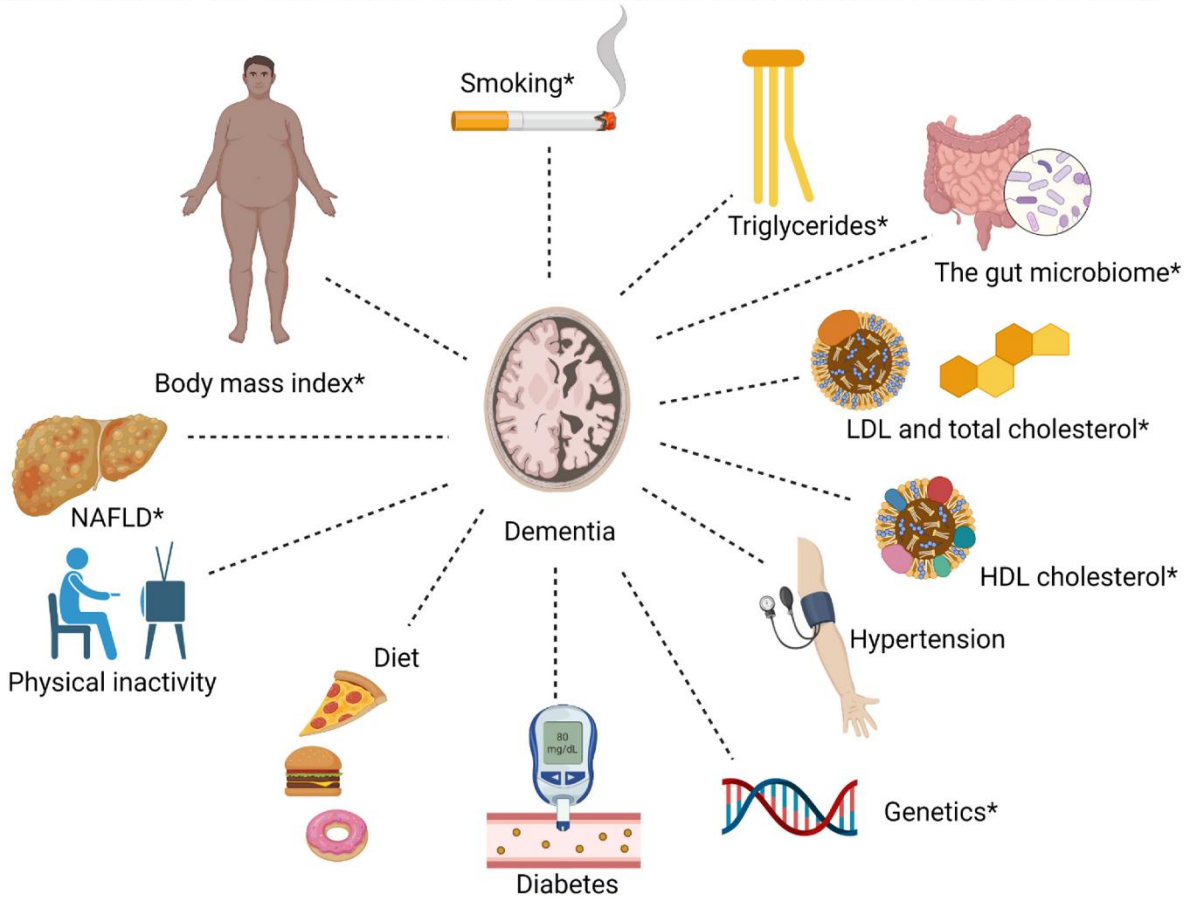
Susceptibility for heart disorders produces structural changes that damage the endothelial cells in the heart, but one can lessen these outcomes by exercising regularly. The risk of developing cardiovascular disease includes the factors of age, weight and hypertension. The heart comprises various kinds of cells, in which endothelial cells are the most common [13]. In the heart, vascular endothelial cells monitor nutrient and oxygen demand and enhance immunity. The neighboring cells are affected by endothelial cell manufacture that disturbs the heart's health. Thus, endothelial cells are responsible for the progression of the heart and blood vessel ailments. Chubbiness and coronary infarction destroys the molecular properties of endothelial cells, just like aging. The factors of being overweight and old also reduce the manifestation of genes related to the endothelial cells. Despite this, the cells present in the genome of mice that are responsible for the expression of genes are related to cells termed mesenchymal cells.



In communities with traditionally active lifestyle behavior, the prevalence of high cholesterol, high blood pressure, obesity, and adult-onset diabetes is far lower than in revolutionized nations, Regardless of age adaptation [14-15]. However, Western nations consider the increase in blood pressure and cholesterol an inevitable consequence of aging, both the bottom level in early adulthood and the slope of age-related changes across regions. Evaluated systematically, >70% of cardiovascular diseases, 80% of CHD events, and 90% of new patients of diabetes type 2 are ascribed to essential lifestyle factors. The dangerous impacts of smoking and the beneficial effects of emitting cigarettes are carefully specified. Prevention of smoking habit decreases the number of deaths by one-third. Further analysis and policy ambitions are vigorously required to boost up the new practices and develop new policies and interventions to reduce smoking.

Stokes can cause intense injuring consequences in people like speechlessness, difficulty with swallowing, and temporary muscle drawback and endless physical dysfunction that may cause immobilization [16]. High blood pressure, which was determined by the World Health Organization (WHO) is responsible for most of the untimely mortalities. It affected 972 million people globally in the year 2000 and is estimated to expand by around 60% to 1.56 billion people by 2025. Type 2 diabetes mellitus also influences 151 million people worldwide and is supposed to boost up by 46% to 221 million by 2010. Determinants of a disease aggregate separately and elevate the hazard of cardiovascular disease, so global risk inspection is important. Global risk assessment can identify patients who need intervention and they might come up with a low risk but have a high risk [10].

## Risk factors for atherosclerotic cardiovascular disease and dementia



**Figure 1:** Shared risk factors between dementia and atherosclerotic cardiovascular disease [16]

### Pathophysiology

A primary threat to microvasculature is the hardening and stiffening of arteries for victims with or without diabetes. High cholesterol level is interlinked with atherosclerosis, and 97% of patients have diabetes—the distinctive design of decreased HDL and expanded fatty acids found in the plasma of patients with diabetes. The primary form of low-density lipoprotein cholesterol is tiny in diabetes. Small low-density lipoprotein molecules cause plaque formation and large low-density cholesterol lipoprotein molecules can smoothly pass through the arterial wall and are more susceptible to oxidation. Blood with high sugar levels is more feasible to contain triacylglycerols. High level of triglycerides in diabetes regulates lipid flex. Hypertriglyceridemia can increase the



exposition of small molecules of low-density lipoprotein (bad cholesterol) and inhibit the transfer of high-density lipoproteins cholesterol back to the liver [17].

Diabetes contributes to a defect in the autonomic nervous system, local metabolism, and endothelium, resulting in macrovascular infection. Patients with diabetic autonomic neuropathy (DAN) are more prone to impulsive heart-related casualties and elevated cardiovascular deaths. The deterioration of the cardiovascular system that is induced by diabetic autonomic neuropathy issues with diabetes has been found to inhibit the bioactivity of nitrogen oxide, a powerful substance that can dilate blood vessels and enhance the production of vasocompressors such as endothelin-1. There is a low supply of nitric oxide in diabetes because of inhibition of insulin availability or insulin antagonism in endothelial cells.

Tissue damage results in inflammation and pathogenic disclosure. It is an essential characteristic because of which the body can recover itself and combat against infection. Diabetes induces a low-level rash, and some studies propose that triggering the immune system may produce insulin opposition in diabetic and pre-diabetic conditions and can promote cardiac and vascular diseases in these disease mechanisms. Obesity is associated with increased adipokines (macrophages secreted from adipose tissue), comprising interleukin 6, TNF, and endothelial plasminogen activator inhibitor (Pal-1), all associated with the inflammatory reaction.

## **Clinical manifestations**

Diabetes can cause disorders inside the vegetative nervous system, inflicting diverse cardiac diseases, which include tachyarrhythmia, stance low blood pressure, better intra/perioperative cardiac and vascular fluctuation, extra common symptomless cardiac aplastic anemia and embolism, and more fatality after cardiac arrest [18]. Laboratory signs related to CAN (complaints of arm, neck, or shoulder) typically arise at later levels and consist of low blood pressure, unsteadiness, loss of balance, fainting, and sudden exhaustion at some workout point. However, subclinical autonomic disorder, found as destructive in HRV, can arise in the 1st year following analysis in individuals with insulin-independent diabetes and within two years following analysis in insulin-dependent diabetic patients [19].

As peripheral neuropathy impacts the lengthiest nerves, the primary expression of diabetic CAN is associated with cranial axon harm, and it is liable for almost 70% of craniofacial system action.



The harm in the vagus nerve provokes a reclining congestive heart failure because the sympathetic tone will become authoritative [20]. Cardiopulmonary arrest ultimately reduces after some time because of innovative, compassionate axon harm. Nevertheless, elevated pulse prevails in those cases. The creative harm to autonomic stability is indicated through extra symptoms, which include unwillingness to do physical activity, a decline in blood pressure while sitting or lying down, and a drop in heart rate variability. Heartache belief frequently worsens by the participation of sensory neurons, putting sufferers at risk of an asymptomatic decrease in blood flow and heart attack [21]. Causative elements related to autonomic neuropathy consist of inadequate monitoring of blood glucose levels, extended diabetes period, elevated age, woman intercourse, and higher body mass-to-height ratio. More than 25%-50% of death rates were discovered in victims with symptomatic involuntary disease within a span of 5-10 years [22]. Amidst diabetic patients, the 5-year mortality rate is three times higher in people with autonomic involvement than in those without. Volume and tension in the blood fluctuate daily. [23]. An increase in blood pressure during daytime and a decrease in nighttime show its circadian rhythm. The unanimous autonomic movement shows the dysregulation of the diurnal rhythm of blood pressure and outcomes in less than 10% contraction in nighttime blood pressure in individuals with CAN. Screening for CAN is recommended before the surgical operation of a person with diabetes for anesthetic administration design.

Several analyses approve the idea of daily exercise, maintaining an appropriate weight, avoiding tobacco products, and nutritional practices significantly reduce CVD risk. Despite various proofs that lifestyle factors influence fitness and grade of life, it is quite challenging to support people embracing such practices. Ideal cardiovascular health involves life-maintaining elements enclosing daily workouts and exercise, proper diet, sound nutrition, cholesterol control, blood pressure, and glucose. People who are physically strong in normal life are at a low risk of CVD compared to those who are not physically active and fit. Physical exercise has many advantages, but many physiotherapists discourage their patients from daily workouts because frequent physical activities relatively proliferate high-density lipoprotein (HDL) cholesterol but minimally affect low-density lipoprotein (LDL) cholesterol [24].

Many medicines are used to treat CVD [25]. Usually, they either aim to reduce blood pressure or widen your arteries. Surveillance of cardiovascular diseases is ubiquitous and it depends on the





clinical condition (catheter-directed thrombolytic therapy for severe ischemic myocardial infarction, coronary stenting for outermost vascular infection, percutaneous coronary intervention). Persons dealing with cardiovascular diseases must acquire education about secondary precautions, hazardous factors, and modifications in their way of living. [26, 27].

## Conclusion

This study provides a comprehensive analysis of cardiovascular diseases (CVDs), which are medical conditions that affect the heart and blood arteries. The essay primarily addresses the underlying cause, of atherosclerosis, and explores how disorders like diabetes and hypertension worsen the problem.

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