

## Coronary Vascular Disease: A General Review with Specific Reference to Etiology

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### Abstract

*Cardiovascular disease (CVD), the foremost cause of mortality worldwide, has surged by 60% globally, reaching 20.5 million deaths in 2021 from 12.1 million in 1990, as per the latest report from the World Health Federation. While this increase is alarming on a global scale, it raises even greater concerns in countries like India where heart ailments are afflicting individuals at a younger age. The escalation of CVD among the younger population in this region is particularly worrisome. The factors driving this trend are diverse, with diabetes, obesity, smoking, and alcohol consumption emerging as major contributors to the early onset of heart disease. These lifestyle choices and health conditions not only increase the risk of cardiovascular issues but also worsen their impact. Tackling this growing problem requires a comprehensive approach, starting with raising public awareness about the root causes of cardiovascular diseases. By implementing targeted educational programs, public health campaigns, and community outreach efforts, we can foster a culture that prioritizes proactive heart health management. These initiatives play a vital role in raising awareness about cardiovascular risks and equipping individuals with the knowledge needed to make healthier lifestyle choices. Providing people with the tools and resources to address these risks empowers them to take control of their health, adopt preventive measures, and make informed decisions about their well-being. Such efforts are crucial not only in reducing the prevalence of premature deaths caused by heart disease but also in laying the foundation for a healthier society. By promoting sustained heart health awareness and encouraging a shift toward healthier habits, we can ensure a brighter, healthier future for the coming generations.*

**Keywords:** Cardiovascular disease, world health federation, diabetes, obesity, etiology

### INTRODUCTION

Cardiovascular disease (CVD) has surged to epidemic levels globally, including in India, posing a significant risk of premature disability or death for many individuals. The onset of coronary heart disease (CHD) often manifests with subtle signs and symptoms, undergoing a prolonged latent period before clinical diagnosis. However, coronary artery disease (CAD) remains largely preventable, with abundant resources available to educate and empower individuals.

The primary culprits behind CHD encompass various risk factors such as sedentary living, hypertension, smoking, and high cholesterol levels. According to the World Health Organization (WHO), hypercholesterolemia alone contributes to over five million premature deaths annually, with

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smoking and hypertension accounting for approximately five million and seven million deaths, respectively.

### **AIMS AND OBJECTIVES**

To elaborate Cardio vascular disease in detail with etiology.

### **CARDIOVASCULAR DISEASE VS. CORONARY HEART DISEASE**

Cardiovascular disease (CVD) encompasses a spectrum of heart and blood vessel disorders, including heart attacks, heart failures, and strokes, among others. Coronary heart disease (CHD), also known as coronary artery disease (CAD), is a cardiovascular condition characterized by the accumulation of fatty substances in the arteries that supply blood to the heart. This condition, called atherosclerosis, causes the arteries to narrow, restricting blood flow and depriving the heart of essential oxygen and nutrients [1]. Chronic diseases of lifestyle (CDL) encompass conditions like obesity, metabolic syndrome, diabetes, hypertension, and hypercholesterolemia, which develop gradually due to prolonged exposure to risk factors such as poor diet, smoking, sedentary lifestyle, and stress. These conditions predispose individuals to various long-term health issues, including cancers, respiratory ailments, renal problems, and more. High cholesterol levels in the blood, a condition known as hypercholesterolemia, significantly increase the likelihood of developing coronary artery disease (CAD). Cholesterol is transported through the bloodstream by different lipoproteins, with low-density lipoprotein (LDL) and high-density lipoprotein (HDL) being the most prominent. Elevated LDL levels, known as "bad" cholesterol, elevate CAD risk, while high HDL levels, termed "good" cholesterol, provide some protective effect against CAD. Family history of premature cardiovascular events also plays a crucial role in CAD risk assessment. Risk factors for coronary artery disease (CAD) are categorized into two types: modifiable factors and non-modifiable factors. Modifiable risk factors, such as physical inactivity, obesity, diabetes, high cholesterol, hypertension, and smoking, can be altered through lifestyle changes, potentially reducing CAD prevalence. Factors such as age and family history are non-modifiable, meaning they cannot be altered, but they play a crucial role in assessing the risk of CAD. Additionally, the presence of multiple risk factors exponentially increases the likelihood of developing CVD [2].

### **MODIFIABLE RISK FACTORS**

Modifiable risk factors play a major role in causing strokes and coronary artery disease (CAD), accounting for nearly 80% of cases. According to the CDC, these factors significantly contribute to CAD, with physical inactivity leading at 53%, followed by obesity at 34%, hypertension at 32%, smoking at 21%, high cholesterol at 15%, and diabetes at 11%. Obesity occurs when energy intake exceeds energy expenditure, leading to the accumulation of visceral fat in the abdominal region and raising the risk of CAD. Its development is influenced by both genetic predisposition and environmental factors, resulting in excessive fat storage.

Extensive research underscores obesity as a significant risk factor for CAD and a crucial predictor of its incidence over the long term. Notably, the prevalence of obesity among adults poses a noteworthy CAD risk, with 65% categorized as overweight ( $BMI \geq 25$ – $29.9 \text{ kg.m}^{-2}$ ) and 31% classified as obese ( $BMI \geq 30 \text{ kg.m}^{-2}$ ), consequently elevating the risk of prediabetes. Obese individuals exhibit a higher likelihood of hypertension, dyslipidemia, and diabetes due to coronary microvascular dysfunction and the accumulation of visceral fat [3].

The close proximity of visceral fat to the heart fosters an unfavorable metabolic environment, contributing to microvascular dysfunction. Additionally, waist-to-hip ratio emerges as a significant predictor of cardiovascular risk, with android fat distribution (weight centered around the midsection) posing a greater CAD risk compared to gynoid fat distribution (weight centered around the hips). The distribution of fat between subcutaneous and visceral compartments differs significantly, with subcutaneous fat making up the bulk of total body fat, comprising over 80%. While men typically have less subcutaneous fat than women, women seem to exhibit a lower susceptibility to accumulating

visceral fat. Numerous studies suggest that excess visceral fat poses a significantly higher risk of coronary artery disease (CAD) compared to excess subcutaneous fat. The elevation of plasma lipids leads to increased hepatic gluconeogenesis, impaired glucose tolerance, and heightened food intake, ultimately promoting visceral adiposity and adipocyte hypertrophy. Consequently, various mechanisms contribute to the development of CAD due to increased adiposity. Moreover, adipose tissue proliferation has been linked to glucose intolerance, endothelial cell dysfunction, dyslipidemia, and hypertension, all of which impact heart function. Weight loss plays a crucial role in decreasing CAD risk. Furthermore, the significance of weight loss extends beyond CAD risk reduction, as it also mitigates other cardiovascular risk factors. This highlights the need for proactive weight loss efforts, which can significantly reduce the risk of CAD.

### **Elevated Resting Blood Pressure**

Hypertension, affecting one in four adults, stands as a significant risk factor for coronary artery disease (CAD). It is characterized by the pressure exerted on arterial walls during heartbeats, recorded as systolic and diastolic pressures. Blood pressure is classified into several stages: normal (systolic below 120 mmHg and diastolic below 80 mmHg), prehypertension (systolic ranging from 120 to 139 mmHg and diastolic from 80 to 89 mmHg), stage 1 hypertension (systolic between 140 and 159 mmHg and diastolic between 90 and 99 mmHg), and stage 2 hypertension (systolic 160 mmHg or higher and diastolic 100 mmHg or above). A 20 mmHg increase in systolic blood pressure above 115 mmHg is associated with a 50% higher risk of cardiovascular-related mortality. Both systolic and diastolic pressures positively correlate with CAD risk, serving as precursors to various cardiovascular diseases due to increased arterial stress. Hypertension's pathophysiology involves endothelial dysfunction from rapid blood flow increases, exacerbating atherosclerosis. Persistent hypertension fosters arterial plaque buildup over time, culminating in atherosclerosis. Left ventricular hypertrophy, a response to elevated blood pressure and increased heart workload due to obesity, decreases cardiac reserve, raising myocardial oxygen demand and contributing to myocardial ischemia. Left ventricular hypertrophy also heightens the risk of heart failure and sudden death [4].

Hypertension presents a notable risk for firefighters and poses a global public health concern. Often dubbed the "silent killer", hypertension can remain asymptomatic for years before precipitating heart attacks or strokes. Lifestyle factors like body weight, exercise, alcohol intake, and diet significantly influence hypertension, which can be effectively managed through lifestyle adjustments, regular physical activity, dietary modifications, and medication.

### **Elevated Fasting Blood Glucose**

The concentration of fasting blood glucose (FBG) serves as a marker for steady-state glucose metabolism in the body. Excess adiposity disrupts glucose metabolism primarily by increasing fatty acid supply into the bloodstream. Normally, insulin suppresses hormone-sensitive lipase activity, reducing lipolysis and thereby limiting fatty acid release. However, enlarged adipocytes become less sensitive to insulin's antilipolytic effect, leading to increased fatty acid release and decreased glucose utilization. This imbalance promotes chronic hyperglycemia as fatty acid metabolites impair insulin sensitivity and hinder glucose transport into muscles. Local adipokines also play a role in modifying insulin sensitivity, contributing to insulin resistance [5]. Diabetes mellitus (DM) is a collection of disorders characterized by elevated blood sugar levels due to issues with insulin production or its effectiveness. According to the Framingham Heart Study, people with diabetes face a two-to-five-fold higher risk of death from CAD. Insufficient insulin or resistance to its effects causes elevated blood sugar, which damages arteries and worsens the progression of CAD. Diabetic individuals often exhibit concurrent risk factors like hypertension and dyslipidemia, further increasing CAD risk. Atheromatous plaque formation and thrombus formation contribute to diabetic macrovascular complications. Microvascular complications, such as CAD, interact with macrovascular complications, leading to myocardial infarction and diabetic foot development due to impaired blood vessel function. Effective management of risk factors like hypertension, obesity, and dyslipidemia reduces major coronary events

in diabetic individuals. Given dyslipidemia's significance, maintaining LDL cholesterol levels below  $3.8 \text{ mmol.l}^{-1}$  is crucial for diabetic individuals.

### **Elevated total cholesterol**

Lipids travel through the bloodstream in the form of lipoproteins, which are produced by the liver and made up of apolipoproteins, phospholipids, and cholesterol. These lipoproteins are essential for cell development and contribute to the synthesis of vitamin D and hormones. The primary categories of lipoproteins include high-density lipoproteins (HDLs), low-density lipoproteins (LDLs), very low-density lipoproteins (VLDLs), and chylomicrons. Total cholesterol (TC) reflects the sum of these lipoproteins, but the distribution of cholesterol among them is a more accurate predictor of heart disease than total cholesterol alone.

Cholesterol can be obtained from dietary sources or synthesized within the body, serving structural and physiological functions. Dyslipidemia is characterized by elevated total serum cholesterol levels ( $\text{TC} > 5.2 \text{ mmol.l}^{-1}$ ). Elevated triglyceride levels in the blood are associated with increased LDL cholesterol levels and, when accompanied by low HDL cholesterol levels, constitute a dangerous triad known as atherogenic dyslipidemia. This condition is often observed in individuals with premature coronary artery disease (CAD) and underscores the link between dietary cholesterol intake, elevated cholesterol levels, atherosclerotic plaque formation, and endothelial dysfunction.

### **Sedentary Lifestyle**

Failing to engage in physical activity for a minimum of 30 min, at a moderate intensity, on at least 3 days/week over a span of 3 months is considered a positive risk factor for coronary artery disease (CAD). Research indicates that insufficient physical activity is an independent contributor to CAD risk. Fewer than 60% of people worldwide adhere to the minimum physical activity guidelines recommended by the American College of Sports Medicine (ACSM) and the United States Centers for Disease Control and Prevention (CDC). As individuals age, physical activity tends to decline, particularly in the presence of chronic illnesses and disabilities [6]. Moreover, a sedentary lifestyle, characterized by low physical fitness, is an independent risk factor for CAD and is associated with an increased risk of stroke and angina. In the absence of exercise, atherosclerosis can rapidly progress, leading to plaque formation in arterial walls and diminished myocardial vascularity. Physical inactivity also influences other CAD risk factors, including low levels of high-density lipoproteins (HDLs), hypertension (HTN), diabetes, and obesity, further elevating the risk of cardiovascular disease. A comprehensive and effective training regimen should incorporate aerobic activities such as walking, cycling, rowing, swimming, or hiking for at least 3 to 5 days/week, with sessions lasting 30 to 60 min at a low to moderate intensity. Additionally, a resistance training program should be integrated 2 to 3-times/week to enhance muscular strength.

### **Cigarette Smoking**

Cigarette smoking or tobacco use, whether active or passive, has been recognized for over four decades as a significant risk factor for cardiovascular disease (CVD). The cardiovascular risks associated with tobacco use are compounded when combined with other coronary risk factors such as high cholesterol and hypertension, further elevating the likelihood of CVD. Tobacco use promotes fibrinogen production, accelerates atherosclerosis, and enhances blood clotting, leading to acute coronary events like plaque instability, thrombus formation, and arrhythmias. Additionally, cigarette smoking is linked to increased levels of inflammatory markers, such as C-reactive protein, which serve as predictors of future cardiovascular events across various populations. Exposure to second-hand smoke may also heighten the risk of CVD among non-smokers [7].

Given the numerous health benefits and cost savings associated with smoking cessation, efforts to prevent tobacco use should be encouraged and expanded, particularly in developing countries where the threat is most severe and where tobacco companies have targeted their marketing efforts for future growth.

### **Non-Modifiable Risk Factors**

Age and family history are non-modifiable risk factors for coronary artery disease (CAD). The likelihood of developing CAD rises in men aged 45 and older and in women aged 55 and older. Family history of heart disease manifests at a younger age in men than in women, with significant clinical history or premature death in first-degree relatives under 55 years for men and under 65 years for women indicating a familial risk. Thus, the rise in absolute risk becomes clinically significant for men in their mid-40s and for women around the time of menopause [8].

### **PREVALENCE OF CAD**

#### **Global Prevalence of CAD**

Strong evidence underscores the combination of modifiable and non-modifiable risk factors for coronary artery disease (CAD) as a leading preventable cause of death, both in developed and developing nations. Developed countries witness CAD accounting for 30 to 50% of all fatalities. Statistics reveal that one in three women and one in two men in their 50s are expected to develop CAD during their lifetimes, with risks escalating due to westernized lifestyles and aging. By 2020, except for sub-Saharan Africa where HIV/AIDS remains predominant, CAD is projected to surpass other causes to become the primary global cause of mortality and morbidity. The burden of CAD extends beyond health implications, encompassing direct and indirect costs that strain public health resources. Direct costs include healthcare expenses related to screening, medication, laboratory tests, and clinical consultations, while indirect costs stem from absenteeism, diminished work productivity, and lifestyle adjustments necessitated by disease management. Prioritizing low-cost interventions that can be universally implemented and yield substantial reductions in CAD risk is imperative, particularly in regions where the burden of the disease is significant [9].

#### **Regional Prevalence of CAD**

In India, the occurrence of coronary artery disease (CAD) stands at 21.4% among diabetic individuals and 11% among non-diabetic individuals. Furthermore, CAD prevalence in rural areas is approximately half that observed in urban areas.

### **CAD PREVENTION**

Due to its prolonged onset, coronary artery disease (CAD) prevention is well-suited for altering risk factors, primarily through lifestyle and behavioral modifications, which carry significant cost-saving potential and public benefits. Prevention historically falls into two categories: primary prevention, occurring before disease manifestation, and secondary prevention, initiated after disease onset. It has evolved to include three types of interventions: primordial (preventing the development of risk factors), primary (managing existing risk factors), and secondary (avoiding recurring cardiovascular events). With CAD prevalence on the rise, there is strong advocacy for making primary prevention the focal point of public health interventions. Primary prevention strategies commonly employ either a population-based approach, targeting community-wide behaviors, or a high-risk approach, concentrating on intervention for a select group of high-risk individuals. While the population approach delivers extensive benefits due to its broad reach, the high-risk approach offers more personalized benefits but with limited impact on the larger community. The American Heart Association (AHA) defines ideal cardiovascular health as a blend of positive health behaviors, optimal health factors, and the absence of clinical cardiovascular disease (CVD). Lifestyle programs for CAD prevention typically include education on diet, weight management, exercise, and smoking cessation, with a significant emphasis on tobacco abstinence. These programs aim to cultivate self-control and self-efficacy among participants by addressing knowledge, skills, and attitudes, empowering individuals to understand and change negative behaviors acquired early in life. Developing such valuable life skills not only reduces CAD risk and healthcare costs but also enhances quality of life, proving to be cardio-protective [10].

### **DISCUSSION AND RESULT**

Educating patients and their families about the disease is a crucial benefit of early diagnosis. Patients should be informed about the disease's progression, available treatments, and its causes, particularly its etiology. Indians face a heightened risk of heart attacks at a younger age compared to Western populations due to various factors including dietary habits, high rates of diabetes, hypertension, dyslipidemia, genetic predisposition, increasing obesity rates, sedentary lifestyles, and smoking habits. The cardiovascular disease (CVD) epidemic in Indians is marked by a higher risk burden, earlier onset of symptoms, greater case fatality rates, and a higher number of premature deaths. However, prevention of heart disease is within our control. This can be achieved by adopting a diet rich in fruits and vegetables while minimizing added sugars and saturated fats, prioritizing stress management and adequate sleep, quitting smoking, reducing alcohol intake, and aiming for at least 10 min of daily exercise. These lifestyle changes are essential for preventing CVD.

## CONCLUSION

Common risk factors for coronary artery disease (CAD) among the general population include a lack of physical activity, obesity, prediabetes, dyslipidemia, and increased waist circumference. Additionally, higher blood pressure levels were found to be linked to lower levels of physical activity. Many individuals diagnosed with cardiovascular disease (CVD) were observed to be obese based on body mass index (BMI) and waist-to-hip ratio (WHR), smokers, and were prescribed blood pressure and cholesterol-lowering medications.

Hence, it is essential for healthcare professionals to educate the general population about their cardiovascular risk factors and the advantages of adopting a healthy lifestyle. Providing CAD education could serve as a significant strategy in reducing cardiovascular risk. By raising awareness about the impact of modifiable risk factors such as physical inactivity, poor dietary habits, and smoking on heart health, individuals can be empowered to make informed decisions about their lifestyle choices.

Furthermore, education can help individuals understand the importance of regular physical activity, maintaining a healthy weight, managing blood sugar and lipid levels, and avoiding tobacco use. By incorporating preventive measures into their daily lives, such as engaging in regular exercise, following a balanced diet, and undergoing routine health screenings, individuals can significantly reduce their risk of developing CAD and other cardiovascular conditions. Ultimately, CAD education plays a pivotal role in promoting heart health and preventing the onset of cardiovascular disease in the general population.

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