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Review Article

Education Section

Factors Causing Cardiovascular Diseases in Young Adults: A Narrative Review

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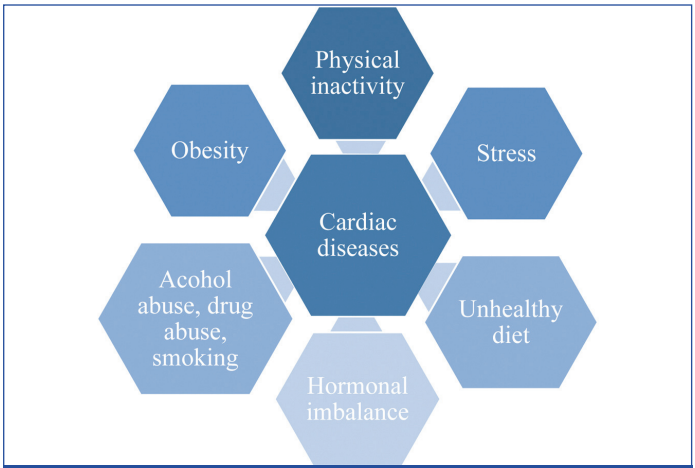
ABSTRACT

Cardiovascular Diseases (CVD) are a major public health problem worldwide. They continue to be one of the leading causes of death worldwide, and it is alarming that these diseases are becoming more common in people of the young age group. Although various risk factors have been proposed, smoking, dyslipidemia, and hypertension are prominent emerging risk factors in the young. The primary pathogenic mechanism for most cardiovascular disorders, such as coronary artery disease, peripheral vascular disease, heart failure, and Myocardial Infarction (MI), is atherosclerosis. Plaque rupture is the most common cause of MI, although distinctive symptoms such as plaque erosion, coronary microvascular dysfunction, spontaneous coronary artery dissection, and drug-related coronary spasm are more common in this age range. Various lifestyle factors, including, but not limited to, physical inactivity, tobacco use, alcohol consumption, poor eating habits, and drug abuse, contribute to the development of comorbid conditions such as hypertension, hypercholesterolemia, obesity, and diabetes, increasing the likelihood of having heart disease. To mitigate the societal impact of CVD and promote a healthier future for the next generation, proactive measures, such as regular physical activity and a balanced diet, are essential. This will be addressed in terms of lifestyle, environmental, physiological, pathological, and psychological aspects.

Keywords: Atherosclerosis, Myocardial infarction, Obesity, Sedentary lifestyle

INTRODUCTION

The CVD are the leading cause of global mortality. While the incidence has declined in older populations, it is on the rise among younger individuals, especially in cases of MI [1]. In India, Coronary Artery Disease (CAD) affects people at a younger age, with over 50% of CVD deaths occurring in individuals under the age of 50 years [2]. [Table/Fig-1] provides an overview of the factors associated with cardiac diseases.



[Table/Fig-1]: Factors associated with development of cardiac diseases [3].

Previous research suggests that external factors such as stress, obesity, sedentary lifestyle, lack of exercise, alcohol abuse, drug abuse, and smoking, as well as hormonal imbalances, can trigger MI [3]. Additionally, underlying or inherited diseases like familial hyperlipidaemia, type 2 diabetes, and hypercholesterolemia impact the cardiovascular system, leading to cardiac diseases [4]. Sex differences also play a role, as heavy physical activities and dietary habits are more frequently associated with MI in men, while emotions and stress are common triggers among females [5]. CVD primarily stems from atherosclerosis, a pathological process underlying the development of conditions like peripheral vascular disease and coronary artery disease, ultimately leading to a MI [6].

The present article provides an overview of various factors contributing to the increased risk of heart attacks in young adults, highlighting the complex interplay of lifestyle, environmental, physiological, pathological, and psychological factors underlying this trend.

DISCUSSION

a. **Obesity and its effects on the cardiovascular system:** Obesity is a medical disorder characterised by the accumulation of excess body fat, often caused by a high calorie intake and a low physical activity. The factors contributing to obesity are outlined in [Table/Fig-2] [7].

Factors	Description
Caloric intake	Excess intake of calories more than daily requirement of body leads to fat accumulation and obesity
Poor diet	Consumption of diet high in sugars, fats, processed or preserved food, and lacking essential nutrients is one of the factor of obesity
Sedentary lifestyle and physical inactivity	A lifestyle comprising of insufficient exercise and movements and prolonged sitting results in low caloric expenditure leading to obesity
Hormonal imbalance	Majority of hormones present in body are calorigenic (increase blood sugar) and any imbalance in their regulation can cause weight gain
Psychological factors	Conditions like stress, anxiety and depression contributes to overeating which results in weight gain or obesity

[Table/Fig-2]: Factors of obesity and their description [7].

Obesity is a significant risk factor for CVD [8]. In urban areas, the Body Mass Index (BMI) tends to be higher (24-25 kg/m^2) compared to rural areas (20 kg/m^2) [9]. Adult BMIs above 21 kg/m^2 are associated with the development of Type 2 Diabetes Mellitus (T2DM), ischaemic heart disease, stroke, and hypertension, primarily due to accelerated atherosclerosis and long-term obesity [9]. Over time, obesity has been shown to negatively affect the anatomy of the heart, as well as the systolic and diastolic functions of the left ventricle, particularly diastolic activities [10].

b. **Physical inactivity and its detrimental effects on the cardiovascular system:** Physical inactivity refers to a lack or

complete absence of exercise and is a significant contributor to decreased life expectancy. Various factors contribute to increased physical inactivity, including individual, societal, and cultural reasons. Modern lifestyle, urbanisation, increased screen time, and lack of motivation or interest in exercise are some of the main factors. Physical inactivity, coupled with a high-calorie diet, especially among young people, contributes to the rise in obesity. It is associated with metabolic disorders such as impaired glucose metabolism, insulin resistance, decreased cardiorespiratory fitness, increased blood pressure, and higher BMI. Additionally, physical inactivity leads to reduced blood flow, which damages vascular function and is associated with the development of CVD [11].

c. **Stress and its effects on the cardiovascular system:** Stress is a normal state of worry or mental tension caused by various situations. There are different types of stress, including acute and chronic stress, both of which can have serious cardiovascular effects [12]. Young adults experience stress due to various reasons, such as family pressure, academic problems, financial burdens, self-doubt, and peer pressure [13]. These factors contribute to stress, increasing the risk of CVD by activating the autonomic nervous system and impacting cardiovascular system functioning. Chronic stress exposure plays a significant role in the development of atherosclerosis and other related chronic health problems. Short-term stressors activate the sympathetic nervous system, resulting in negative effects such as hypertension, increased blood viscosity, and endothelial cell dysfunction [12]. Stress causes the activation of the sympathetic nervous system in individuals, leading to physiological responses such as elevated heart rate, arterial vasodilation, vasoconstriction, and increased cardiac muscle contractility due to the stimulating effect of the sympathetic nervous system on the cardiovascular system [14]. It is important to note that these responses are normal and adaptive mechanisms that help respond to stressors, but prolonged activation of the sympathetic nervous system leads to negative health outcomes. Occasionally, stress can also activate the parasympathetic nervous system, resulting in decreased heart rate, reduced force of contraction, hypotension, reduced impulse, and peripheral vasodilation, which impede proper cardiovascular system functioning [15]. Initially, the effect of stress is usually observed on heart rate [16]. Psychological distress increases the risk factors associated with CVD because individuals experiencing stress are more likely to engage in unhealthy behaviours like smoking, alcohol abuse, drug abuse, and overeating [17].

d. **Unhealthy diet and its effects on the cardiovascular system:** An unhealthy or inadequate diet is a significant risk factor for CVD [18]. Consuming a diet high in processed foods, added sugar, unhealthy fats, and low in fruits, vegetables, fibres, grains, and nuts, combined with a lack of exercise, obesity, alcohol abuse, and smoking, increases the risk of heart disease [18]. Nutrients like vitamins, minerals, Polyunsaturated Fatty Acids (PUFA), and fibres have beneficial effects on the cardiovascular system by reducing inflammation, blood pressure, Low Density Lipoprotein (LDL) levels (bad cholesterol), maintaining body weight, and lowering the risk of thrombosis and myocardial infarction [19]. Consumption of fruits and vegetables helps protect against reactive oxygen species, offering a potential mechanism for preventing CVD [20]. Nuts are rich in tocopherols, phytosterols, phenolic chemicals, fibre, minerals, and high-quality vegetable protein with a healthy fatty acid composition that is high in unsaturated fats and low in saturated fats. They help lower cholesterol, reduce body fat mass and weight, and when included in calorie-restricted diets, aid weight loss and improve insulin sensitivity in obese individuals [21,22]. Consumption of nitrates and their by-products has been associated with endothelial dysfunction, insulin resistance, and atherosclerosis. Additionally, dietary sodium from processed foods can increase blood pressure and peripheral vascular resistance while diminishing arterial compliance [23]. Canned fruit, compared to fresh fruit, may contain additional sugars and Bisphenol A, and the acidity of canned food can dissolve lead solder from food cans, which is a cause for concern [24]. Given the substantial increase in the consumption of unhealthy processed and junk food, a proper diet is crucial in reducing the risk of CVD.

e. **Cholesterol and the cardiovascular system:** Cholesterol and lipid levels directly impact the cardiovascular system, as even modest increases in cholesterol or lipid levels are associated with a higher risk of CVD [25]. Lipids and lipoproteins play a role in regulating the inflammatory process and the function of vascular and cardiac cells, thereby influencing the health of blood vessels and the heart. They also contribute to atherosclerosis, which is the underlying cause of CVD [26]. LDL and other apo-B-containing lipoproteins transport cholesterol from the liver to tissues, significantly increasing the risk of atherosclerosis. On the contrary, High-Density Lipoprotein (HDL) is inversely correlated with CVD, as it transports cholesterol from tissues back to the liver, making it beneficial and referred to as “good” cholesterol [27].

Hyperlipidaemia: It is a condition characterised by higher-than-normal levels of lipids or lipoproteins in the blood. It manifests as an increase in LDL levels, triglyceride levels, total cholesterol levels, accompanied by a decrease in HDL levels [4]. Hyperlipidaemia can be inherited (familial hyperlipidaemia) or acquired. Due to the increased likelihood of plaque formation in blood vessels due to cholesterol and triglyceride deposition, individuals with hyperlipidaemia are at an increased risk of developing CVD.

Hypercholesterolemia: It is a condition characterised by high levels of LDL, which increases the risk of CVD. It can be inherited (familial hypercholesterolemia) or acquired. Lifetime exposure to high levels of LDL caused by familial hypercholesterolemia increases the chance of developing atherosclerotic plaque and early CVD [28].

f. **Hormones and their effects on the cardiovascular system:** Many hormones directly influence organs and tissues, including the heart and cardiovascular system, through specific receptors in the heart or artery wall. Some hormones also function indirectly by stimulating other neuroendocrine processes [29]. Hormones such as urotensin II, endothelin, angiotensin II, catecholamines, aldosterone, antidiuretic hormone, glucocorticosteroids, thyroid hormones, Growth Hormone (GH), and leptin can cause an increase in blood pressure. On the other hand, natriuretic peptides, Calcitonin Gene-Related Peptides (CGRP), angiotensin 1-7, substance P, neurokinin A, ghrelin, Parathyroid Hormone-Related Protein (PTHrP), oxytocin, and sex hormones can lower blood pressure [29]. Excess levels of hormones like leptin, PTHrP, endothelin, thyroid hormones, glucocorticoids, catecholamines, and endothelins can increase heart rate, while hormones like natriuretic peptides, substance P, neurokinin A, oxytocin, and angiotensins 1-7 can decrease heart rate [29].

Oestrogen: Oestrogen plays a role in regulating the cardiovascular system. It improves lipid profiles by significantly increasing HDL levels and lowering LDL levels, which is beneficial for the heart and blood vessels. Oestrogen also promotes vasodilation, angiogenesis, and reduces oxidative stress and fibrosis, exerting its cardioprotective function. Postmenopausal women, who have lower oestrogen levels, have a higher prevalence of CVD [30].

Testosterone: Testosterone affects the cardiovascular system in various ways. Male testosterone levels start to decline around the age of 40, which is associated with a higher risk of CVD in men [31].

Studies suggest that raising serum testosterone levels can reduce the risk of myocardial ischaemia and cardiac mortality in men. Testosterone increases coronary blood flow, coronary vasomotion, and exercise capacity in heart failure [31-33]. Testosterone binds to cytoplasmic Androgen Receptors (AR), which are chaperoned by heat shock proteins. The testosterone-AR complex migrates to the nucleus, where it dimerises with another complex, binds to coactivator proteins, and transactivates a family of genes with androgen response elements, altering the behaviour of myocardial and vascular cells [31].

Thyroid hormones: Changes in thyroid hormone levels can increase the risk of MI and other cardiac diseases [34]. Thyroid dysfunction can cause cardiovascular abnormalities [35]. Thyroid hormones have both cardiac chronotropic (effect on heart rate) and inotropic (effect on force of contraction) effects. In the normal range, these effects are beneficial, but they can also have negative effects on the cardiovascular system [34]. Thyroid hormone reduces peripheral vascular resistance and increases cardiac output by lowering diastolic blood pressure through low systemic vascular resistance. Thyroid hormone also plays a role in controlling HDL and LDL levels. Individuals with hypothyroidism have elevated levels of LDL, Very Low Density Lipoprotein (VLDL), HDL, apolipoprotein B-71 (Apo B71), and lipoprotein(a), which contribute to the development of atherosclerosis [34]. Other effects of thyroid hormone include cardiac hypertrophy, increased cardiac output, greater cardiac effort, and increased cardiac contractility. Thyroid hormone has direct effects on cardiac myocytes, as well as indirect effects on haemodynamic parameters and peripheral oxygen consumption [36].

Growth Hormone (GH): GH is primarily responsible for regulating somatic development, but it also helps maintain muscle mass and strength, regulate body composition, and manage food metabolism [37]. There is evidence linking GH and/or its regional effector Insulin-Like Growth Factor I (IGF-I) to the processes involved in controlling heart development and hypertrophy [38]. GH directly influences heart composition and operations, and changes in GH levels have been shown to impact vascular stiffness and peripheral systemic resistance [39]. Patients with Growth Hormone Deficiency (GHD) have thinner left ventricular posterior walls, lower left ventricular mass indices, impaired cardiac contractility, and a higher likelihood of developing hypertension, which can lead to heart enlargement and congestive heart failure [40]. Individuals with GHD also have low HDL levels and high LDL and total cholesterol levels [41]. Conversely, patients with early-stage acromegaly, who have chronically high GH levels, are more likely to experience an increase in cardiac index and cardiac output, a decrease in vascular resistance, and elevated blood glucose levels [42].

g. **Smoking and the cardiovascular system:** Smoking is one of the main risk factors for CVD and a leading preventable cause of cardiac mortality [43]. Since smoking has been more popularised in young generation, the prevalence of cardiovascular problems in this age range has increased [9,44]. The composition of cigarettes includes harmful substances such as nicotine, hydrogen cyanide, formaldehyde, lead, arsenic, ammonia, radioactive elements, and benzene. Nicotine has adrenergic effects on the cardiovascular system, resulting in increased heart rate, reduced insulin sensitivity, increased inotropic status, and endothelial dysfunction [45]. Smoking can compromise oxygen delivery to tissues due to increased carboxyhaemoglobin levels, increasing the risk of tissue necrosis [46].

g. **Alcohol and the cardiovascular system:** Alcohol intake is associated with a higher risk of developing CVDs, such as coronary artery disease, leading to heart failure and cardiac mortality [47]. Moderate alcohol consumption can benefit the cardiovascular system by increasing HDL, reducing LDL oxidation, improving insulin sensitivity, having antioxidant effects, and reducing fibrinogen [47]. However, alcohol abuse is associated with the development of cardiac arrhythmias, atrial fibrillation, toxic effects on cardiac monocytes, and an increased risk of stroke [48]. Alcohol addiction has been observed in young people, further increasing the risk of cardiac death.

i. **Drug abuse and the cardiovascular system:** Drug abuse has increased in recent years among young people, whether as a result of peer pressure, a desire to try new things or as a means of escaping reality and pressures. As a result, the risk of CVD has increased [49,50]. Drug abuse is the most common preventable cause of CVD. Cannabis, opioids (such as heroin and morphine), cocaine, charas, ganja, etc., are the most exploited drugs in India [51].

Cannabinoids: The activation of Cannabinoid Receptor type 1 (CB1R) in humans promotes endothelial dysfunction, which is a crucial factor in the development of atherosclerosis and cardiac diseases [52]. CB1R activation triggers pathways that prevent normal vasodilation in endothelial cells [53].

Cocaine: Cocaine has a well known ability to cause vasoconstriction of the coronary arteries. Coronary arteries tend to have more spasms in cocaine users, furthermore, cocaine reduces blood flow, which reduces oxygen supply and increases oxygen demand in the myocardium [54]. Cocaine is an adrenergic agonist because it prevents norepinephrine from being reabsorbed and releases epinephrine from the adrenal glands, it also inhibits sodium channels, reducing the resting membrane potential and the amplitude of the action potential while increasing the duration of the action potential [55].

CONCLUSION(S)

A sedentary lifestyle, unhealthy diets, stress, smoking, alcohol and drug abuse, as well as inherited or acquired disorders like hyperlipidaemia, are the main risk factors contributing to the alarming rise in CVDs among young people. To prevent this increasing trend, it is recommended to maintain a balanced diet and engage in regular exercise. It is important to avoid smoking, alcohol, and drug abuse. Additionally, maintaining a healthy weight and managing stress are crucial. Early detection and control of risk factors such as hypertension, high cholesterol, hormone deficiencies, and diabetes are critical in preventing the progression of CVD.

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