

Observational Study

Poor Diet Leading to the Increasing Risk of Atherosclerosis in the World

Bijaya Bhusal*

Department of Cardiology, Shankhamul, New Baneshwor, Kathmandu, Nepal

Abstract

Atherosclerosis Ischemic Cardiovascular Disease (ASICD), one of the leading causes of global deaths, is mainly caused due to the development of plaque on the inner walls of arteries of the human heart. Ischemia refers to the lack of enough oxygen (O₂), nutrient delivery, and improper waste removal in the cardiac cells. About 90% of cardiovascular diseases in the present world are due to the formation of lipid/cholesterol-based plaques that can form under the lining of the smooth epithelial blood cells. In the US, a study published in the Journal of the American College of Cardiology estimated that poor diet is responsible for about 45% of Cardiovascular Disease. Atherosclerosis doesn't cause much effect until and unless the plaque becomes unstable due to the accumulation of thrombus that shows Acute Coronary Syndrome. Acute Coronary Syndrome is the result of blockage of blood vessels leading to Myocardial Infarction (Unstable Angina Pectoris). Cardiac Cells require a sufficient amount of Oxygen to function properly. Thus, the demand and supply of oxygen to the cardiac cells should be properly balanced. Atherosclerosis Ischemic Cardiovascular syndrome can worsen if the person is more involved in exercise or emotional stress because at that time their body requires higher oxygen but blood flow gets disrupted due to the formation of plaque. Later in the paper, we will discuss the New York Heart Association classification, followed by the top 3 poor diets that are considered to be increasing the cases of cardiovascular disease around the world.

Introduction

Ischemia is the condition of lack of blood flow in the blood vessels of the human heart.

The blood carries oxygen, nutrients, minerals, blood cells (Erythrocytes, leukocytes, Thrombocytes), water & some toxic chemicals like Urea, Uric acid & Ammonia. Our heart muscle continuously pumps blood to its parts through different arteries of the heart. The Left descending artery feeds third fourth of the interventricular septum and most anterior wall of the left ventricle, the Left circumflex feeds the lateral wall of the left ventricle, the Right coronary artery (RCA) feeds all the right ventricular wall and one-third of the posterior wall of the septum likewise Posterior descending artery along with RCA feeds the back bottom part of the inferior wall of the human heart. While functioning, if our body has a high cholesterol level, then that unsaturated fat gets accumulated in the inner wall of epithelial smooth muscle cells in the form of plaque. The plaque acts as a blockage for the supply of blood or narrows the size of arteries supplying blood to the heart muscles. Atherosclerosis is one of the world's leading causes of Ischemic [1].

Cardiovascular disease is due to the formation of plaque in the blood vessels. Proteoglycans, or other matrixes that trap lipids in the intima and cause modifications, are primarily responsible for the continuous process of arterial wall

More Information

*Address for correspondence: Bijaya Bhusal, Department of Cardiology, Shankhamul, New Baneshwor, Kathmandu, Nepal, Email: bijayabhushal08@gmail.com; kushumbhusal75@gmail.com

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lesions that lead to atherosclerosis. This process aggravates chronic inflammation at vulnerable sites in the arteries and is crucial to the development of atherogenic progression at all stages. This process starts with developing fatty streaks in the artery intima, which progress into fibrous plaques and ultimately become intricate, rupture-prone atherosclerotic lesions. Additionally, stenosis brought on by the atheroma's inward enlargement may obstruct blood arteries like the coronaries. However, vigorous collateral circulation can lessen the severity of the disease's symptoms. Atherosclerosis is mainly of two types according to the amount of effects it has on the heart. The one type is stable plaque. Stable plaques mainly occur due to an imbalance of demand and supply of oxygen and nutrients to the cardiac cells. For instance, Doing Cardio exercises, running fast, Climbing hills, and Emotional stress when your heart rate and oxygen demands increase. Since it is stable it does not cause much harm to your health. However, if you trigger your cardiac cells by increasing the oxygen demands of cells then it can cause Angina Pectoris. Furthermore, another type of atherosclerosis is the Unstable Plaque: During this phase, the accumulation of fat gets covered by the thrombus and gives rise to the Acute Coronary Syndrome that leads to the Myocardial Infarction. According to the New York Heart Association, functional classification of angina is divided into four different classes. Class I says, "Patients with cardiac disease but without resulting limitations of physical activity. Ordinary physical activity does not cause



undue fatigue, palpitation, dyspnea, or anginal pain [2].”, Case II: Patients with cardiac disease resulting in slight limitation of physical activity. They are comfortable at rest. Ordinary physical activity results in fatigue, palpitation, dyspnea, or anginal pain. Case III: Patients with cardiac disease resulting in marked limitation of physical activity. They are comfortable at rest. Less-than-ordinary physical activity causes fatigue, palpitation, dyspnea, or anginal pain. Similarly, last case IV: Patients with cardiac disease resulting in an inability to carry on any physical activity without discomfort. Symptoms of cardiac insufficiency or anginal syndrome may be present even at rest. If any physical activity is undertaken, discomfort is increased. (The Criteria Committee of the New York Heart Association. Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels, 9th ed, Little, Brown & Co, Boston 1994. p.253.) while analyzing the statistical data of the past few years, it is found that about 11 million people die annually due to poor diet causing atherosclerosis in the world.

So, what are Poor Diets?

Poor Diets are the group of foods that are highly processed, Sugary sodas, salty spicy diets, Low fibers, low-quality vegetables & fruits, etc which degrade the health status of the people. While healthy diets are rich in good-quality foods. For instance: Eggs, unsalted nuts, Chia seed, tahini seed, coconut oil, palm oil, medium baked sweet potato (650 mg), Broccoli (450 mg), Banana (420 mg), Cantaloupe(430 mg), winter squash(890), 2 apples a day, Berries, 100% whole grain bread, etc.

In the name of cravings, people are consuming oily processed foods, sugary sodas, ice cream, and High-calorie sweets, these foods are causing problems like cavities, high fructose corn syrup disrupting the function of internal organs, clogging the blood vessels, raising the level of glycogen in the body leading to the risky condition of the human body.

Present scenario of malnutrition in the world

Malnutrition is the condition of lack of enough nutrition that is required for the overall growth of our body. It has become a global authority to create sustainable and resilient healthy habit diets. Acknowledging the current status of Malnutrition, we found about 149 million children under 5 years of age were estimated to be suffering from stunting, 45 million were recorded to be living with thinness and 37 million were living with obesity. Analyzing the information has become a crucial issue that needs to be addressed with proper planning.

Recommendations

According to the World Health Organization, Here is the list of top 3 healthy diet plans to reduce the risk of CVD in the present world.

- **Adopt a healthy diet:** A healthy diet here refers to the consumption of vegetables, legumes, beans & fruits. There are lots of green, and yellow veggies that act as antioxidants and enrich our body with vitamins & minerals. We can get Fat-soluble vitamins A, D, E & K, minerals like magnesium, phosphorus, zinc, and folic acid from leafy green vegetables, citrus gooseberries, fortified cereals, eggs, dairy products, brown rice, pumpkin seeds, nuts, carrots, brussels sprouts, fermented foods. Chickpea flour, haricot beans, snow beans, etc. They benefit us in various ways. For instance, Folic acid helps to lower homocysteine levels in the blood, and maintain healthy blood circulation: Magnesium is the main component to maintain a regular heart rhythm by reducing arrhythmias, it reduces vascular resistance for blood flow. Our body requires Calcium and Magnesium to maintain heart rhythm which can be balanced by phosphorus. Moreover, it helps in the production of Adenosine Triphosphate (ATP) in cells. It is also linked to vascular calcification and arterial stiffness. Vitamins like E and K act as a mild- Coagulant reducing the risk of blood clots in arteries by activating a protein called Matrix GlaProtein (MGP). MGP through a process called carboxylation helps to bind with calcium ions that prevent them from depositing in the walls of arteries and blocking the blood vessels [3-5].
- **Limit sugar consumption:** About 32.2% of people around the world are affected by CVDs due to Type II diabetes Mellitus (T2DM). Consumption of high sugar daily can cause insulin resistance in your blood and that can lead to high glucose levels in your body. If your body can't utilize that excess sugar for ATP, it is converted as glycogen and stored as fat causing blockage in blood vessels and developing angina pectoris. Reducing the consumption of ingredients like high fructose corn syrup, sucrose, glucose, caffeine, etc can reduce your risk of CVDs. If your body craves sweets, you can stevia, homemade fruit juice, and grains having high fiber that helps to stabilize blood glucose levels in your body.
- **Reduce salt intake:** Salt is the composition of Sodium and Calcium. These elements improve the function of nerves, and muscles and keep the body fluid level in proper balance. Too much sodium level can cause fluid retention. According to the Sodium intake recommended by WHO, about 14.6% of total CVD deaths (95% UI: 5005- 5998) cases are due to high sodium consumption. Furthermore, hormones like Aldosterone and Anti-diuretic hormone (ADH) are also influenced by sodium intake. Aldosterone signals the kidneys to retain Sodium and H₂O, while ADH helps the kidneys to retain water. Thus, high NaCl intake disrupts their function. DR. Luke J. Laffine, a physician in the

preventive cardiology and Rehabilitation section says, “Almost everyone with high blood pressure should aim to keep Sodium intake below 2300 milligrams per day which is equal to about 1 teaspoon of salt.” to maintain your body health [6-9].

Statistics

Globally, Atherosclerosis is one of the leading causes of mortality and morbidity in 146 countries for men and 98 countries for women. The major factors aiding this cause are people’s lifestyle, diet, alcohol consumption, genetics, environmental factors, and certain physical factors. According to the data mentioned in World Heart Report 2023, about 620 million people are becoming victims of cardiovascular disease and 1 in 3 people are affected by it (Figure 1).

Here is the bar graph showing global deaths due to CVDs from 1990 to 2021, broken down by gender (Figure 2). From 1990 to 2021, global deaths due to cardiovascular disease (CVD) increased significantly. In 1990, there were 12.1 million deaths, with 6.3 million females and 5.8 million males. By 2000, deaths rose to 14 million, with female deaths increasing to 7.5 million and male deaths to 6.5 million. In 2010, the total reached 16.4 million, with 8.7 million females and 7.7 million males. The trend continued upward in 2018, with 18.6 million deaths, including 9.56 million females and 9.04 million males. By 2021, total deaths had climbed to 20.5 million, with 10.45 million females and 10.05 million males. This data reflects a steady rise in CVD-related mortality over the decade.

Talking about most causes of people suffering from CADs in the year 2021.

Here we can see that physical inactivity is the leading cause, accounting for 35% of cases, followed by poor diet at 30%. Tobacco use and harmful alcohol consumption contribute 10% and 5%, respectively, while other causes make up the remaining 20 % (Figure 3).

Splitting the 30% of causes into micro division, we can get lots of morbidity and mortality caused due to unhealthy dietary

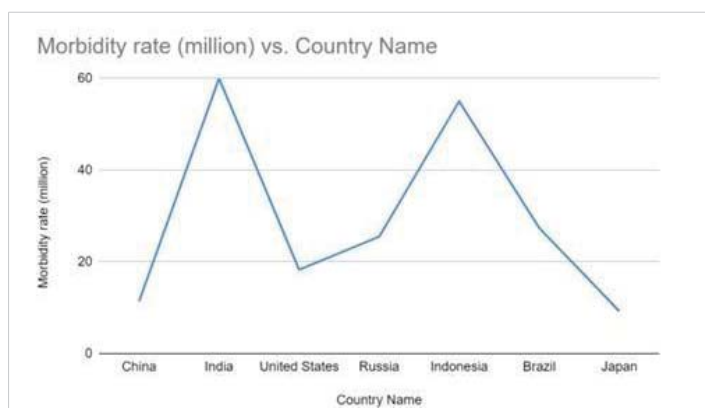


Figure 1: Global data of Atherosclerosis highlighting the data of the top 7 countries according to their population. Source: Global burden of cardiovascular disease and risk collaboration (2022).

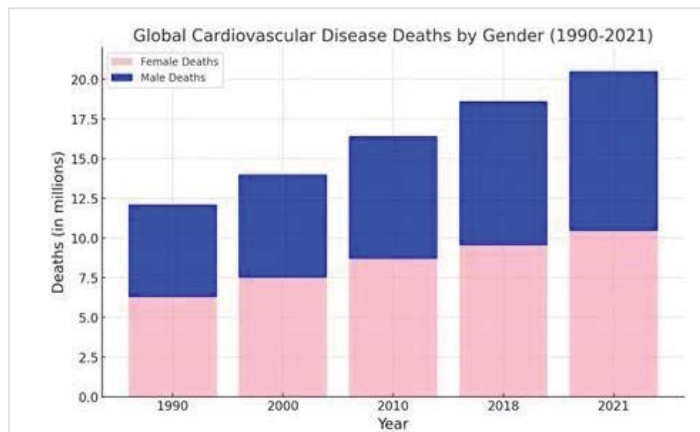


Figure 2: Here is the bar graph showing global cardiovascular disease deaths by gender from the year 1990 to 2021. Source: World Heart Report (2023/2024).

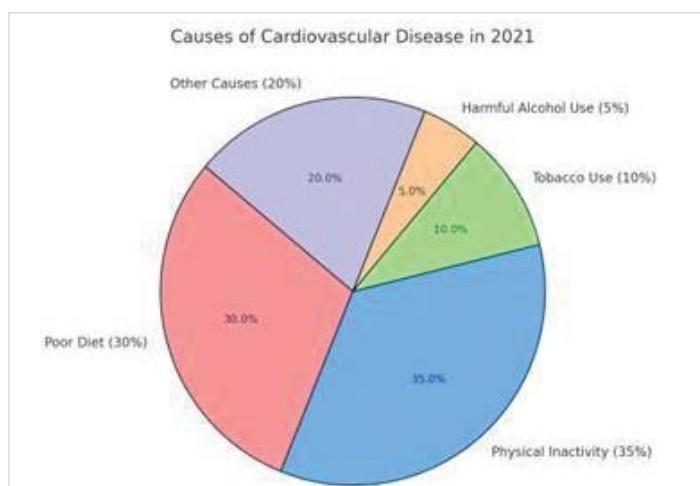


Figure 3: Causes of CV diseases according to WHO.

practices. Among them, refined grains and added sugars, salt, unhealthy fats, low-quality fruits, veggies animal-source foods, and so on are the foods that serve as a low-quality food item. About 32.2% of the people globally are affected by CVDs due to high sugar consumption similarly 14.6 % mortality rate due to CVDs is because of high NaCl consumption.

Beyond the borders, the rate of morbidity from cardiovascular disease in 2021 will be 11.39 million people are affected in China. India has 60 million people. 18.3 million Americans live in Russia, which has 25.5 million inhabitants. Indonesia is home to 55 million people. 9.25 million people live in Japan, and 27.4 million people live in Brazil.

Here is the graphical representation of the above data:

Now, what’s to do? How to identify whether you are affected by Atherosclerosis or not?

Exercise stress test: It is usually done by exercise tolerance test (treadmill protocol) along with Electrocardiogram (ECG) and Combined imaging test; Single Photon Emission Computed Tomography (SPECT), and Positron emission tomography (PET).



Nuclear and echocardiographic imaging: It can address the location of Ischemia in the heart. The most commonly used Pharmacological stress agents for SPECT and PET are the vasodilators dipyridamole, adenosine, regadenoson, and Dobutamine. Dobutamine is a positive inotropic agent that increases the force or energy of muscular contraction and increases the heart rate and blood pressure through the coronary artery. All these agents create differences in blood flow between coronary arteries that have high-grade blockages and normal arteries which result in perfusion defects that can be detected using radioactive imaging.

Cardiac CT scan: This test can determine if you have a build-up of Calcium in your coronary arteries- a sign of coronary atherosclerosis. Similarly, Coronary CT angiography is another imaging technique during which an iodinated contrast dye using an Arterial Catheter is injected through a peripheral vein and images of the coronary arteries are taken using a CT faster. To detect large vessel occlusion, we can take the help of Computed tomography angiography (CTA).

Treatment

Dr. Ahmed Hasan (Cardiovascular Science at the National Heart, lungs, and blood institute) said, "The discovery of cancer-like features in the patient of atherosclerosis, has opened up a whole new dimension for our understanding about therapeutic strategies for the prevention and treatment of atherosclerosis." The National Institute of Health (NIH) has paved the way for the use of anti-cancer drugs to counteract the tumor-like mechanisms driving the buildup of plaque in the arteries. Doctors used different pharmacological drugs like statin (Ezetimibe, PCSK9 inhibitor) for dyslipidemia Management.

Ezetimibe: It is an inhibitor of the Nieman n-pick C1- like 1 (NPC1L1) transporter which is used to control the absorption of Cholesterol in the small intestine. Inhibition of NPC1L1 transports impedes the reabsorption in the Small intestine which leads to overall increased excretion of cholesterol from the body.

Aspirin: It is an antiplatelet drug that prevents your blood cells from clumping together, thereby stopping clots from forming. This reduces the risk of blockage. It is prescribed to be consumed daily and also used after a procedure called stent Placement.

Calcium channel blocker: It helps to lower arterial pressure by widening blood vessels. It helps to suppress the accumulation of intracellular lipids, decrease atherogenic plasma lipoproteins, and suppress atherogenic platelet dysfunction.

Angiotensin-converting enzyme (ACE) inhibitors: It works by inhibiting the mechanism that the body normally uses to maintain blood pressure. Angiotensin I is an enzyme in your bloodstream. Angiotensin Converting Enzyme (ACE) converts angiotensin II to Angiotensin. Since Angiotensin II

helps to increase blood pressure thus, ACE generally helps to reduce the amount of Angiotensin II, a potent Vasoconstrictor in your blood. During the experiment with the Mice, Long-term supplementation with high-dose nitrate resulted in approx. 50% reduction in plaque lesion area.

During this experiment, it was found that Collagen suppression and smooth muscle accumulation were increased and lipid deposition and macrophage accumulation were reduced within the atherosclerotic plaque of Mice. Furthermore, Advances in revascularization include the development of drug-eluting stents and the introduction of percutaneous support devices in patients undergoing PCI. As approved by the Food and Drug Administration, Renolazine is one of the drugs that acts by reducing intracellular calcium overload ischemic myocytes by inhibiting late inward sodium current entry.

Overall, there will be a reduction in left ventricular wall tension and myocardial oxygen demand. Thereby, reducing angina and Ischemic.

Methodology

The data presented here were mostly taken from secondary sources like records of CVDs from World Heart Center 2023, 2024, etc. Through an informal interview with Dr. Samir Yadav and Utsav Bhusal who are currently involved in the cardiovascular department in the teaching hospital, we got to know about the basic knowledge of Atherosclerosis and drugs given to treat clogging of arteries in the human heart in Nepal.

Secondary sources: The international data mentioned here were taken from a report of Cardiovascular data from World Heart Center 2023 and 2024, World Heart Day 2023, Global Burden of Cardiovascular Disease and Risks, National Library of Heart Science, and Soon. I also reviewed the research paper done by Dr. Hasan Ahmad, Cardiovascular Science at the National Heart, lungs, and Blood Institute. Where the report of recommended dietary allowance (RDA) for salt was taken. Moving forward, the RDA data for the different vegetables and fruits that need to be consumed by people with CVD were taken from a combined analysis of the report presented by the School of Public Health under Harvard University and Kris Gunnars, BSc from the University of Iceland. Lastly, a review of research data by Okhlama Children Hospital, the Department of Public Health of Deakin University, and Papers on the World Health Organization (WHO) website also played a key role in briefly understanding the concept of Atherosclerosis globally. Thus, through the review of most papers and reports, I compiled the report presented in this paper [10-15].

Discussion

Author's perspective

The rising issue of atherosclerosis in Nepal has given birth to an idea to go deep on this topic. Ideology of the arterial

plaque mostly prevails because of poor health habits of the people. If the saying “Prevention is better than cure” is properly implemented in life then half of the people wouldn’t have been the victim of Atherosclerosis. Through the analysis of data, we can see how degrading health habits are of the people residing in China and India. The increasing traits of CVDs from the last decades give us foresight that by the year 2030, about 23.6 million people could sacrifice their lives due to CVDs. The main theme of publishing this research journal is to spread awareness among people about CVDs, their ascending negative impacts & how people can decline them through the application of good healthy habits mentioned here. While addressing the perspective of different people, I found a reason that Atherosclerosis is mostly caused due to smoking cigarettes, partially true alcohol consumption. They were oblivious to the effects of Malnutrition and low-quality dietary consumption which is one of the leading causes of death in the world.

Limitations of this review

Since the data was taken from different websites so while noting data I found a slightly different record of data in every website. Thus, the statistics mentioned here are taken as an average value after analyzing the data from different websites. Similarly, here we can see that India is at a rising peak of atherosclerosis patients when the data was according to the population. So, while talking about percentages we can find China is the leading country with maximum CVD deaths while India is in terms of population. Additionally, the paper’s theme was to emphasize more on the poor diet that can cause Atherosclerosis. However, because of an unclear report, I wasn’t able to find the exact number of people suffering from Atherosclerosis due to unhealthy dietary consumption.

Future directions

The WHO is currently working on these key agendas to reduce the risk of CVDs shortly:

- Establishing successful inter-country, interregional, and global partnerships and networks to promote synchronized global action
- Global initiatives to improve nations’ ability to address the health care requirements associated with CVD
- Creating workable surveillance techniques to track preventative and control programs and evaluate the patterns and trends of the main CVDs and risk variables.

Even though the WHO is working to decrease the death rate by CVDs, by the end of 2030, it is estimated to be 23.6 million deaths if the proper action is not taken by the health ministry of different countries. We can also expand the field of research by differentiating the different age ratios of people affected by CVDs. Research regarding the cure and treatment of Atherosclerosis is still going on by people. We can expect improvement in the field of cardiovascular disease shortly.

Conclusion

In closing, here are the several points to conclude the title:

- ❖ Atherosclerosis is one of the leading causes of death in the world; more specifically in China.
- ❖ About more than half a billion of the population from the world are getting affected by it.
- ❖ According to the WHO, Physical inactivity (35%) and Poor diet (30%) are the main factors causing Atherosclerosis.
- ❖ Slicing the poor diet, more sugar consumption, low-quality vegetables and fruits & high Sodium consumption are the three main reasons behind causing this disease.
- ❖ Nuclear and echocardiographic imaging is the most effective method to detect Atherosclerosis.
- ❖ The pharmacological drugs mainly Statin such as Ezetimibe, and PCSK9 inhibitors are used to reduce the risk of Atherosclerosis.

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