Acute myocardial infarction (AMI) remains a leading cause of morbidity and mortality worldwide. It occurs when myocardial ischemia, a diminished blood supply to the heart, exceeds a critical threshold and overwhelms myocardial cellular repair mechanisms designed to maintain normal operating function and homeostasis. This review highlights risk factors that are responsible for the onset of AMI. Among the most important are physical inactivity, smoking, alcohol consumption, dyslipidemia, diabetes mellitus, hypertension, and obesity. Hence, management of these risk factors is important in order to prevent the development of AMI, and should also be taken into consideration during the treatment of AMI.

**Keywords:** Acute myocardial infarction, dyslipidemia, risk factors

The incidence of myocardial infarction in the world varies greatly. In the United States and United Kingdom, nearly 650,000 and 180,000 patients get an acute myocardial infarction every year, respectively. Worldwide, more than 3 million people have STEMI and 4 million have NSTEMI. Indians are four time more prone to AMI as compared to the people of other countries due to a combination of the genetic and lifestyle factors that promote metabolic dysfunction. The incidence of myocardial infarction in India is 64.37/1000 people. The mortality rate of myocardial infarction is approximately 30% and for every 1 in 25 patients who survive the initial hospitalization, dies in the first year after AMI. In India, 31.7% of deaths occur due to myocardial infarction. Incidence of cardiovascular diseases was about 7% in 1970 and increased up to 32% in 2011 in India.
Risk Factors

There are various risk factors of AMI. Among them, some are modifiable (treatable) and others are non-modifiable (can not be changed). The major risk factors of AMI are described hereunder;

Physical activity:

Inactive people with multiple cardiac risk factors are more likely to develop AMI.[14] Physical activity may contribute up to 20%-30% reduced risk of coronary heart disease.[15, 16] However, studies have shown that different types of physical activities may have different effects on the risk of cardiovascular disease (CVD) and may interact together. For example, some leisure time activities such as walking, stair climbing, and cycling provide protection against CVD[17-22] whereas others, such as intensive domestic physical activity, may not offer protection against CVD.[21] There are also interactive effects between lack of exercise and sitting at work and between demanding household work and sitting at work on the association with increased risk of acute myocardial infarction (AMI).[19] D’Avanzo et al., examined the relationship between physical activity and acute myocardial infarction (AMI) and confirm that low physical activity is an indicator of subsequent risk of AMI.[22] Similarly, Gong et al., suggested that a light indoor activity pattern is associated with reduced AMI risk.[20]

Smoking:

Smoking is considered to be strong risk factor of myocardial infarction, premature atherosclerosis and sudden cardiac death. Smoking results in early STEMI especially in otherwise healthier patients.[24, 25] Cigarette smoking increases the risk for AMI by multiple and complex mechanisms.[26] With respect to atherogenesis, smoking increases serum LDL-cholesterol and triglyceride concentrations and reduces serum HDL-cholesterol. Furthermore, cigarette smoke promotes free radical damage to LDL, leading to accumulation of oxidized LDL-cholesterol within the arterial wall. Smoking appears to contribute vascular inflammation characteristic of atherosclerosis, as reflected by higher serum C-reactive protein levels in smokers than in non-smokers.[27] Smoking, mainly through its nicotine content, activates the sympathetic nervous system (SNS), increasing both heart rate and systolic blood pressure. This increase in the rate-pressure product results in increased myocardial oxygen demands. Increased in activity of SNS also leads to coronary arterial vasoconstriction,[28] decreasing myocardial blood flow at a time when oxygen demand is increasing. In addition to increasing myocardial oxygen demand and reducing coronary blood flow, cigarette smoking also causes increase in the levels of carboxyhemoglobin in the blood, with the potential to further reduce myocardial oxygen delivery from oxyhemoglobin.[26]

Alcohol Consumption:

Alcohol consumption is associated with an acutely higher risk of myocardial infarction in the subsequent hour among people who do not typically drink alcohol daily. There is consistent evidence that moderate habitual alcohol consumption is associated with a lower risk of cardiovascular events in subsequent months and years[29] and that heavy episodic (binge) drinking is associated with higher cardiovascular risk.[30]

As reviewed by McKee and Britton[31] and further sources,[32, 33] a number of possible mechanisms have been discussed explaining the acute effects of binge drinking on CHD events. These include: (i) Binge drinking has been shown to increase low-density lipoproteins, which in turn are linked to cardiovascular morbidity and mortality. However, low to moderate steady drinking, heavy irregular drinking has not been associated with increased levels of high-density lipoproteins, which are linked to favorable cardiovascular outcomes. (ii) Binge drinking has been associated with an increased risk of thrombosis, occurring after cessation of a heavy drinking episode. (iii) Binge drinking appears to predispose drinkers to histological changes in the myocardium and conducting system, as well as to a reduction in the threshold for ventricular fibrillation.[34] However, there is a controversy regarding consumption of alcohol and risk of AMI. Most researches showed that alcohol consumption can increase high density lipoprotein cholesterol (HDL-C), apolipoprotein-a1 and adiponectin and reduce fibrinogen level, in which the HDL-C was the main protective factor which could explain about 50% of the causal relationship.[35-38] But, some researchers believed that the value of HDL-C was low, which could only explain about 16% of the causal relationship.[39, 40] Besides, some researchers found that alcohol consumption could increase the prostacyclin of blood vessel wall, improve functions of vascular endothelial cells, increase insulin sensitivity and resist thrombosis.[41, 42] Moreover, long-term regular alcohol consumption could improve heart rate variability[43, 44] and thus reduce MI onset risks. Most researches showed that alcohol consumption could increase LDH-C, triglyceride, heart rate, blood pressure[45-47] and thus increase the risks of atherosclerosis, atrial fibrillation and anoxia, resulting in damaging cardiac muscle cells and cardiovascular system and producing fibrinolytic enzyme inhibitor.[48] Saremi et al.,[49] stated that moderate alcohol consumption is not associated with any significant morbidity; however,
three or more drinks per day is associated with hypertriglyceridemia, cardiomyopathy, hypertension, and stroke.

**Dyslipidemia:**

Dyslipidemia, a major risk factor of cardiovascular disease, is generally defined as the total cholesterol, LDL, triglycerides, apo B or Lp (a) levels above the 90th percentile or HDL and apo A levels below the 10th percentile of the general population. Increased triglyceride levels and dense, small LDL particles act as predisposing risk factors for myocardial infarction. Non-fasting triglyceride level appears to be a strong and independent predictor of future risk of AMI, particularly when the total cholesterol level is also increased. The reason behind it is that decreased HDL-C levels and increased triglyceride levels cause metabolic perturbations and thus causing adverse consequences. Ali et al., concluded that there is a high frequency of dyslipidemia in young patients presenting with acute myocardial infarction, with descending order hypertriglyceridemia followed by hypercholesterolemia, raised LDL and low HDL. The prospective studies such as those of Framingham study established the relationship of dyslipidemia and coronary artery disease. High levels of total cholesterol, LDL and low level of HDL are major risk factors for coronary atherosclerosis. Correction of dyslipidemia can reduce the risk of myocardial infarction.

**Diabetes Mellitus:**

Type 2 diabetes mellitus is on the verge of becoming a pandemic in India. It is a chronic condition that occurs when the body can not produce enough or effectively use of insulin, and are induced by a genetic predisposition coupled with environmental factors. As type 2 diabetes shares several risk factors in common with coronary artery disease (CAD), such as age, hypertension, dyslipidemia, obesity, physical inactivity and stress, an increase in the prevalence of diabetes indirectly implicates an escalating risk of CAD as well. Diabetes mellitus is a well-established risk factor for cardiovascular disease (CVD). People with type 2 diabetes mellitus have a higher cardiovascular morbidity and mortality and are disproportionately affected by CVD compared with non-diabetic subjects. Diabetes increases risk of coronary heart disease (CHD) by two to four times. Patients with diabetes bear greater risk of atherosclerotic vascular disease in the heart as well as in other vascularized areas.

The life expectancy of people with diabetes is reduced by nearly eight years due to increased mortality. Coronary artery disease accounts for more than 80% of all deaths and 75% of all hospitalizations in diabetic subjects. It is also reported that plaques are more vulnerable to rupture among patients with diabetes. The protective female gender effect is lost in diabetic subjects, and indeed, women with diabetes are possibly more prone to develop CAD than men with diabetes.

Diabetes increases the risk of myocardial infarction because it increases the rate of atherosclerotic progression and adversely affects the lipid profile and facilitates formation of atherosclerotic plaque. In a hospital based case control study, conducted in a rural population of India, cases of AMI were twice as likely to have history of diabetes compared to controls. Bibbins et al., says that diabetes mellitus is the biggest individual risk factor of heart disease. Diabetes is also a risk factor for myocardial infarction case fatality: that is, myocardial infarction is more often fatal in people with diabetes compared with myocardial infarction in those without diabetes.

**Hypertension:**

Both systolic and diastolic hypertension increase the risk of a myocardial infarction and the higher the pressure, the greater the risk. It is major risk factor of causing atherosclerosis in coronary blood vessels, result in heart attack or myocardial infarction. Hypertension and myocardial infarction are closely linked. In old age, hypertension is even worse to heart and responsible for at least 70 percent of heart disease. Several mechanisms can account for the increased coronary risk in hypertensive patients. Hypertension accelerates the effects on atheroma, increases shear stress on plaques, exerts adverse functional effects on the coronary circulation, and impairs endothelial function and control of sympathetic tone. Ciruzzi et al., reported that in Argentine population, hypertension is a strong and independent risk factor for acute myocardial infarction. The control of hypertension with strict compliance of proper medication and adoption of lifestyle modifications reduce the risk of myocardial infarction significantly.

**Obesity/BMI:**

Increased BMI is directly related to incidence of myocardial infarction. Infarction is greatly enhanced by extreme obesity because it is a recognized risk factor for myocardial infarction. Zhu et al., performed the meta-analysis of previous studies and suggested that overweight and obesity are associated with higher risk of AMI. Overweight and obesity may affect health, and it is necessary to control one's BMI to prevent AMI. Schargrodsky et al., demonstrated that overweight is an independent risk factor for MI. Yusuf et al., demonstrated that abdominal obesity increased the risk of AMI in both ages and sexes in all regions.
Stress:
Chronic life stress, social isolation and anxiety increase the risk of heart attack and stroke. Acute psychological stress also is associated with increased risk for coronary heart disease, and it has been reported that intense grief in the days after death of a significant person may trigger the onset of myocardial infarction. The pathophysiological mechanism of acute emotional stress remains unclear, but it is assumed to be related to hemodynamic stress in the coronary arteries and rupture of an atherosclerotic plaque, with consequent thrombosis.

Gout:
Patients with gout have an increased risk of myocardial infarction. In gout patients, the inflammatory response associated with gout plays a key role in the initiation and progression of atherosclerosis, and promotion of a pro-thrombotic environment that leads to acute coronary events such as angina or myocardial infarction.

Periodontal Diseases:
Periodontal diseases are a group of inflammatory diseases in which bacteria and their by-products are the principal aetiologic agents. The first indication of association between dental disease and atherosclerosis was given in 1963. Since then, there is growing evidence that poor dental health, especially the presence of periodontal disease, increases the risk of occurrence of CHD. The study done by Kaisare et al., also indicates an association between periodontal disease and acute myocardial infarction.

Family history:
Family history of myocardial infarction is an independent risk factor for AMI. Several genetic variants are associated with increased risk of AMI and family history of AMI in a first-degree relative doubles AMI risk. A recent combined analysis of 12 cohort studies found a combined relative risk of 1.6 for future events in persons with a first-degree relative with cardiovascular disease, compared with persons without an affected first-degree relative. Ciruzzi et al., reported that family history of acute myocardial infarction was a strong and independent risk factor in a study of 1.060 cases and 1.071 controls from Argentina. The antecedent of ≥1 first-degree relative with acute myocardial infarction increased the risk about twofold in men and nearly threefold in women, with a significant trend in risk in the number of relatives affected. Friedlander et al., reported that family history of AMI is positively associated with the risk of early AMI in women. If a father develops heart attack before the age of 55 and mother before the age of 65 years, this positive family history becomes very significant for the next generation and mere presence of parental and maternal history for premature myocardial infarction may increase the risk to 7 folds in descendents.

Age:
Advanced age is associated with an increased mortality in acute myocardial infarction. The mechanism by which increasing age contributes so dramatically to mortality is unknown. About 80% of heart disease deaths occur in people aged 65 or older.

Gender:
Men tend to have heart attacks earlier in life than women. Women's rate of heart attack increases after menopause but does not equal men's rate. Even so, heart disease is the leading cause of death for both men and women.

Conclusion
There are various risk factors of acute myocardial infarction which should be taken into consideration while treating patients of AMI.

Disclosures
Ethics Committee Approval: Ethics committee approval was not requested for this study.

Conflict of Interest: None declared.


References


31. McKee M, Britton A. The positive relationship between alcohol and cardiovascular disease- more than one paradox to consider. Average volume of alcohol consumption, patterns of drinking and risk of coro-
63. Moreno PR, Murcia AM, Palacios IF, Leon MN, Bernardi VH, Foster V, et al. Coronary composition and macrophage infiltration in atherectomy specimens from patients with diabetes mell-
71. Kannel WB, Gordon T, Schwartz MJ. Systolic versus diastolic
69. Gaba MK, Gaba S, Clark LT. Cardiovascular disease in patients
68. Davis TM, Parsons RW, Broadhurst RJ, Hobbs MS, Jamrozik K.
67. Cooper RS, Pacold IV, Ford ES. Age-related differences in
66. Bibbins-Domingo K, Lin F, Vittinghoff E, Barrett-Connor E, Hul- 
64. Khan MZ, Pervaiz MK, Javed I. Biostatistical study of clinical
63. Libby P, Theroux P. Pathophysiology of coronary artery dis-
62. Khan SA, Safdar S, Ijaz A, Taseer I. Acute myocardial infarc-
61. Mackenzie RS, Millard H D. Interrelated effects of diabetes, 
60. Beck J, Garcia R, Heiss G, Vokonas PS, Offenbacher S. Peri-
59. Joshipura KJ, Rimm EB, Douglass CW, Trichopoulos D, Ascher-
57. Simon J, Rosolová H. Family history--and independent risk 
55. Brevetti G, Silvestro A, Schiano V, Chiarriello M. Endothelial 
54. Guo F, Wang X, Li G, Chen X, Jin Y. Risk factors of acute myo-
53. Libby P, Theroux P. Pathophysiology of coronary artery dis-
52. Muller JE, Abela GS, Nesto RW, Tofler GH. Triggers, acute risk 
51. Mostofsky E, Maclure M, Sherwood JB, Tofler GH, Muller JE, Mitt- 
50. Schargrodsky H, Rozlosnik J, Ciruzzi M, Ruffa R, Paterno C, Ar- 
46. Davis TM, Parsons RW, Broadhurst RJ, Hobbs MS, Jamrozik K. Arrhythmias and mortality after myocardial infarction in diab- 
45. Cooper RS, Pacold IV, Ford ES. Age-related differences in 
44. Bibbins-Domingo K, Lin F, Vittinghoff E, Barrett-Connor E, Hul- 
43. Patil SS, Joshi R, Gupta G, Reddy MV, Pai M, Kalantri SP. Risk 
42. Khan MZ, Pervaiz MK, Javed I. Biostatistical study of clinical 
31. Simon J, Rosolová H. Family history— and independent risk factors for coronary heart disease, it is time to be practical. Eur Heart J 2002;23:1637–8.