1.0 INTRODUCTION

Coronary artery disease (CAD) is a chronic non-communicable disease with a prevalence of 11% in urban and 5% in rural settings in India (Prabhakaran, Jeemon, & Roy, 2016). It is associated with impaired cardiovascular functioning and is the leading cause of morbidity and mortality globally(Gupta, Mohan, & Narula, 2016). Urbanization, sedentary lifestyle and other associated risk factors such as dyslipidemia, hyperglycaemia, high triglycerides, and hypertension further elevate the chronic disease. These factors, along with obesity increases endothelial injury further developing to atherosclerosis, which causes cardiac arrest (Fernandez et al., 2013; Hippisley-cox & Coupland, 2016). CAD is the primary manifestation of atherosclerosis, whereas, anxiety, depression, reduced activity and poor quality of life (QOL) constitute its secondary manifestations (Chauvet-Gelinier & Bonin, 2017; Prabhakaran et al., 2016).

The left ventricular ejection fraction (LVEF) measures the left ventricular systolic function. The LVEF is a powerful predictor of cardiac mortality and the accurate measurement of LVEF is very important for managing patients with cardiovascular disease. LVEF values >50% is normal while those < 30% is severely abnormal (Gibson, 1981; Tanaka et al., 2006). Lower percentages of LVEF is associated with unfavorable long-term prognosis in CAD patients (Raghuram et al., 2014). Left Ventricular dysfunction is a term used to describe the state that develops when the heart cannot maintain an adequate cardiac output or can do so only at an expense of an elevated filling pressure. In its mildest form, the cardiac output is adequate at rest and becomes inadequate only when the metabolic demand increases during exercise or some other forms of stress (Colledge; Walker; Ralston; Davidson, 2010). The more severe form of left ventricular dysfunction may be termed as heart failure. Based on the patients' symptoms and the functional exercise capacity, heart failure may be classified into four stages of severity under the New

York Heart Association guidelines. The prognosis of heart failure secondary to ischaemic heart disease is not encouraging (Pollentier et al., 2010).

The epidemiological transition towards urbanization tends to raise the plasma cholesterol levels in the population largely due to a shift in the consumption of dietary fats and reduction of physical activity(Gaziano, Bitton, Anand, Abrahams-Gessel, & Murphy, 2010). The use of the lipid profile as a screening procedure for CAD patients may be beneficial (Dasgupta et al., 2015; Ferduos et al., 2014; Haque et al., 2016; Kondredddy et al., 2012). Lipids are known to play a key role in the development of CAD(Fernandez et al., 2013). The pathophysiology of atherogenesis and oxidative stress is directly linked to the oxidation of low-density lipoproteins (LDL) particles (El-Yassin, Hasso, & Al-Rubayi, 2005). Elevated risk of CAD has been linked with an increased ratio of total cholesterol to high-density lipoproteins (HDL) cholesterol (DeFrances, Lucas, Buie, & Golosinskiy, 2008). Raised plasma triglycerides are associated with type 2 diabetes, which in turn is considered to be a strong risk factor for CAD (Meikle et al., 2013). Numerous measures to lower the serum cholesterol levels including lifestyle modifications, exercises, and physical activities should be considered complementary to lipid-lowering drugs in order to keep MI and CAD at bay(Dasgupta et al., 2015).

Following acute myocardial infarction (MI), patients are adversely affected by anxiety and depression, resulting in a profound impact on their CAD prognosis (Contractor, 2011; Nielsen, Vestergaard, Christensen, Christensen, & Larsen, 2013; Ren et al., 2017). Psychological risk factors are approximately 10% more prevalent among the CAD population with 15%-20% cardiac patients exhibiting depressive symptoms. The first two years of follow-up after MI is considered crucial because of the high risk of developing anxiety and depression, which further leads to recurrent MI (Feng et al., 2016; Rozanski, Blumenthal, Davidson, Saab, & Kubzansky,

2005). The American heart association recommends routine screening for depression in patients with CAD in various health care settings and professionals qualified in the diagnosis and management of depression evaluate these patients (Ontario, 2013).

Cardiac patients, especially the elderly, experience difficulty in activities of daily living, including self-care which is crucial for a satisfactory QOL (Evangelista et al., 2015). In CAD patients, angina, fatigue, dyspnoea, and depression are important symptoms that limit QOL. Previous studies of CAD patients have demonstrated a direct relationship between individual functional status and QOL. Assessment of health-related QOL as a clinical endpoint in chronically ill patients has gained importance over the past few decades (Saengsiri & Hacker, 2015). Particular attention towards interventions that enhance QOL through the promotion of self-care is necessary for the reduction of symptoms of both physical and psychological origin (Evangelista et al., 2015; Lennie et al., 2013; Pullen, 2010).

1.2 BURDEN

1.2.1 GLOBAL PREVALENCE

Non-communicable diseases such as CAD, cancer, diabetes and Chronic Obstructive Pulmonary Disease (COPD) put together contribute to 50% of global mortality. It was estimated that Coronary Vascular Disease (CVD) contributed to 30.9% of mortality and 10.3%of disability adjusted life year loss (DALY loss) in 1998 (Yusuf, Reddy, Ôunpuu, & Anand, 2001b). CAD is the foremost among the non communicable diseases causing mortality under the age of 50 in urban India, Latin America and the former Socialist countries. In the developing countries the burden of CAD adds on to those due to infection, perinatal diseases etc to cause a situation termed 'double burden' (Yusuf et al., 2001b). There is a global increase in the rate of urbanization from 36.6% of the population living in urban areas in the year 1970 to 44.8% in 1994 and the

trend is expected to continue with an estimated 61.1% of the world population living in urban areas by the year 2025. Urbanization is directly linked with the increased calorie intake, lack of physical activity and decreased social support which influences the cardiac health drastically (Yusuf, Reddy, Ôunpuu, & Anand, 2001a).

1.2.2 ASIAN PREVALENCE

The Indian sub continent which comprises of India, Pakistan, Bangladesh, Sri Lanka and Nepal houses approximately 20% of world's population and is estimated to bear the highest burden of CVD in the world (Goyal & Yusuf, 2006). South Asian migrants to United Kingdom and other countries experience deaths due to CAD 1.5 to 4 times that of the indigenous population (Yusuf et al., 2001b). CAD is one of the leading causes of death in India and is projected to rise in the future. Nearly 30 million people in India, making up almost 30% of the population were estimated to suffer from CAD in the year 2000 (Huffman & Prabhakaran, 2010). The huge prevalence of CVD in India could be a consequence of large population and increased CVD risk factors (Goyal & Yusuf, 2006). An overview of a 2 decade long prevalence survey demonstrated a 9 fold increase in CAD in urban centers compared to a 2 fold increase of it in the rural ones. This difference was attributed to the lipid and glucose abnormalities along with hypertension and obesity (Goyal & Yusuf, 2006; Yusuf et al., 2001b).

1.2.3 ECONOMIC BURDEN

Coronary vascular diseases contribute to a major percentage of mortality and morbidity in the western population and hence the economic burden is a major issue (Piepoli et al., 2012). It has been projected that the number of patients ≥65 years of age in North America is expected to rise from 34.7 million in the year 2000 to approximately 78.9 million by 2050 with an exponential increase in the heart diseases as well as the cost towards the health care of these patients (Blair,

Huffman, & Shah, 2013). Between 1%-2% of Europe's national budget is spent on heart diseases with the majority of this, say around 60%, spent for the purpose of hospitalization (Roger, 2010; Servier, 2011; Valdivia-arenas, Michael, & Rami, 2009). In addition to this, patients with heart disease suffer associated co-morbidities which complicate the condition, further affecting the survival of the patients (Atherton, 2012).

1.3 PATHOPHYSIOLOGY

Cardiac output is a function of the preload (the volume and pressure of blood in the ventricle at the end of diastole), the after load (the volume and pressure of the blood in the ventricle during systole) and myocardial contractility. The interaction of these variables is based on Starling's law of the heart (Colledge; Walker; Ralston; Davidson, 2010). After myocardial infarction, cardiac contractility is impaired and neuro-hormonal activation may lead to hypertrophy of non infarcted segments, with thinning, dilatation and expansion of the infarcted segment (remodeling). Myocardial scarring following MI results in its inadequate relaxation during diastole and impaired contraction during the systole. This may lead to further deterioration in ventricular function and worsening of the condition (Colledge; Walker; Ralston; Davidson, 2010). Additionally, the remodeling process alters the geometry of the heart and ventricular enlargement predisposing to distortion of the mitral apparatus causing mitral regurgitation. The dis-synchrony in the infarcted segment of the ventricular wall decreases the efficiency of the heart as a pump (Pazos-López et al., 2011). The consequent pulmonary and/or peripheral oedema are due to high atrial pressures compounded by salt and water retention caused by impaired renal perfusion and secondary hyperaldosteronism (Colledge; Walker; Ralston; Davidson, 2010). The congestion of systemic veins results in raising venous pressure, peripheral oedema (ankle swelling) and hepatomegaly. Fatigue and breathlessness are results of pulmonary oedema, low

cardiac output, reduced peripheral perfusion and skeletal muscle de-conditioning (Task et al., 2005).

1.4 **MANAGEMAENT**

The therapeutic approach towards left ventricular dysfunction may be broadly classified as pharmacological therapy, device based therapies and coordinated disease management. Most of the pharmacological therapies aims at the management of congestion and hemodynamic derangements. In spite of this, progressive adverse remodeling cannot be stopped. Device based therapies advocate the use of devices such as an implantable cardioverter defibrillator in an attempt to prevent the sudden arrhythmic deaths of left ventricular dysfunction patients at a primary level. Most of the hospital readmissions can be avoided with the utility of coordinated disease management, which focuses on lifestyle adjustments, initiation and up titration of medical therapy and selective utilization of the device based therapies in an attempt to prolong survival, reduce hospitalization and improve quality of life (Atherton, 2012).

Yoga, a mind-body therapy, would be a promising therapeutic and health promotional strategy in the management of risk factors associated with CAD (Innes et al., 2007). Yoga enhances psychological wellbeing by reducing psychological morbidity, modifying reactivity to stressors, adapting stress-related coping mechanisms, minimizing the symptoms of anxiety and depression, reducing tension, anger, and fatigue, improving sleep quality, and enhancing the quality of life (Innes et al., 2007). Figure 1 illustrates how yoga helps to establish collateral pathways towards health and well-being by breaking the vicious circle of progressive emotion, the cognitive, structural and psychological disturbance that would lead to the development and aggravation of CAD risk factors (Pullen, 2010).

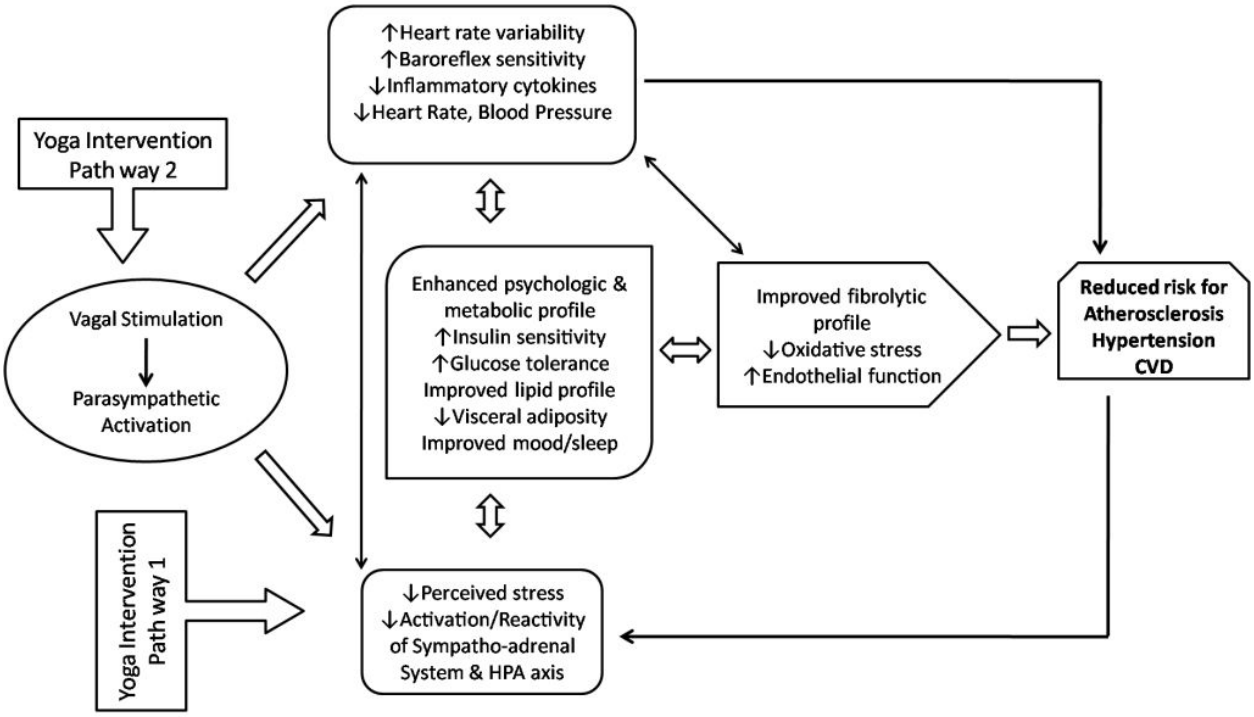

Figure 1: Vagal stimulation and parasympathetic activation pathways.

Raghuram et al. investigated yoga-based cardiac rehabilitation programs for patients who had undergone coronary artery bypass grafting (CABG). Patient follow-up demonstrated improvements in LVEF, body mass index (BMI), serum glucose, lipids, and a decrease in stress, anxiety, and depression (Raghuram et al., 2014). Another study, which incorporated 12 weeks of Hatha Yoga intervention in Chinese adults suggested yoga to be a good alternative to modify cardiac risk factors owing to its low-to-moderate exercise intensity and a high adherence rate (Lau, Yu, & Woo, 2015).