INTRODUCTION

1.1 BACKGROUND:

Health is a state of mental, physical and social wellbeing and not merely the absence of disease or infirmity according to World Health Organization (Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States and entered into force on 7 April 1948, the Definition has not been amended since 1948).

One of the leading causes of death in most of the part of world is cardiovascular diseases (World Health Organization.-Global status report of NCD 2010. Geneva.). They cause severe irreversible physical impairment and neurological disabilities. Cardiac Rehabilitation (CR) is a multidisciplinary program that includes patient’s education on the importance of exercises and reduction of risk factors by combined measures of medical, surgical, nutritional, exercises, lifestyle modification and psycho-social adaptations.(Brown 1964, Zwischenberger, Moore et al. 2011).

Cardiac rehabilitation has both primary and secondary prevention. By primary prevention most of the risk factors can be reduced and the recurrence of cardiac event can be prevented. By taking secondary
prevention measures, the post cardiac event patients can be treated and their original physical capacity can be restored. Both can be made possible by modifying the risk factors and making changes in lifestyle along with appropriate medical therapy.

The risk factors need to be managed with lifestyle modifications along medical therapy is initiated. These risk factors include:

- Smoking
- Hypercholesterolemia
- Hypertriglyceridemia
- Low HDL cholesterol
- Arterial hypertension
- Hyperglycemia
- Physical inactivity

Physical inactivity has been considered to be one of the important indicators of morbidity for everyone including normal subjects and patients. Usually medical therapy will be initiated to avoid further vascular damage and thus to halt or slow down the progression of atherosclerosis.

More often when medical therapy is started, life style modification is also started. Only after a cardiac event the patients take this advice. This is the time to initiate education to change their life style. At the same time, education on changing their life style should be given to the partner who
attends to the patients for a lifelong journey. They need to be encouraged and facilities should be available to them to actually modify their lifestyle.

Our country lack out-patient cardiac rehabilitation facilities that would provide a base for lifelong rehabilitation with current guidelines. Such facilities have to be in every community dwelling, this will enable us to give Physical, psychological, nutritional and medical attention several times a week, for a long time. The institutions offering outpatient cardiac rehabilitation facilities has to increase, this should apply to most of the hospitals, to start outpatient rehabilitation programs, so that patients get a enough chance to actually change their lifestyle. It is not enough only to concentrate on revascularizing patients, but also ensure optimal reduction in morbidity and mortality by giving suitable rehabilitation thereafter. Health insurance coverage for Cardiac Rehabilitation for outpatient care during Phase II and Phase III will enable many of them to take up supervised exercise training programs.

Among cardiac disease like Chronic Heart Disease (CHD), myocardial infarction (MI) is the leading cause of death. Patients who survive an MI, the prevention of subsequent coronary events and the maintenance of physical functional capacity become the major challenge (Ades 2001). Secondary prevention is an essential part of the continuous care of the patient with CHD. According to Balady, Williams et al.,Cardiac rehabilitation/secondary prevention programs are recognized as
integral to the comprehensive care of patients with CHD and as such are recommended as useful and effective (Class I) by the American Heart Association (AHA) and the American College of Cardiology in the treatment of patients with CHD (Balady, Williams et al. 2007).

Candidates for cardiac rehabilitation services historically were patients who recently had a myocardial infarction or had undergone Coronary artery bypass grafting (CABG), but candidacy has been broadened to include patients who have undergone percutaneous coronary interventions; or heart transplantation candidates or recipients; or have stable chronic heart failure, peripheral arterial disease with claudication, or other forms of CVD. In addition, patients who have undergone other cardiac surgical procedures, such as those with valvular heart disease, are also eligible (Leon, Franklin et al. 2005).

Coronary artery bypass grafting (CABG) is one among the most common surgery performed in the world and accounts for more resources expended in cardiovascular medicine than any other single procedure (Eagle, Guyton et al. 2004). Cardiac Rehabilitation following CABG involves imparting exercise training, smoking cessation, diet, lipid and psychosocial management according to various guidelines (Hellerstein and Ford 1957). Primary aim is to reduce modifiable risk factors which play a vital role in prevention of future coronary event apart from enhancement of exercise capacity and Quality of Life (QOL).
Following Coronary artery bypass grafting surgery (CABG), patients primarily attain a state of wellbeing through Cardiac Rehabilitation (CR). After CABG, CR is given as a multi-disciplinary team imparting the importance of exercises and reduction of risk factors by combined measures of medical, surgical, nutritional, exercises, lifestyle modification and psycho-social adaptations (Brown 1964, Zwischenberger, Moore et al. 2011). CR also improves the quality of life and assists to have an enhanced social and professional performance (Newman, Andrews et al. 1952).

1.2 NEED FOR THE STUDY:

Patients after Coronary artery bypass graft surgery (CABG), achieve abilities to do their activities of daily living by end of Phase I. But, they need to continue with exercise training in a progressive manner to attain the optimal functional improvement. Henceforth, the need for research to prove the efficacy of Cardiac Rehabilitation (Specifically exercise training) in this part of our population.

As there is very less research and dearth of literature during Phase II CR and lack of awareness among public in our population, this study was done to find out the effects of supervised exercise training on the Functional capacity, Physical, Physiological outcomes and Quality of Life during Phase II Cardiac Rehabilitation following CABG for Low Risk Cardiac Patients at Sri Ramachandra Medical Centre, Chennai.
GROUPING: It was divided into Study Group and Control Group.

STUDY GROUP: The patients in Interventional group underwent a set of structured exercise program at out-patient physiotherapy department 3 sessions /week for a period of 12 weeks.

CONTROL GROUP: In control group, patients after discharge continued to followed conventional home based self-monitored exercise training program and were asked to record in an activity log.

1.3 OBJECTIVES OF THE STUDY:

1. To find out the effectiveness of supervised exercise based Cardiac Rehabilitation (study group) over unsupervised exercise training (control group) on functional capacity.

2. To find out the effectiveness of supervised exercise based Cardiac Rehabilitation (study group) over unsupervised exercise training (control group) on the Quality of Life.

3. To find out the effectiveness of supervised exercise based Cardiac Rehabilitation (study group) over unsupervised exercise training (control group) on Physiological determinants of Cardio-Respiratory function.

4. To find out the effectiveness of supervised exercise based Cardiac Rehabilitation (study group) over unsupervised exercise training (control group) on Physical determinants of Cardio-Respiratory function.
5. To explore the adherence of patients to Phase II Cardiac rehabilitation (supervised exercise based Cardiac Rehabilitation).

6. To determine the safety and feasibility of outpatient exercise training program.

1.4 NULL HYPOTHESES:

• $H_0^1$ - Functional capacity would be same among supervised exercise based Cardiac Rehabilitation (study group) and unsupervised exercise training (control group).

• $H_0^2$ - Quality of Life would be similar after the supervised exercise based Cardiac Rehabilitation (study group) and unsupervised exercise training (control group).

• $H_0^3$ - The changes in the Physiological determinants of Cardiac-Respiratory function would be similar in supervised exercise based Cardiac Rehabilitation (study group) and unsupervised exercise training (control group).

• $H_0^4$ - Physical determinants would be similar following supervised exercise based Cardiac Rehabilitation (study group) and unsupervised exercise training (control group).
1.5 ALTERNATE HYPOTHESES:

- $\text{Ha}^1$: Supervised exercise based Cardiac Rehabilitation (study group) would improve in functional capacity greater than unsupervised exercise training (control group).

- $\text{Ha}^2$: Quality of Life would be better after supervised exercise based Cardiac Rehabilitation (study group) than the unsupervised exercise training (control group).

- $\text{Ha}^3$: The changes in the Physiological determinants of Cardiac-Respiratory system would be greater in Supervised exercise based Cardiac Rehabilitation (study group) than unsupervised exercise training (control group)

- $\text{Ha}^4$: The physical determinants will be different between the Supervised exercise based Cardiac Rehabilitation (study group) and unsupervised exercise training (control group).

1.6 ASSUMPTIONS:

Supervised exercise training provides the psychological support, confidence and achievement-motivation during every session of individual training which lacks in unsupervised training. The improvement in the ejection fraction, autonomic regulation and ventricular function due to supervised exercise training would contribute to the better outcomes than unsupervised exercise training (control group) having conventional home
based self-monitored exercise training program). This will improve the Functional capacity, Quality of Life and Physiological and Physical parameters.

The adherence to exercise and the possibility of intensity progression would be better in supervised training than unsupervised training.

Supervised exercise training makes the training systematic and useful in attaining better outcomes than home based unsupervised exercise training (control group) having conventional home based self-monitored exercise training program. The safety is ensured by presence of qualified therapist and scientific approach in intensity prescription.
DEFINITION OF TERMS

Cardiac Rehabilitation (CR): Cardiac Rehabilitation is a multidisciplinary program that includes patient’s education on the importance of exercises and reduction of risk factors by combined measures of medical, surgical, nutritional, exercises, lifestyle modification and psycho-social adaptations (Brown 1964, Zwischenberger, Moore et al. 2011).

Physical Activity: Physical Activity is any muscle contraction resulting in an energy metabolism above basal metabolic rate (Thompson, Buchner et al. 2003).

Exercise Capacity: Exercise capacity is the power output a person can sustain during an exercise tolerance test and is independent of any pathological symptoms and/or medical indications. (Granger, McDonald et al. 2013).

Functional Capacity: Functional Capacity is the exercise capacity equivalent to day to day normal routine activity (Activity of Daily Living) as measured using a standardized functional test such as Six Minute Walk Test (ATS Statement: Guidelines for the Six-Minute Walk Test) (2002).

Functional Capacity Evaluation (FCE): Functional Capacity Evaluation is set of tests, like Six Minute Walk Test, practices and observations that are combined to determine the ability of the evaluated to function in a variety of circumstances, most often employment, in an objective manner (Jette, Sidney et al. 1990).
**Exercise Training**: Exercise training is any physical activity that is planned, structured, performed repeatedly, and specifically aimed at improving the physical fitness level (Thompson, Buchner et al. 2003).

**Supervised Exercise Training**: Supervised Exercise training is the training performed under the guidance and monitoring of a qualified person with optimal training to conduct exercise testing and prescribe the exercises according to individual criteria and requirements (Cardinal 1999, Thompson, Arena et al. 2013).

**Exercise Therapy**: Exercise therapy is medically indicated and prescribed exercise, planned and dosed by therapists, controlled together with the physician and carried out with the patient either alone or in a group (Hellerstein 1970).

**Physical Fitness**: Physical fitness comprises a set of attitude that is related to the ability to perform physical activity including cardiovascular endurance, muscle strength, body composition, flexibility, and coordination (Thompson, Buchner et al. 2003)(Morrow, Jackson et al. 1999)(U.S. Department of Health and Human Services. Physical activity and health: a report of the surgeon general. Atlanta: Centers for Disease Control and Prevention National Center for Chronic Disease and Health Promotion; 1996).

**Cardiorespiratory Fitness**: Cardiorespiratory fitness is determined by the maximal cardiovascular exercise capacity. Cardiorespiratory fitness is indicative of the ability to transport oxygen upon inhalation to the muscle cell where it is
used in the mitochondria for energy (ATP-synthase). Assessment of maximal oxygen uptake (VO2peak) is the gold standard for evaluating cardiorespiratory fitness. (Hollmann et al 2000).