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The effects of exercise on quality of life before myocardial infarction and during four phase exercise rehabilitation.

By

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ABSTRACT

Quality of life may be enhanced after myocardial infarction through participation in exercise rehabilitation. Improvements as a result of exercise participation are seen in physiological function, in psychological state and in the performance of social roles. Changes in physiological function are increased oxygen uptake of skeletal muscle, increased flexibility and increased co-ordination. Changes to psychological state are a reduction in depression and anxiety and improved self esteem and confidence. The performance of social roles is enhanced through psychological and physiological changes and in the sense of achievement generated by attainment of rehabilitation goals.

Through the course of exercise rehabilitation from phase one through to phase four, the role of exercise in the components of quality of life changes.

Exercise may be used as a tool for the prevention of myocardial infarction. During phase one of rehabilitation, quality of life is reduced by the infarction. Exercise may be used in phase one to restore patient confidence and assist in adjustment to illness. During phases two exercise is used for improvements in physiological function and in psychological adjustment. Phases one and two are marked by the psychological and social considerations of adjustment as well as physiological healing.

In phase three, exercise improves quality of life through further improvements in physiological function. Phase three has many physiological gains to be made, whilst in phase four sociological considerations dominate. Adherence to lifelong exercise patterns is a major consideration in phase four since advantageous long term physiological changes, such as enhanced
co-lateral circulation can occur. Phase four, the maintenance phase relies on social support of significant others for exercise adherence.

Overall the positive effects of exercise rehabilitation after exercise outweigh the risks associated with exercise in this population.
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7. SUMMARY.
1. INTRODUCTION

Cardiovascular disease is the most common cause of mortality in Australia (Jennings, 1993) and because of the high mortality rate associated with myocardial infarction much research both in Australia and overseas has concentrated on cardiovascular disease. Medical science has learned about the causes of cardiovascular disease. Myocardial infarction is caused by cardiovascular disease, and for this reason the risk factors for cardiovascular disease also apply to the risk of experiencing a myocardial infarction. Some of these known risk factors may be altered by behaviours of the individual, some are not able to be altered. The aim of rehabilitation is to reduce risk factors in the individual with cardiovascular illness, thereby reducing the incidence of myocardial infarction or the severity of infarction.

Known risk factors for myocardial infarction which cannot be modified are a genetic predisposition to cardiovascular illness and becoming older. Risk factors which can be modified by the behaviour of the individual with the illness are: elevated serum cholesterol, elevated blood pressure, being overweight, smoking cigarettes, an increased level of perceived stress, social isolation and the hostility and anger components of the type A behaviour pattern. There may also be other risk factors which have not yet been investigated. Known risk factors for myocardial infarction which may be altered by exercise will be examined later in this paper.

1.a. QUALITY OF LIFE

This paper describes the effect of exercise on the quality of life of a person who has had a myocardial infarction through five phases of illness from the pre-illness state, through the four
recognised phases of cardiac exercise rehabilitation. The concept of quality of life implies health along a continuum and that the individual experiences either an improvement in quality of life, maintenance of quality of life, or experiences a reduction in quality of life, as a result of life events. It is particularly relevant in the rehabilitation of chronic illnesses, since the time span involved is long and the progression of the disease may be monitored. Quality of life is the concept used by the patient to assess their own illness and the effects of treatments.

Quality of life is a multifaceted concept which involves assessment by the patient of the valued aspects of their life (Wegner, 1990), such as the active person who as a result of a myocardial infarction is unable to participate in vigorous activity for a period. During this period of reduced activity, the individual's perception may be of reduced quality of life. Quality of life is dependent on subjective assessment by the patient of abilities and disabilities as well as expectations (Harlpern, 1993).

1.b. COMPONENTS OF QUALITY OF LIFE

For the purposes of this paper quality of life is divided into three interacting components; physiological functioning, psychological state and performance of social roles. During pre-illness, illness and exercise rehabilitation, the influence of physiological functioning, psychological state and performance of social roles on the overall quality of life of the individual will vary. Different aspects of quality of life will dominate at different times as the individual progresses through pre-illness, illness and exercise rehabilitation.
Fundamental in the provision of services which aim to improve quality of life is the assumption that we know what will improve quality of life for the patient and that the patient attending for rehabilitation assumes that we know also. The objective measurement of quality of life in cardiac exercise rehabilitation is important, since improvements in quality of life are the goal of the rehabilitation. Quality of life may be measured qualitatively or quantitatively. Qualitative research is subjective and is less likely to be able to be validated by other research because of its subjective nature, however, quantitative research over simplifies the complex issue of quality of life (Dennis, Williams, Giangreco and Cloniger, 1993). Gross, Cox, Tayrek, Pollay and Barnes (1983), proposed that quality of life is the product of natural endowment and the sum of contributions from home and society. In this essay, quality of life similarly is the product of physical function, and the sum of psychological state and social inputs.

1.b(i). **Physiological component**

The physiological functioning component includes those events, symptoms, interactions that occur within the body, without the conscious control of the patient. Physiological factors which may affect quality of life are functional capacity, which is the ability to perform activities of daily life and symptoms, including side effects of treatment, the types and number of treatments and hospital admissions, disability and illness symptoms. The physiological components of exercise rehabilitation for patients who have had a myocardial infarction are the exercise itself, pharmacological therapy and dietary changes.
1.b(ii). Psychological component

The second component of quality of life is psychological state which includes a patient’s emotional reactions, interpretations, intentions and attitudes to the disease and their satisfaction with life, their perceptions and expectations of recovery (Barr Taylor, Sallis and Needle, 1985). All of these factors will affect quality of life after myocardial infarction. Psychological aspects to cardiac exercise rehabilitation programmes include exercise, relaxation and psychotherapy.

1.b(iii). Sociological Component

The third component of quality of life is the performance of social roles. This component includes changes in the performance of pre-illness roles and social interactions throughout the course of the disease (Runions, 1985; Siegrist, Dittman, Rittner and Weber, 1982). Informal support groups within cardiac exercise rehabilitation programmes can provide assistance in social adjustment throughout the course of rehabilitation.

1.c. EXERCISE REHABILITATION

The aim of cardiac exercise rehabilitation is to improve the quality of life of the person who has had a myocardial infarction. The role of exercise in cardiac rehabilitation historically has been emphasised as a physiological role, however there are psychological and social effects of exercise also contributing to the final outcome of improved quality of life. The literature examining the experience after myocardial infarction has concentrated on these aspects of quality as singular and complete. The interactions between physiological, psychological and sociological recovery have largely been ignored
or have been assumed. Since each influences the others these interactions should be examined.

Physical exercise is a set of body movements performed deliberately with the purposes of gaining a perceived improvement (Powell and Paffenbarger, 1985) to some or all aspects of quality of life. That is; either physiological, psychological or social benefit. Since the purpose of performing exercise is to experience positive effects, if the effects were determined by the individual to be negative or not producing benefit, the individual would not continue to participate in exercise.

In this article physical exercise is presented as a physiologically based tool to assist in the improvement of quality of life through changes in physiological functioning, psychological state and performance of social roles.

This paper aims to draw these areas together. It will examine the role of physical exercise in improving quality of life in cardiovascular illness by examining the pathway of social, psychological and physiological effects and the interactions between these effects throughout the progression of the disease from pre-illness through the phases of rehabilitation after the infarction.
2. EXERCISE PRE MYOCARDIAL INFARCTION

The effects of exercise on quality of life in the pre-illness period are the possible prevention of myocardial infarction or a lessening of the effects of the disease should an infarction occur. Habitual exercise has been credited with improvements in physiological function; including aerobic fitness, flexibility, strength (Skinner, 1987; Lamb, 1984), agility, improved reaction time, reduced mortality rate (Pollock, Wilmore and Fox, 1984).

The benefits to psychological state of long term exercise are a reduction in depression and anxiety (Barr Taylor et al. 1985), improvements in self esteem, well being and confidence (Powell and Paffenbarger, 1985; Blumenthal et al. 1982; Stephens, 1988). Improvements in social function and quality of life as a result of long term exercise include greater independence in daily living, reduced isolation (Runions, 1985).

2.a. EFFECTS OF EXERCISE ON RISK FACTORS

Exercise is used in primary prevention of cardiovascular disease mainly by reducing or controlling risk factors (Fletcher, 1984). Risk factors for myocardial infarction which can be favourably adjusted by participating in an exercise programme include elevated cholesterol, elevated triglycerides, extra body fat (Fletcher, 1984; Houston Miller, Barr Taylor, Davidson, Hill and Krantz, 1990), social isolation (Orth-Gomer, Rosengren and Wilhelmsen, 1993), elevated blood pressure (Jennings, 1993), diabetes (Fletcher, 1984), inability to effectively deal with stressful situations (Friedman, Thoresen, Gill, Ulmer, Powell, Price, Brown, Thompson, Rabin, Breall, Bourg, Levy and Dixon, 1986), aspects of the type A behaviour pattern (Helmers, Krantz,
Howell, Klein, Bairey and Rozanski, 1993) and possibly smoking (Houston Miller, et al. 1990). Risk factors not altered by exercise include age, family history, socioeconomic factors, aspects of the type A behaviour pattern, alcohol consumption, stressful life events and locus of control (Fletcher, 1984).

2.b. PHYSIOLOGICAL RISK FACTORS EFFECTED BY EXERCISE

2.b(i). Serum lipids.

The incidence of coronary heart disease is directly linked to elevated serum low density lipoprotein levels. High density lipoprotein levels appear to have a protective effect against the development of coronary heart disease (Houston Miller et al. 1990). Regular aerobic exercise produces an increase in high density lipoproteins, a lowering in triglyceride levels and a lowering of blood sugar levels (Curfman, 1993; Paffenbarger, Hyde, Wing, Lee, Jung and Kampert, 1993; Fletcher, 1984). The treatment of elevated serum cholesterol can be aided by exercise.

2.b(ii). Elevated body fat.

Achieving normal weight, through a combination of diet and exercise is the first step, followed by a diet low in saturated fats. Exercise aids in maintaining weight lost by decreasing appetite and increasing self-esteem and confidence. Weight loss and exercise are important in controlling total serum cholesterol levels and in the prevention or treatment of diabetes through improved metabolism of lipoproteins and carbohydrates (Skinner, 1987; Houston Miller et al. 1990; Pollock et al. 1984). A person who exercises aerobically three or more times a week, is more likely to have a normal body weight (Sandvik, Erikssen, Thaulow, Erikssen, Mundal and Rodahl, 1993; Fletcher, 1984). By
maintaining normal body weight the individual will be less likely to develop diabetes or elevated cholesterol levels.

2.b(iii). **Elevated blood pressure.**

Long term physical training helps to reduce diastolic blood pressure in hypertensive people. This may have been through a physiological mechanism or through a psychological mechanism, since increased levels of mental stress have been associated with elevated blood pressure and exercise improves the way that people deal with stressful situations (Jennings, 1993). Aerobic exercise leads to a decrease in resting blood pressure both for single exercise bouts (Hobson & Rejeski, 1993) and long term reductions in resting blood pressure. In sedentary individuals with high or normal blood pressure who exercise moderately (between sixty and seventy percent of maximal oxygen uptake) three times a week there is a drop in blood pressure of between ten and fifteen millimetres of mercury. This is not seen in individuals where they already exercise strenuously (Jennings, 1993). Moderate exercise is an effective way of lowering blood pressure without using drugs.

2.c. **PSYCHOLOGICAL RISK FACTORS EFFECTED BE EXERCISE**

2.c(1). **Type A behaviour pattern.**

Type A behaviour pattern has been a controversial topic in the study of cardiovascular disease risk factors and rehabilitation post infarction. Type A behaviour pattern is characterised by an increased sense of time urgency, anger and hostility. The hostility and anger components of type A behaviour pattern are believed to be most relevant to the development of cardiovascular disease, however factors such as age, social status and gender
all influence the degree of influence that it has over risk factors and rehabilitation (Houston Miller et al. 1990; Abbott, Peters and Vogel, 1990; Friedman et al. 1986). In a follow-up study of type A behaviour and exercise in coronary patients the only difference between type A and type B that was noted was that subjects with high type A scores perceived themselves to be more physically active than the objective measures indicated. Hostility has been shown to be positively associated with the occurrence of ischaemia caused by physical exertion (Helmers et al. 1993) and to decrease the strength of type A behaviour pattern (Blumenthal et al. 1982).

2.c(ii). Elevated mental stress and anxiety.

Elevated levels of perceived psychological stress may place an individual at higher risk for myocardial infarction than those who do not perceive high levels of psychological stress (Siegrist et al. 1982). Exercise reduces anxiety and the effect lasts for at least 30 minutes (Petruzzello, Landers and Salazar, 1993). Myocardial ischaemia in persons with known disease can be induced by psychological stress and anxiety (Fletcher, 1984). Hobson and Rejeski (1993) suggest that the reason for exercise reducing anxiety is by a decrease in the reactivity of the cardiovascular system and an improvement in psychological response to stress. Mental stress at the workplace and exposure to acute life change expose the person to increased risk of myocardial infarction (Siegrist et al. 1982; Orth-Gomer et al. 1993).

Blumenthal, Sanders Williams, Wallace, Williams and Needles, (1982) studied the psychological changes that occur as a result of aerobic exercise, subjects demonstrated a decrease in state
and trait anxiety, depression, fatigue and confusion and felt more vigour than non-exercising controls.

2.d. SOCIAL RISK FACTORS

2.d(i). Lack of social support.

The support of significant others is important in achieving weight loss and other lifestyle modifications after myocardial infarction, such as adherence to exercise programmes (Orth-Gomer et al. 1993).


Persons who have a high degree of social isolation experience a higher rate of post infarction morbidity. They are also at greater risk of death from cardiovascular disease because of a lack of social support (Orth-Gomer et al. 1993; Ruberman, Weinblatt, Goldberg and Chaudhary, 1984). Exercising in groups may alleviate social isolation through the development of contacts/ friendships within the group. People who exercise regularly are likely to do so away from the home and therefore have a greater number of contacts outside the home.

2.e. EFFECTS OF EXERCISE PRE MYOCARDIAL INFARCTION

2.e(i). Physical effects

Moderate, regular exercise reduces mortality risk by twenty-three percent (Paffenbarger et al. 1993). A high level of aerobic fitness is associated with a low risk of developing heart disease (Sandvik et al. 1993). Therefore people who do not exercise regularly are more likely to develop cardiac illness. The degree of physical activity sufficient to improve cardiovascular fitness and to decrease cardiovascular risk is 1500 Kilocalories per week expenditure (Skinner, 1987), which reflects only a moderate
Central circulatory changes attributable to exercise training which may improve quality of life through improved physical function, include a decrease in resting heart rate and or a decrease in resting blood pressure and a reduction of heart rate during exercise (O'Connor, Buring, Yusuf, Goldhaber, Olmstead, Paffenbarger and Hennekens, 1989). Stroke volume is increased both at rest and during exercise (Pollock et al. 1984). As a person becomes more aerobically fit their heart muscle requires less oxygen at a given workload because of associated peripheral changes which reduce the load of activity during daily tasks. The physiological mechanism for using less energy in daily activities lies in a decreased heart rate response to activity. An increased efficiency in the use of available oxygen can offset the natural decline in heart rate (Shepard, 1990) that occurs as a result of aging. This is achieved through an increase in vagal tone through exercise, which stimulates cardiac output (Astrand & Rodahl, 1987; Lamb, 1984).

Improved strength and flexibility help in reflex adaptation for improvements in physical function and improvements in quality of life. Improved physical mobility has been reported after long term exercise programmes (Skinner, 1987; Shepard, 1990; Kavanagh and Shephard, 1990), which may also contribute to improved quality of life through improved physical function.

2.e(ii). Psychological effects

Physical exercise whether aerobic, flexibility or strength work improves mobility through improved balance and co-ordination, leading to improved confidence through enhanced physical
Reduced depression and anxiety has been demonstrated after moderate levels of exertion. People who exercise regularly also have reduced tension and fatigue than those who do not (Blumenthal et al. 1982). Other positive effects of physical activity on psychological state are an increased sense of well-being and improved intellectual functioning (Barr Taylor et al. 1985).

A high level of physical fitness allows a greater workload to be performed for a given output. The physically fit person is less likely to need to push themselves hard in the performance of daily tasks. They may also be more aware of their limitations and be less likely to exceed these physical limitations. The perception of an increased physical function may encourage further participation.

2.e(iii). Sociological effects

Increased mobility may improve the psychological state of the individual and their performance of social roles. Sharing of the experience of physical activity and its effects on physical function and the associated changes in quality of life, can have a positive effect on self confidence and assertiveness in social situations (Houston Miller et al. 1990).

2.f. NEGATIVE EFFECTS OF EXERCISE PRE MYOCARDIAL INFARCTION

If cardiovascular disease is present and the exerciser is unaware of its presence, intense vigorous physical activity may induce a myocardial infarction. Another negative aspect of exercise in the pre-illness phase is an addiction to exercise. Exercise addiction is a negative factor when exercising takes
priority over other important aspects of a person's life, such as work and personal relationships (Bar Taylor et al. 1985). Over exertion and overtraining can lead to fatigue and possible musculo-skeletal injury.

2.g. QUALITY OF LIFE PRE MYOCARDIAL INFARCTION

Quality of life in the pre-illness phase may be the point of reference by which the patient makes future judgements about quality of life during illness or recovery. If quality of life has been declining during this phase, it may be due to cardiovascular disease. Exercise used as a tool in primary prevention of cardiovascular illness may serve to maintain or enhance quality of life due to the changes in physical function, psychological state and in the performance of social roles.
3. PHASE ONE EXERCISE REHABILITATION

Phase One refers to the period of hospitalisation after an acute myocardial infarction.

3.a. EXERCISE IN PHASE ONE

Exercise in phase one is somewhat self-limiting because of the experience of pain and other symptoms, reducing physiological function and the psychological after-effects of the infarction. The term myocardial infarction refers to the death of a section of the myocardium due to an interruption of blood supplied to that area. Generally following an uncomplicated myocardial infarction the period of hospitalisation is between six and fourteen days. The heart takes between eight and twelve weeks to heal after infarction (O' Connor et al. 1989). In hospital physical activity and mental stress are kept to a minimum. Deliberate exercise, apart from daily activity is limited. The person who has recently had a myocardial infarction will be limited in exercise capacity by symptoms such as angina, shortness of breath, fatigue, depression and a reduction in heart rate seen after infarction. In most patients, the severity of symptoms will limit the amount and type of physical activity performed.

Angina pectoris is a symptom associated with myocardial ischaemia. Physical activity performed in this phase of rehabilitation is mainly targeted at maintaining function for daily activities. Its aim is to reduce the effects of bed rest. Effects of very low intensity exercise rehabilitation on the physiological aspect of quality of life at this point include: prevention of muscle wasting and associated loss of strength,
maintenance of functional capacity, prevention of reduced lung function, prevention of orthostatic hypotension, prevention of reduced blood volume and minimising risk of thromboembolism (Leon, Certo, Cormoss, Franklin, Froelicher, Haskell, Hellerstein, Marley, Pollock, Ries, Froelicher Sivarajan and Kent Smith, 1990; Pollock et al. 1984). All of these factors contribute to a decreased exercise and functional capacity. A further reduction in function is due to the area of myocardium affected by the infarct.

3.a(i). Physiological effects of exercise in phase one

During the first few days after infarction, if the patient who has had a heart attack attempts activity too early, physiological complications may result, through serious arrhythmia caused by a change in the conduction of impulses in the area of infarct tissue. If the client continues exercise, further ischaemia with possible infarction will result. Someone with well developed collateral circulation in the myocardium will exhibit fewer symptoms during exercise. Exercise helps to develop collateral circulation within the myocardium. The size and location of necrosed tissue will determine the extent to which stroke volume is reduced.

Some patients who have suffered a heart attack respond as a healthy individual to exercise. Skinner (1987) reports that even people who have arrhythmia can exercise safely. Arrhythmia is common post infarct and are the cause of a proportion of deaths. The capacity of the person to exercise depends on the number of diseased vessels, the extent of narrowing present and the extent and location of the damaged tissue.
3.a(ii). **Psychological effects of exercise in phase one**

Psychologically myocardial infarction is a frightening event which often leaves the patient feeling vulnerable and depressed. Feelings of sadness and helplessness are also often present (Barr Taylor, DeBusk, Davidson, Houston and Burnett, 1981). Reactions to the infarction are important in the prognosis for recovery and in participation in rehabilitation, including exercise rehabilitation. Anxiety and depression after a myocardial infarction are reported in the literature (Barr Taylor et al. 1981). Some degree of depression after a myocardial infarction is almost universal however most cases of depression will improve without treatment within six months (Barr Taylor et al. 1981). Between ten and thirty percent of patients continue to feel symptoms of depression up to one year later which requires treatment (Runions, 1985; Barr Taylor, 1981; Harrington, 1989). Causes for depression include the realisation of mortality, inability to perform previous social roles, the loss of autonomy, the threat of invalidism and hypoxia (Zimmerman and Vyden, 1983; Harrington, 1989). Exercise may assist in treatment of depression through an increase in oxygen supply to working tissues, improvements in self-esteem through feelings of accomplishment and independence and relief of boredom associated with inactivity.

Psychological limitations to physical activity include a possible fear of physical activity because of the possibility of re-infarction (Mayou, 1979).

Ischaemia may occur without symptoms, which will further limit functional capacity and possibly erode patient confidence in
performing physical activity due to anxiety caused by dependence on others or machinery to monitor activity. Symptom limited exercise testing in phase one is used to assess the prognosis of future cardiac events, for the design of exercise programmes after discharge, for restoring patient confidence and educating the patient about advised limitations for activity.

Patients who have a greater sense of mastery or control may have higher levels of self-esteem and confidence and therefore be more likely to achieve more just because they are willing to attempt exercise. Those who have higher levels of self-esteem and confidence are less likely to become depressed post infarction (Yates and Belknap, 1991). Patient education and mobilisation whilst still in hospital has reduced anxiousness about physical activity and quality of life after leaving hospital (Cay, 1988).

3.a(iii). Sociological effects of exercise in phase one

The social aspect of myocardial infarction include personal and societal costs through the sudden dependency of the individual on others for care. The attitudes of significant others has a strong influence in determining the reactions of the patient to the infarction (Mayou, 1979). The patient who has recently had an infarct will have a decreased activity level, at least short term, whilst the heart heals. Thus they cannot get out as often as they would perhaps like, and this will lead to boredom possibly, and frustration at not being able to fulfil previous social roles. The perception of reduced life quality due to reductions in activity is a common cause of post myocardial infarction depression (Yates and Belknap, 1991; Mayou, 1979; Zimmerman and Vyden, 1983). Dependency for the care of others,
on pharmacological therapy and machinery, may cause anxiety due to a change in roles.

The support and approval of the spouse is important in developing the intention to participate in an exercise programme (Daltroy and Godin, 1989).

3.b. **NEGATIVE EFFECTS OF EXERCISE IN PHASE ONE**

Denial of the severity of the myocardial infarction may manifest in the attempt to be more physically active than the physiological function of the individual dictates (Zimmerman and Vyden, 1983). Intense exercise in a person with sufficiently occluded cardiac arteries will produce angina, or its equivalent symptom, and if exercise is continued, exercise may cause infarction. Cardiac arrest is the most frequent major cardiovascular complication of physical activity during phase one (Pollock et al. 1984). This results from decreased coronary reserve and or decreased electrical stability of the myocardium from myocardial necrosis.

3.c. **EFFECT OF EXERCISE ON QUALITY OF LIFE IN PHASE ONE**

During the infarction and afterward, as a direct result of the infarction, the assumption is that quality of life is reduced. The main causes of a decrease in quality of life are cardiac symptoms and anxiety (Myrtek, 1987). Exercise may be used to alleviate both of these causes of reduced life quality. An increase in functional capacity, a decrease in disability and a decrease in symptoms through increased cardiac and muscular efficiency and psychosocial adjustment through exercise training will improve satisfaction with life and thereby improve psychological state and quality of life.
4. PHASE TWO EXERCISE REHABILITATION

Phase two of cardiac rehabilitation programmes usually last between eight and twelve weeks. The primary focus is to restore the level of functional capacity to a level where supervision by exercise and medical staff may be reduced, thereby advancing quality of life, through the achievement of better health and independent function, including physical activity.

4.a. EXERCISE DURING PHASE TWO

During phase one, activity was reduced. A return to normal activity levels and exercise will lead to increases in physical function, changes in psychological state and sociological function.

The type of exercise most favoured by rehabilitation providers and researchers has been aerobic, that is repetitive continuous movement of large muscle groups. In aerobic exercise the heart rate is held constant between sixty and eighty-five percent of maximal oxygen uptake. Exercise response is dependent on the amount of damage the myocardium has suffered, whether the conduction system of the heart has been damaged, the extent of co-lateral circulation, and the extent of myocardial ischaemia present (Skinner, 1987). Someone who has suffered a lot of damage to the myocardium will have limited capacity for exercise because they have already used much of their adaptive capacity at rest (O’Connor et al. 1989).

The generally accepted duration of this type of exercise is between twenty to thirty minutes within the heart rate training zone with additional warm up and cool down periods (Lamb, 1984). Some cardiac patients however may be unable to achieve this...
duration and so shorter bouts of exercise are substituted.

Oxygen uptake is usually assessed by exercise testing either on a treadmill or cycle ergometer. Many cardiac patients however will be limited in achieving a maximal test by their symptoms such as angina or angina equivalent, shortness of breath, unrelated orthopaedic or muscular symptoms, potentially dangerous changes in the electrocardiograph, anxiety or certain medications. Symptoms of ischaemia generally occur at the same level of work, indicated by heart rate, in individuals. In these patients the maximal heart rate achieved before the onset of cardiac related symptoms is substituted for the maximal oxygen uptake and the same training heart rate zone used for non-cardiac exercisers is used (Skinner, 1987).

The patient’s electrocardiograph during phase two has traditionally been closely monitored as a safety feature for indicators of ischaemia. However current thinking supports intermittent monitoring in order to reduce the cost of cardiac rehabilitation, since during phase one exercise rehabilitation patients have been taught to exercise below this point.

Some people, although physically capable will prefer to exercise less strenuously. Sixty percent of oxygen uptake at the angina threshold may be perceived as too strenuous. Other may prefer to exercise strenuously. Their wishes should be respected. Physical activity may include; aerobic exercise, mobility exercise, flexibility training, proprioceptive training, strength training, body toning, relaxation. Supervised and semi-supervised exercise improved aerobic fitness more than unsupervised exercise. Physical activity may be performed either
as deliberate exercise or as part of the daily routine. Physical activity need not be structured as in a formal gym or exercise centre. It may be performed in groups or individually away from such centres.

4.a(i). Effect of exercise on physiological function in phase two

Phase two cardiac exercise programmes contribute to improving quality of life through the three parameters described earlier; physiological function; the now stabilised patient is able to participate in a greater variety of physical activity, A symptom limited, graded exercise test performed at the beginning of phase two is useful in determining physical functional status and determining exercise to be performed in this phase of rehabilitation.

The greatest physiological improvements occur during the first three months after the infarct (Leon et al. 1990). This is due to a combination of the healing process and an increase in functional capacity due to resumption of normal activity. Once the heart has healed, compensatory changes occur in the tissue surrounding the infarct area, allowing improvement in cardiac output (Skinner, 1987; Pollock et al. 1984).

4.a(ii). Effect of exercise on psychological state in phase two

Smokers who exercise as part of their cardiac rehabilitation programme have greater success in cessation (Fletcher, 1984), this is attributed to the support and counselling received as part of the rehabilitation exercise programme. Anxiety has been reduced in patients exercising in unsupervised situations, such as home walking (Kugler, Dimsdale, Howard Hartley and Sherwood, 1990). This may be because walking
unsupervised is less likely to be perceived as being ill whereas when exercising in a hospital setting people who have had a heart attack may think of themselves as disabled.

People who have experienced MI or who have cardiovascular disease can experience the same psychological benefit from exercise as people without cardiovascular disease; increased sense of wellbeing and decreased tension/anxiety. An improvement in self esteem can be generated by participating in exercise through a sense of achievement, a sense of helping oneself and an improved body image. The feeling of accomplishment through mastery of new skills may be achieved by participating in exercise. The patient is taking their mind off their immediate concern and taking control and responsibility for their health and well-being.

The phase two exercise programme may operate as a distraction. It is possible that if a patient were preoccupied with the sick role that participation in an exercise programme could divert immediate concern. Exercise may also act as a mechanism for denial in post infarct patients (Yates, and Belkap, 1991). Patients will be less likely to perceive themselves as ill and therefore have an improved quality of life through increased physical function and reduced depression. Most patients with post MI depression will recover without treatment for depression within six months. However for the proportion that do not an exercise programme may assist in relieving the depression.

The reduction of depression associated with exercise rehabilitation during phase two may affect physical function. Effects include an increased level of self esteem and mastery of
new skills and an increased sense of control (Lewin, Robertson, Cay and Campbell, 1992), these factors may contribute to lower levels of depression in post myocardial infarction patients (Zimmerman and Vyden, 1983). This can be achieved through participation in an exercise programme. During the process of exercise rehabilitation psychological factors that boost self esteem and prevent/alleviate depression, such as the sense of achievement and accomplishment and the relief of stress (Ruberman et al. 1984) may enhance quality of life.

Exercise can be used to alleviate anxiety by the activity acting as a distraction from the role of being ill or symptoms, the expectancy of improvement by participating in exercise and by increasing body temperature (Petruzzello et al. 1993).

As physical ability improves through participation in exercise rehabilitation, the patient’s sense of independence may also improve (Yates and Belknap, 1991).

Psychological reactions to lifestyle intervention, especially exercise, as part of secondary prevention are increased self esteem and wellbeing and increased confidence. These factors contribute to the end goal of maximising quality of life. The relief of boredom, regained confidence in physical activity and education about physical limitations are positive psychological effects of exercise rehabilitation.

Upon homecoming activities of daily life are often the first physical activity that is performed. Fatigue and depression are very common (Zimmerman and Vyden, 1983) even though the patient has not yet returned to full activity due to the period of minimal activity in phase one. Lewin et al. (1992) found that
around one third of patients who had not gone through a rehabilitation programme were clinically anxious or depressed one year later. This lead to a preoccupation with physical symptoms, an inappropriate use of health services and increased health care costs. Illness behaviour is dependent on life satisfaction (Myrtek, 1987). People with low levels of life satisfaction are more likely to perceive themselves as ill and therefore make more visits to the doctor. Yates and Belkap (1991) set out to observe how a person’s perceptions of their physical ability relates to the objective results of their physical function. The results suggest that the person who returns to greater activity levels will be less depressed, have higher self esteem, have a higher level of perceived recovery and have less severe illness and less physical impairment. Levels of work output were not associated with either subjective or objective levels of physical function. Depression was associated with decreased physical function. Psychological reactions are not related to the severity of illness (Zimmerman and Vyden, 1983). Relaxation exercises have been shown to increase the patient’s ability to perform in exercise tests and have improved the patient’s ability to deal with stressful situations (Davidson, Winchester, Barr Taylor, Alderman and Ingels, 1979).

Changes in lifestyle, including exercise rehabilitation, made as part of the rehabilitation programme may be a source of anxiety or depression.

4.a(iii). Effect of exercise on the performance of social roles in phase two

Improved social confidence may be achieved through mixing with
others who have experienced the same problems and have successfully rehabilitated. Exercise in a group setting has a number of advantages over individual exercise. Confidence may be boosted by participation in group sessions. The group may act as a support group, there are personnel available should an emergency occur, and personnel available to monitor physiological and behavioral aspects of the programme and to promote adherence. Exercising in a group will help those who are anxious about exertion triggering a cardiac event. Support groups within cardiac exercise rehabilitation programmes can provide mutual support for both patients and their spouses. Social isolation and dependency on others may also be alleviated by exercising with other people. The chance to socialise with other people who have experienced similar circumstances also assists in improving quality of life.

Informal support groups within cardiac exercise rehabilitation programmes can provide mutual support for both patients and their spouses.

4.b. NEGATIVE EFFECTS OF EXERCISE IN PHASE TWO

Some individuals may find exercising in a group stressful (Blumenthal et al. 1982) and since psychological stress can produce electrocardiographic changes indicative of myocardial ischaemia (Davidson et al. 1979), patients should be given the choice of whether they prefer to participate in rehabilitation in groups or singularly.

4.c. EFFECT OF EXERCISE ON QUALITY OF LIFE IN PHASE TWO

When patients exercise as part of a comprehensive cardiac rehabilitation programme they are taking control and
responsibility for their quality of life. Quality of life may be enhanced through the psychological and sociological benefits of low intensity exercise for those with limited exercise capacity. Rehabilitation goals should be set by the patient within their limitations or desires, since it is they who have to actively participate. When assessing quality of life the current level of function is compared with previous levels of function. Assessment is useful when determining the goals of the exercise rehabilitation programme.

Ultimately because only the patient can judge their own quality of life, decisions about treatment, including exercise intensity, must be their own.

Myrtek (1987) demonstrated the value of exercise rehabilitation showing that as clients gradually incorporated greater levels of activity into their daily routine as a result of their exercise programme, they experienced an improvement in quality of life.
5. PHASE THREE EXERCISE REHABILITATION

Phase three exercise rehabilitation usually lasts four to six months and is essentially a programme of exercise designed for the maintenance and reinforcement of lifestyle changes, especially exercise, made in phases one and two. Phase three exercise programmes are essentially a transition between supervised exercise and self monitored exercise programme of phase four. It is a transition period between reliance on rehabilitation staff to self maintenance. For participation in this type of programme, the patient must be clinically stable, have no angina or angina which is predictable in its onset and experience no potentially dangerous arrhythmia. The patient should have the self confidence to attempt self regulated exercise, and the desire for self-monitoring. The participants in phase three programmes generally represent a low risk of secondary infarction. When entering phase three of cardiac rehabilitation, patients have had more time to recover from their heart attack and are more stable and stronger physically than in previous phases of recovery. Social and psychological adjustments to illness or disability are stronger. For people who have had an uncomplicated myocardial infarction, the time period between myocardial infarction and leaving phase three is usually one year (Wilson, 1988).

5.a. EXERCISE IN PHASE THREE

An exercise test is usually performed before entering phase three to determine exercise capacity (Skinner, 1987), and to determine the patient’s suitability for leaving closely supervised exercise (Leon et al. 1990). The exercise programme
targets a heart rate of between seventy to eighty percent of the maximum heart rate achieved in this test.

Phase three exercise includes longer duration of exercise bouts and a higher frequency or four to five times a week instead of three to four times as phases one and two of cardiac rehabilitation (Leon et al. 1990).

5.a(i). Physiological effects of exercise in phase three

The physical result of exercise in phase three is a continuation of the decrease in myocardial oxygen demand. This occurs through a decrease in heart rate (through increased parasympathetic activity of the vagus nerve), and a decrease in systolic blood pressure. Peripheral adaptations contributing to a decreased oxygen demand include an increased arteriovenous oxygen difference, indicating more efficient utilisation of oxygen by other muscles and improved oxygen transport to working muscles.

Physical changes as a result of long term exercise are predominantly non-cardiac. There is an increased ability of the skeletal muscles to utilise oxygen leads to a greater work output for less energy expended (O’Connor et al. 1989). Hence the cardiac patient is able to exercise at a greater intensity before the onset of symptoms or potentially dangerous electrocardiograph changes. The intensity of work at which ischaemic symptoms or electrocardiograph changes occur is increased by exercise training. Less energy is utilised in normal daily activity. The capacity for greater levels of physical activity exists.

5.a(ii). Psychological effects of exercise in phase three

After participating in phase three exercise, participants feel
less anxious, less introverted, less irritable and have higher self-esteem (Blumenthal et al. 1982).

Physiological changes may lead to the patients feeling that they have more energy, when they are actually using less and therefore have energy in reserve. Further enhancement of the sense of mastery and improvements to self-esteem are seen possibly due to enhanced physical recovery and psychological adjustment (Ben-Sira and Eliezer, 1990). A reduction in depression is seen in long term exercise groups (Stephens, 1988).

5.a(iii). **Sociological effects of exercise in phase three**

Long term adherence to lifestyle modification is dependent on the support of significant others (Daltroy and Godin, 1989). Some patients may be concerned about leaving supervised exercise. Exercising in an unsupervised situation, however, reduces anxiety more than in supervised situations, possibly through an increase in confidence and independence. If the patient exercises unsupervised they may be less likely to perceive themselves as being disabled by their illness (Kugler et al. 1990).

5.b. **NEGATIVE EFFECTS OF EXERCISE IN PHASE THREE**

There is a risk of sudden death during exercise (Curfman, 1993). People of varying levels of fitness all experience an increased risk of sudden death during exercise, however, for people who have high levels of habitual activity as part of their lifestyles, the risks are reduced, compared to those who do not exercise regularly (Siscovick, Laporte and Newman, 1985).

The monetary cost in supply of the service of cardiac rehabilitation and the time taken from other activities to perform exercise (Shephard, 1989) may be considered as a negative
aspect to exercise in phase three cardiac rehabilitation.

5.c. EFFECT OF EXERCISE ON QUALITY OF LIFE IN PHASE THREE

The main causes of a decrease in quality of life are the experience of cardiac symptoms and anxiety (Myrtek, 1987). Thus graduation to phase three exercise programme can improve quality of life because the patient has been exercising consistently and will benefit in both physically and psychologically.

The potential of each patient to improve quality of life depends on the magnitude of disease, age, gender, previous exercise habits, hereditary, psychological factors such as motivation, adherence and social factors such as the support of significant others (Daltroy and Godin, 1989).
6. PHASE FOUR EXERCISE REHABILITATION

Phase four is designed to be a life long maintenance programme, which is usually unsupervised or minimally supervised. Adequate instruction and the facility for further advice on exercise from health professionals if required later is essential.

6.a. EXERCISE IN PHASE FOUR

It is important to individualise unsupervised exercise programmes for phase four cardiac patients for the reasons of access to equipment, physical ability, psychological limitations, and social requirements of the patient.

The benefits of exercising on one’s own, as occurs in phase four, are that the type of exercise, intensity and duration can be tailored to the individual. Exercises can be performed at a time most convenient and when the patient’s energy levels are most suited. This is not always achievable in a group exercise session.

Because the programme is suited to the individual’s goals and expectations and abilities, progress may be achieved more quickly for the highly motivated exerciser. Problems exist in that correct technique and intensity cannot always be adhered to through inadequate instruction.

6.a(i). PHYSIOLOGICAL EFFECTS OF EXERCISE IN PHASE FOUR

The physiological changes which occur as a result of exercise in phase four are minimal compared to earlier phases. The function of phase four is the maintenance of changes made in the supervised component of rehabilitation.

The capacity or flexibility for readmission into any phase of
rehabilitation if required due to an increase in symptoms or decrease in functional capacity should be present due to the chronic nature of cardiovascular disease.

6.a(ii). **Psychological effects of exercise in phase four**

Motivation to adhere to a cardiac rehabilitation exercise programme remains high, at eighty percent, for three months following the infarction. Twelve months after the infarction adherence levels drop to forty-five percent. By the second year, adherence to regular exercise programme is reduced to as low as thirty percent (Houston Miller et al. 1990). At this time also, many have returned to their pre-infarct dietary and exercise habits (Houston-Miller, 1990).

Blumenthal et al. (1982) showed that after an MI those who were most likely to drop out of exercise rehabilitation exhibited greater depression scores, were more hypochondrial, more anxious and more introverted and had lower ego scores than those who stayed in the programme. It was not physical status that indicated whether patients would adhere, but rather these psychological variables. The exercisers must perceive that adhering to the programme will have beneficial effects on their quality of life, since the purpose for performing exercise is to experience positive effects. If the effects were determined by the individual to be negative, they would not continue to participate.

6.a(iii). **Sociological effects of exercise in phase four**

The approval and support of spouses is important in maintaining long term adherence to exercise (Daltroy and Gaston, 1989).

Patients may enjoy the socially interactive aspects of their
exercise programme; for example they may meet new people on their daily walk.

6.b. NEGATIVE EFFECTS OF EXERCISE IN PHASE FOUR

Whilst some people need encouragement to keep exercising but others need guidance to keep from over exercising. Some patients may feel dependent on rehabilitation staff for exercise advice.

Musculoskeletal injury following long term exercise may be caused by mechanical or physiological mechanisms, or be metabolic in origin (Powell and Paffenbarger, 1985). The injury may be acute or chronic and may be exacerbated by exercise; hence the requirement of individualised exercise programmes.

Addiction to exercise occurs when exercising takes priority over other important aspects of an individual’s life, such as work commitments or family (Barr Taylor et al. 1985). A person who has experienced a myocardial infarction may come to believe, that the chances of reinfarction will be reduced the more exercise performed. Since phase four is self monitored excessive exercise or addiction to exercise may result.

6.c. EFFECT OF EXERCISE ON QUALITY OF LIFE IN PHASE FOUR

Adherence to the exercise programme over a long period of time is essential to optimise the positive effects on quality of life. The impact of first myocardial infarction on subjective health has been examined (Myrtek, 1987). The patient’s sense of wellbeing improved, compared to the sense of wellbeing on entry to the programme, after the heart attack. This may be attributed to the rehabilitation programme and the encouragement of patients to take an active role in care for their own health.
7. SUMMARY

Patients who have had a myocardial infarction who do not attend rehabilitation cost the community ninety-four percent more in lost wages, medical expenses and subsequent morbidity in the twelve months following an infarct, than those who attend rehabilitation (Shephard, 1989). The secondary prevention of infarction is important not only from a monetary viewpoint, but quality of life in patients would be very much reduced with a second infarction; due not only to a decrease in physical function but possibly an increase in depression, anxiety, dependency on others for care. Positive effects on quality of life of participation in exercise rehabilitation are increases in physiological functional capacity, improvements in self esteem, confidence, general wellbeing and social support. The positive effect of participation in exercise rehabilitation on the quality of life of myocardial infarction patients is greater in most individuals than the negative aspects to exercise rehabilitation. The negative aspects to exercise are; a fear of exertion, increased anxiety in group situations, increased risk of cardiac arrest and addiction to exercise. The benefits of exercise in post myocardial infarction patients outweigh the risks to the patient. The effect of exercise in the pre-illness phase on quality of life is that of possible prevention of further cardiovascular illness, maintenance and improvement of physiological function, improvements in psychological state and the performance of social roles.

Quality of life during phase one is reduced by a decreased functional capacity due to physiological, psychological and
sociological changes as a direct result of the myocardial infarction. The person who has recently had an infarction usually suffers symptoms of ischaemia and may also suffer from side effects of pharmacological therapy. The patient must cope with depression and anxiousness. They must also learn to accept, at least short term, a change in their social role.

Phase two exercise rehabilitation concentrates on improving the psychological state of the individual with a gradual introduction of physical activity in addition to activities of daily life and testing. Physiological function is still somewhat limited by the infarction however can be improved with positive changes in the psychological state of the individual.

Exercise rehabilitation in phase three of cardiac exercise rehabilitation concentrates on improving physiological function and thereby improving quality of life.

An important factor in phase four rehabilitation is that of exercise adherence. Behaviours associated with health are influenced by the amount of perceived threat associated with that illness (Holm, Christman and Ashley, 1985). Patients are likely to return to former lifestyle as the experience of infarction becomes distant with time (Houston Miller et al. 1990), however the cardiac patient must maintain regular exercise and commitment to exercise in order to achieve the psychosocial and physical benefits of exercise (Holm et al. 1985). Social factors are most important in maintaining commitment to exercise in phase four of exercise rehabilitation.

The maintenance of quality of life through continuous overall benefit from participation in exercise rehabilitation is the goal
of exercise rehabilitation. There is the possibility of prevention of future cardiac morbidity through the modification of exercise habits, with associated benefits to physical function, psychological state and the performance of social roles, thereby leading to improved quality of life.
REFERENCES


