Physical Activity and Exercise

Benefits of Exercise
Measuring Intensity
Risk Stratification
Facilitating Physical Activity at Home
Heart Manual Exercises
Long-term Maintenance
FAQs

Physical Activity and Exercise

It is widely known that exercise has many physiological and psychological benefits. Despite this, there remains a high prevalence of inactivity in the UK population (Allender et al. 2006, Department of Health 2011). Physical inactivity is the 4th leading risk factor for global mortality resulting in a significant burden on individual health and indeed the health service. (Dept of Health 2011) How exercise is promoted in a safe and effective way within home-based settings does however raise a variety of questions for practitioners who have limited knowledge of exercise prescription. This section aims to provide a broad overview of exercise within the context of cardiac rehabilitation, its underpinning principles and recommendations.

Exercise has been shown to reduce total and cardiac mortality by 20% - 32% in those with cardiovascular disease, with inactivity as a risk factor being comparable to smoking and almost as great a risk factor as high cholesterol when linked to coronary heart disease (McPherson et al. 2002; Heran et al. 2011). At this point it is probably worth considering the difference between physical activity and exercise. Physical activity is defined by Moore et al (2006) as any physical movement produced by skeletal muscles that result in energy expenditure greater than that at rest. In this respect, any activity which involves a good range of movement could be considered to some extent beneficial, be it sporting activities, active hobbies, house work or activity associated with employment, travel or daily living. Exercise is therefore an extension of physical activity. It is often carried out in a planned, structured and repetitive way, in order to improve or maintain the body's physical fitness (Caspersen et al. 1985).

Physiological benefits of exercise

The benefits of exercise are numerous; these include reduced risk of cardiovascular disease, thrombo-embolic stroke, muscular-skeletal conditions, hypertension, type 2 diabetes, osteoporosis, obesity and some cancers such as colonic and breast cancer (Department of Health 2011). Advantages of regular exercise are also associated with increased functional capacity (Heran et al. 2011). This is frequently linked with rehabilitation, risk reduction through reduced prevalence of incidents such as falls, as well as averting functional limitations through exercise based interventions.

Leon and Fox (1981) suggest that exercise has either a direct or indirect effect on the following physiological factors:

- Improved physical capacity
- Increased cardio-respiratory system efficiency
- Optimisation of body mass through reduced adiposity, maintenance or increased muscle tissue and bone mineralization
- Improved or maintained muscle tone and strength
- Increased soft tissue and joint flexibility
- Reduced or controlled blood pressure
- Improved blood lipid profile
- Improved glycaemic control and insulin sensitivity

(cited in Serfass and Gerberich 1984, p.80)

In the context of cardiovascular disease, research has shown that regular exercise can influence several physiological factors which may reduce the risk of disease development and limit the threat of an acute event. This is achieved through improved blood pressure control, blood lipid profile, endothelial function, clotting response and myocardial perfusion (Smith et al. 2006).

Blood pressure is most effectively controlled through improved weight control, enhanced glucose utilisation and increased capillary networks within muscle tissue (Whelton et al. 2002). However recent trials have shown that people who are less fit have a 30%-50% greater risk of high blood pressure, while aerobic exercise is shown to lower blood pressure even in participants who are not overweight (Smith et al. 2006). Results indicate that all forms of exercise work in lowering blood pressure but adherence to an exercise programme is essential. The underlying mechanism responsible for this is uncertain (Whelton et al. 2002).

Exercise has demonstrated a positive impact on blood lipids by improving the high density lipoprotein profile, reducing the total plasma triglycerides and the triglyceride associated with low density lipoproteins (Fletcher et al. 1996; Durstine and Lyerly 2007). The exact mechanism for these changes is currently unclear although it has been suggested that an increase in skeletal muscle may affected fat metabolism (Department of Health 2004).

As atherosclerosis is the root cause of cardiovascular disease, any lifestyle associated behaviour which reduces the development of the disease must be advocated. Physical activity has been shown to have a direct effect on the coronary arteries through improved endothelial function and response to shear related stress

(Moore et al. 2006). Exercise also plays a protective role in coagulation and fibrinolysis, both of which are significant factors in relation to acute coronary syndrome (Caspersen et al. 1985).

One of the primary objectives of exercise in patients with coronary artery disease (CAD) is to improve the heart's functional capacity and blood supply through the enhancement of collateral circulation. Coronary collaterals, or "natural bypasses", are anastomatic connections without an intervening capillary bed between portions of the same coronary artery and between different coronary arteries (Popma and Bitti 2001). Collateral circulation has been recognised as an alternative source of blood supply to an ischaemic area of the heart for more than 200 years (Seiler 2010). The presence of collaterals in patients with stable angina who underwent elective PCI experienced a lower incidence of myocardial infarction (MI) (Berry et al. 2007). This demonstrates the importance of collateral circulation in improving myocardial perfusion.

It has been suggested that the formation of collateral circulation is related to prolonged periods of ischaemia, duration of occlusion, proximal lesion location, and long term physical exercise (Knaapen et al. 2006). Although the exact cause of collateral development may be unclear, there is agreement that this is an important adaptive response (Berry et al. 2007).

Psychological benefits of exercise

Most people who have participated in regular exercise will have at some time experienced the sense of well being that exercise can bring. Experimental research has indeed shown that all levels of exercise can lead to an increase in positive mood regardless of personal levels of physical fitness (Steptoe et al. 1993) however there is some evidence to support a positive dose related benefit (Galper et al 2006). In addition, physical activity has an important role to play in promoting mental health and wellbeing and can reduce the risk of developing depression, dementia and Alzheimers (Dept of health 2011).

In the general population, physical activity appears to be inversely associated with adverse depression and positively linked with emotional wellbeing. Exercise, therefore, can be used as a useful coping mechanism in dealing with stress and anxiety, via its use as a distraction technique to reduce anxiety or stress provoking

thoughts about a stressful event or situation. (This same technique can also be employed in health behaviour change when dealing with cravings for cigarettes or unhealthy snacks.) In addition there appear to be a number of mechanisms which may account for a reduction in depression. Exercise may prevent or reduce depression through the release of endorphins, the brains natural 'feel good' opiate, and through the increase in levels of nor-epinephrine (a deficiency of which can trigger depression). A clinical trial found that an exercise intervention (supervised or home-based) resulted in reduction in depressive symptoms, comparable to anti-depressant medication. (Blumenthal et al 2007)

A Cochrane review on the evidence for the effectiveness of exercise for those with a diagnosis of depression also indicated an improvement in depressive symptoms. However, the inclusion of more robust trials in the review found that overall the effects were small (Rimer et al. 2012). There is still a need therefore for further trials before the evidence base for exercise interventions to reduce depression in clinically depressed populations can be fully established.

More recently, the NACR report (2015) observed the improvements in levels of anxiety and depression as measured using the HAD scale pre and post cardiac rehabilitation intervention.

A non-biological explanation of the benefits of exercise on anxiety and depression may be the association with increased levels of social interaction.

Increased physical stamina may assist individuals in achieving daily activities as well as personal goals. Improved body image gained through weight reduction or increased muscle tone can enhance self esteem leading to participation in activities previously avoided. In turn this may result in an increased sense of self efficacy (King et al. 1992).

Measuring Intensity of Exercise

Absolute intensity

Intensity refers to the energy required to carry out a particular activity or how hard an individual has to work. For any given task there is an absolute rate of energy required. This is therefore referred to as the 'absolute' intensity. Absolute intensity is determined by calculating the metabolic equivalent of the task (MET).

One MET is referred to as the amount of oxygen which is consumed while at rest and is the equivalent of 3.5 ml of oxygen (O_2) per minute for each kilogram of body weight (mlO_2/kg/min). Therefore a MET is the multiple of the resting metabolic rate (the rate of energy consumption) and at rest, the average person has an oxygen consumption of 1 MET (Thow 2006). This consumption increases depending on the activity undertaken. METs have therefore been used to guide exercise prescription by allocating an estimated MET level to a wide range of leisure and daily living activities (Tables 1 and 2). MET values may range extensively within some activities such as playing tennis or making the bed, while others do not, for example walking.

Walking has a relatively constant MET value as there is very little variation in the way in which it can be performed. This allows it to be an activity which can be selected as a baseline for exercise prescription and can be modified by the speed and/or the intensity by which it is performed.

MET tables, such as the one offered by the Dept of Health (2004) (Table 1), can be useful tools when comparing various activities and their estimated energy costs. It can assist practitioners to set realistic and achievable baselines with patients by comparing the energy cost of exercise they are currently doing such as walking (3 mph) and converting this to a different activity at a comparable MET level or higher.

Table 1: Intensities and energy expenditure for common types of physical activity.

Activity	Intensity	Intensity (METS)	Energy expenditure (Kcal equivalent, for a person of 60kg doing the activity for 30 minutes)
Ironing	Light	2.3	69
Cleaning and dusting	Light	2.5	75
Walking – strolling, 2mph	Light	2.5	75
Painting/decorating	Moderate	3.0	90
Walking – 3mph	Moderate	3.3	99
Hoovering	Moderate	3.5	105
Golf – walking, pulling clubs	Moderate	4.3	129
Badminton – social	Moderate	4.5	135
Tennis – doubles	Moderate	5.0	150
Walking – brisk, 4mph	Moderate	5.0	150
Mowing lawn – walking, using power-mower	Moderate	5.5	165
Cycling – 10-12mph	Moderate	6.0	180
Aerobic dancing	Vigorous	6.5	195
Cycling – 12-14mph	Vigorous	8.0	240
Swimming – slow crawl, 50 yards per minute	Vigorous	8.0	240
Tennis – singles	Vigorous	8.0	240
Running – 6mph (10 minutes/mile)	Vigorous	10.0	300
Running – 7mph (8.5 minutes/mile)	Vigorous	11.5	345
Running – 8mph (7.5 minutes/mile)	Vigorous	13.5	405

MET = Metabolic equivalent
1 MET = A person's metabolic rate (rate of energy expenditure) when at rest
2 METS = A doubling of the resting metabolic rate
For a full definition of METS, see Appendix 1.

Source: Department of Health (2004) At least five a week: Evidence on the impact of physical activity and its relationship to health. A report from the Chief Medical Officer. *as cited in* DOH (2011) document *Start Active ,Stay Active*.

For some patients, it is more important to know the relative energy costs of tasks of daily living (Table 2). This information can help guide individuals by contrasting the energy costs of activities, such as showering, with those of a relatively high energy cost, such as unloading a washing machine. In some cases, the use of MET tables can help reassure individuals who are anxious about returning to an activity such as sexual intercourse by relating the energy costs of the desired activity to activities already successfully under taken.

It is worth noting that adverse events when resuming sexual activity are rare. (Steinke et al 2013) It is advised, however, that patients who wish to resume sexual relations should be able to undertake physical activity equating to 3-5 METS of energy expenditure. This is the equivalent of walking up 2 flights of stairs at a brisk pace. (Dory 2002) Steinke et al (2013) suggest that cardiac surgery patients are able to resume sexual activity at approximately 6-8 weeks post op providing the sternal incision is well healed. The prevalence of sexual problems in cardiac patients is higher than in the general population and research has revealed that this is an area that is rarely addressed by health professionals. (Byrne 2010).

It has been suggested that cardiac rehabilitation professionals are well placed to support patients in this regard (Byrne 2010) and the European Consensus document (Steinke et al 2013) advises that we take a more active role in tackling the concerns of these patients. Please also see chapter on Sex for more information on this topic.

Some sources would suggest that achieving a physical activity level of a **moderate intensity** i.e. 3 - 6 METs, is appropriate for healthy adults (Fletcher et al. 1996; Nelson et al. 2007). It is important however to remember that the assigned level of METs given to activities (Table 2) are an 'estimation' of an average person's metabolic rate or the 'absolute' rate of energy expenditure (metabolic cost). It does not consider additional variables such as the simplicity or complexity of the movements undertaken or the age or physical capacity of the individual involved (Thow 2006).

Table 2: (British Association of Cardiac and Rehabilitation 2000)

Energy Costs Tasks of Daily Living		
Task	**MET (MIN)**	**MET (MAX)**
Bed making	2	6
Carrying heavy groceries	5	7
Cleaning windows	3	4
Cooking (standing)	2	3
Dressing	2	3
Driving a car	1	2
Eating	1	2
General housework	3	4
Grocery shopping	2	4
Loading/ unloading washing machine	4	5
Lying awake	1	2
Mowing (by hand)	5	7
Painting/ decorating	4	5
Sexual intercourse	3	5
Showering	3	4
Vacuuming	3	3.5
Walking upstairs	4	7
Washing car	6	7
Washing dishes	2	3
Watching Television	1	2

Relative intensity

Relative intensity is defined as the effort in relation to the individual's level of fitness (Department of Health 2004). Lee et al (2003) demonstrated an inverse association between relative intensity and risk of CAD; the higher the relative intensity the lower the risk of CAD. The study showed how relative intensity can be of greater use than absolute intensity. It achieved this by demonstrating how lower level physical activities could benefit inactive participants even when absolute intensity levels were lower than current recommendations (<3 METs) (Lee et al. 2003). Relative intensity therefore has a significant part to play when guiding exercise within clinical settings.

Definitions of Intensity

Moderate Intensity:

A person who is doing moderate intensity activity will usually experience an increase in breathing rate and an increase in heart rate, will feel warmer and may perspire on hot or humid days. This amount will vary from one individual to another depending on that person's level of fitness. A moderate intensity activity requires a moderate amount of effort e.g. brisk walking, housework and domestic chores. On an absolute scale, moderate intensity is defined as physical activity that is between 3 and 6 METs.

Vigorous Intensity:

Someone undertaking vigorous intensity physical activity will usually be breathing very hard, have a rapid heartbeat, be perspiring and unable to carry on a conversation. A vigorous intensity activity requires a large amount of effort, e.g. running and climbing briskly up a hill. On an absolute scale, vigorous intensity is defined as physical activity that is above 6 METs.

Rate of Perceived Exertion (RPE)

The Borg scale (Table 3) is a recognised scale first produced in the 1970's and used in many exercise programmes. It is a tool for estimating effort and exertion, breathlessness, and fatigue during physical work. It was designed to be a simple method taking into account all-important messages from the body and using them to regulate behaviour. **The scale can be used both to prescribe exercise and score an activity**, allowing individuals to note their improvement and potential to increase their activity.

Perceived exertion is rated based on a person's experiences during physical activity including heart rate, respiratory effort, body temperature, muscle fatigue and effort. Although it is a subjective measure, Borg et al (1982) found that there was a correlation between a person's rate of perceived exertion (RPE) and their heart rate, lactate levels, percentage VO_2max and breathing rate (Noble et al. 1983).

It is possible to estimate an individual's heart rate simply by multiplying their RPE by 10, although this is only an approximation, as their actual heart rate must factor in multiple variables such as: age, physical condition and pharmacological therapies.

Table 3: Borg Scale (Borg 1982)

The 15 point Borg Scale
6
7 very, very light
8
9 very light
10
11 fairly light
12
13 somewhat hard
14
15 hard
16
17 very hard
18
19 very, very hard
20

When using the Borg scale, a level of 12-14 refers to a moderate rate of intensity or 'somewhat hard'. A patient working at this level will describe: **feeling warmer, notice their heart and breathing rate higher, feel tired but are able to continue and should still be able to talk easily.**

We have included the Borg scale information as it is frequently used by exercise practitioners and in research.

Unlike the Borg scale, the Heart Manual's self perceived exertion scale is not numerically linked to a verbal expression of effort, but aims to offer a highly simplified method of detecting and monitoring ones level of effort by assessing perceived difficulty. The Heart Manual uses a 'Likert scale' which ranges from approximate levels of ease to levels of difficulty (Figure 1) (NHS Lothian 2010). When correlated with the Borg numerical scale, a rate of 11-13 is therefore considered as being between 'too easy' and 'somewhat hard' on the Heart Manual exercise/activity scale. This is the level we encourage our patients to work towards for benefit. Although a very simple tool, the scale has been proven to be highly effective when supporting patients not only to set goals related to physical activity but while working on other aspects of behavioural change.

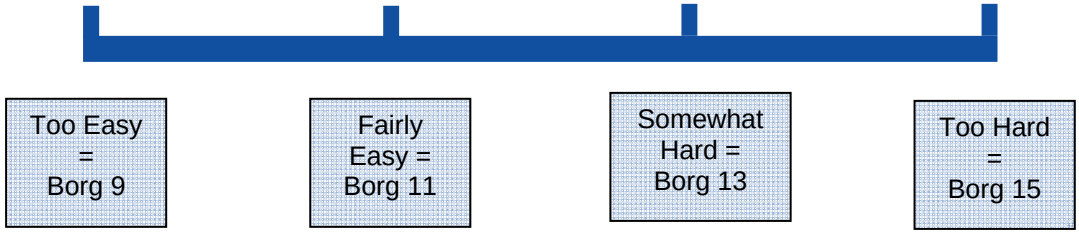


Figure 1: The Heart Manual Rate of Perceived Exertion Scale and the equivalent rating on the Borg Scale (Borg, 1982; NHS Lothian 2010)

Estimation of exercise training heart rate

In some rehabilitation settings and for some exercise or rehabilitation specialists, it is appropriate to calculate a patient's 'training heart rate'. The training intensity (training zone) for most patients will be between 60-75% of their predicted maximum heart rate (HRmax). Maximal tests such as the ISWT (integrated shuttle walk test) will typically have a test HR cut off of 80% of the patient's predicted maximum heart rate.

Specialists often use the Karvonen method for calculating target heart rate, (particularly if the patient is in atrial fibrillation) as it also takes into account the difference between your maximal heart rate and your resting heart rate, called the 'heart rate reserve'. As you train, your resting heart rate decreases while your maximal heart rate stays much the same so the gap increases with an increase in your fitness. This formula accounts for this and is therefore seen by many professionals as the best formula for these calculations (Thow 2006).

As individuals using the Heart Manual exercise/activity plan do so independent of any direct professional supervision, the use of heart rate monitoring can only be advocated by those who have specialist knowledge in exercise prescription and undertaken by the patients themselves. In practice patients are often encouraged to pay more attention to their rating of perceived exertion and "getting to know their bodies" rather than becoming reliant on artificial methods of monitoring heart rate.

Risk Stratification

The main risks of exercise for people post MI or coronary artery bypass graft (CABG) is associated with the possibility of provoking arrhythmia or wound instability (British Association of Cardiac Rehabilitation 2000). Those at greatest risk of the development of arrhythmia are patients who have experienced extensive myocardial damage, continue to demonstrate residual ischaemia and/or have exercise induced ventricular arrhythmias.

In order to guide practitioners in the delivery of a safe and effective service, the American Association of Cardiovascular and Pulmonary Rehabilitation (AACPR), British Association for Cardiovascular Prevention and Rehabilitation (BACPR) and Scottish Intercollegiate Guidelines Network (SIGN) guideline 57 advocate the adoption of a risk stratification criteria for patients participating in cardiac rehabilitation (British Association of Cardiac Rehabilitation 2000; Scottish Intercollegiate Guidelines Network. 2002; American Association of Cardiovascular and Pulmonary Rehabilitation. 2004).

Risk stratification should take into consideration the patient's functional capacity, ischaemic burden, potential for arrhythmias and left ventricular function (Thow 2006). Key considerations include:

- A history of more than one previous infarct
- An anterior infarct
- High biomarkers at the time of infarct
- Complications such as left ventricular failure or cardiogenic shock
- Symptoms such as breathlessness or orthopnea
- Clinical findings such as an enlarged heart or pulmonary venous congestion on x-ray or poor ventricular function on echocardiogram
- A low exercise capacity on exercise testing

(Thow 2006).

Typically the AACVPR risk stratification table is utilised. (2012) (Table 4 below) Please note that patients can only be considered “low risk” if they meet every criteria. If a patient meets even one of the criteria in the moderate column, they cannot be classed as truly low risk. The majority of our patients therefore are likely to fall into the low to moderate risk category.

Table 4: AACVPR (American Association of Cardiovascular and Pulmonary Rehabilitation) 2012. Stratification Algorithm for Risk of Event

AACVPR Stratification Algorithm for Risk of Event

Not specific solely to exercise events.

❶ Patient is at **HIGH RISK** if ANY ONE OR MORE of the following factors are present:

- Left ventricular ejection fraction < 40%
- Survivor of cardiac arrest or sudden death
- Complex ventricular dysrhythmias (ventricular tachycardia, frequent [> 6/min] multiform PVCs) at rest or with exercise
- MI or cardiac surgery complicated by cardiogenic shock, CHF, and/or signs/symptoms of post-procedure ischemia
- Abnormal hemodynamics with exercise, especially flat or decreasing systolic blood pressure or chronotropic incompetence with increasing workload
- Significant silent ischemia (ST depression 2mm or greater without symptoms) with exercise or in recovery
- Signs/symptoms including angina pectoris, dizziness, lightheadedness or dyspnea at low levels of exercise (< 5.0 METs) or in recovery
- Maximal functional capacity less than 5.0 METs*
- Clinically significant depression or depressive symptoms

❷ Patient is at **LOW RISK** if ALL of the following factors are present:

- Left ventricular ejection fraction > 50%
- No resting or exercise-induced complex dysrhythmias
- Uncomplicated MI, CABG, angioplasty, atherectomy, or stent:
  - Absence of CHF or signs/symptoms indicating post-event ischemia
- Normal hemodynamic and ECG responses with exercise and in recovery
- Asymptomatic with exercise or in recovery, including absence of angina
- Maximal functional capacity at least 7.0 METs*
- Absence of clinical depression or depressive symptoms

❸ Patient is at **MODERATE RISK** if they meet neither High Risk nor Low Risk standards:

- Left ventricular ejection fraction = 40–50%
- Signs/symptoms including angina at “moderate” levels of exercise (60–75% of maximal functional capacity) or in recovery
- Mild to moderate silent ischemia (ST depression less than 2mm) with exercise or in recovery

**If measured functional capacity is not available, this variable can be excluded from the risk stratification process.*

Functional capacity

There are several methods to measure functional capacity. These include: exercise tolerance testing (treadmill test) with or without gas analysis, cycle ergometry, shuttle testing, the 6 minute walk test and box stepping exercise such as the Chester step test. It is important however, to consider the feasibility, accuracy and validity of each of these measures before attempting to implement these within clinical practice (Dugdill et al. 2009).

Accurately assessing exercise intensity can only be achieved by measuring the body's oxygen uptake (VO2). VO2 max refers to the body's maximum capacity to transport oxygen and use it during increasing physical activity. This may be calculated at an absolute rate as litres of oxygen per minute (l/min) or relative rate in millilitres of oxygen per kilogram of body weight per minute (ml/kg/min). True measures of VO2 can only be obtained through cardio-pulmonary exercise testing along with gas analysis (Thow 2006). When measuring intensity, a moderate level of activity would be measured as 40 – 60% of the individuals VO2 max.

VO2 max can be used to calculate the relative intensity of an activity or exercise. Exercise testing with gas analysis can therefore provide information, not only the VO2 max, but an accurate guide to an individual's peak MET (metabolic equivalent of the task) capacity. It is important to point out however, that very few patients will undergo this form of exercise testing.

The Scottish Intercollegiate Guidelines Network (SIGN) cardiac rehabilitation guideline 57 (2002) recommend that exercise testing and echocardiography be primarily used for those deemed at high risk or who require high intensity exercise training. The majority of patients that we see in cardiac rehabilitation settings will fall into the low to moderate risk category. It is therefore common for those supporting patients within cardiac rehabilitation and in particular in the home setting, to have little or no formal guidance as to the specific exercise capacity of the patients that they see (McConnell et al. 1998; British Association of Cardiac Rehabilitation 2000)
It is important to note that for most patients, clinical risk stratification is a sufficient measure of risk prior to undertaking low to moderate levels of exercise. (SIGN 57 2002)

Clinical risk stratification

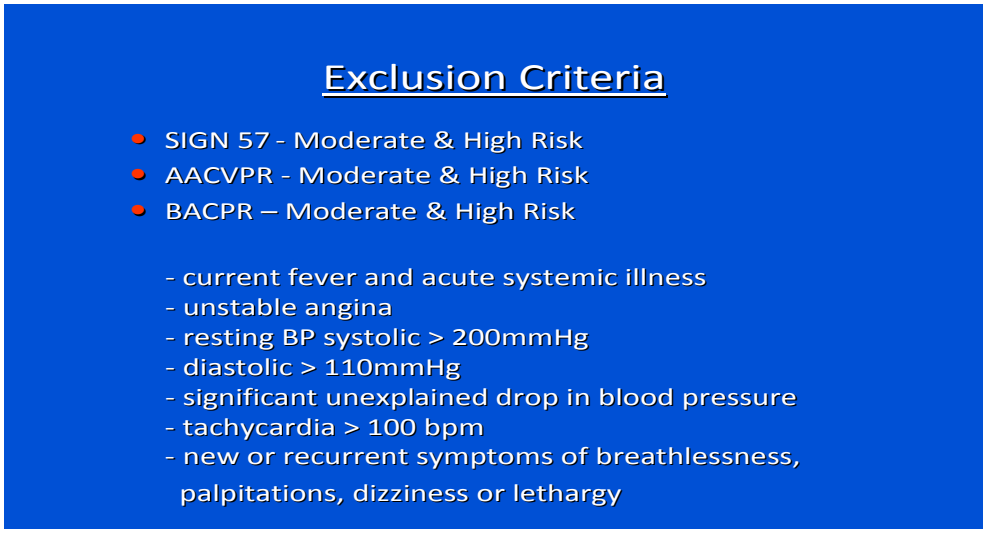
- Patient history
- Clinical examination
- Resting ECG
- Functional capacity test (ISWT: integrated shuttle walk test or 6 minute walk test)

It is common for a functional capacity test such as the ISWT to be carried out pre and post cardiac rehabilitation programmes and is often a key outcome measurement. They are relatively easy to perform and do not require too much equipment, with a set protocol described in the SIGN 57 guideline (2002) It is a maximal and progressive test. For patients who are less able, the 6 minute walk test is a good alternative. This is a sub-maximal test where patients choose their own intensity of exercise as it is self-paced over 6 minutes, and they are able to stop and rest. (American Thoracic Society:ATS 2002) Facilitators or staff working within cardiac rehabilitation settings, may wish to complete the core competencies booklet for physical activity and exercise produced by the BACPR (2012).

Contraindications to exercise

Patients who are displaying unstable symptoms or who are awaiting imminent intervention should not be included in cardiac rehabilitation programmes. In general, good practice, and common sense should dictate that if a patient is currently unwell, they should be excluded from exercise. Regardless of risk category, we would advise patients not to exercise if any of the criteria in table 5 below are met.

Table 5: Exclusion criteria for exercise



Exercise after a cardiac event

While recommendations for exercise in the general population are clear (see section below) the recommendations for those 'immediately' post cardiac event or intervention appear less clear. This is particularly important as the patient's exercise capacity is infrequently assessed prior to discharge and tailored exercise prescribed. Although the American College of Sports Medicine (ACSM) have produced guidelines to assist practitioners, these guidelines tend to be offered with the assumption that exercise testing be conducted before any structured physical activity takes place (Cooper et al. 2007). However routine exercise testing often does not take place until the patient is enrolled into a phase III cardiac rehabilitation programme.

A meta analysis conducted by Haykowsky et al (2011) found that exercise training has beneficial effects on left ventricular remodelling in stable post MI patients, with the greatest benefits being seen when activity is started early (from one week) and is sustained for at least three months (Haykowsky et al. 2011). This is particularly important as remodelling can predict cardiac mortality post event (Sutton and Sharpe 2000; de Waard et al. 2007). There is however a lack of evidence within guidelines as to when the optimum time to commence exercise post cardiac event/treatment is. We do however know that within the UK, cardiac rehabilitation programmes may not commence for 2 to 7 weeks post discharge depending on the type of event, treatment and local service provision (British Heart Foundation 2010).

These delays have clear implications, considering that each week delay in starting a programme may require an additional month of training in order to achieve the same physiological benefits (Haykowsky et al. 2011). NICE QS99 (2015) recommend that cardiac patients commence cardiac rehabilitation programmes as soon after a heart attack as possible as this greatly improves their likelihood of attending a centre based programme.

Starting exercise programmes at such an early stage does raise concern regarding patient safety. There is however evidence to suggest that early activity in those classified as being at low risk is safe for most people, with the use of stress testing using the Bruce protocol being advocated as early as 3 days post infarction (de Waard et al. 2007; Haykowsky et al. 2011).

As this is not routine practice, the BACPR offers some guidance on initiating exercise during the early phases of recovery through the promotion of an incremental walking plan (Table 6)

Table 6: Incremental walking plan (British Association of Cardiac Rehabilitation 2000).

Week	15 Borg Scale	Duration (mins)	Distance (yards)	Frequency (per day)
1	11-12	5	200	1-2
2	11-12	10	400-500	2
3	11-12	15	500-750	2
4	12	20	750-1250	1-2
5	12	25-30	1250-1750	1-2
6	12	30-40	1750-3000	1-2

As the Heart Manual exercise/activity plan is frequently started with no preliminary exercise testing, it is important to err on the side of caution and offer conservative guidance, unless the facilitator is trained in exercise prescribing. The aim is to encourage the patient to work within a rate of perceived exertion which is between 'fairly easy' and 'somewhat hard'. This equates to between 11 and 13 on the Borg scale and is therefore equivalent to low to moderate exercise It is important however to be aware of the possible impact that lower physical capacity and medication such as beta blockers may have on the individual's exercise tolerance, with activity being titrated according to their clinical status (Thow 2006). Even if no functional testing has been carried out, knowledge of risk stratification, patient history and intervention carried out, will be important when starting the programme. If there are any contraindications to exercise (see above) these would need to be addressed/discussed with a specialist before the Heart Manual programme is commenced.

Facilitating Physical Activity within the Home Setting

For some patients, centre based exercise programmes will not be suitable for a variety of reasons. There may be physical incapacity, early return to work or practical issues such as lack of transport. For such patients the Heart Manual provides a viable alternative as the only home based comprehensive cardiac rehabilitation programme currently endorsed by NICE (2013) and SIGN (2002).

Research supports the efficacy of home based programmes in comparison to centre based programmes (Jolly et al 2007, Cochrane Review 2010) and with the introduction of digital versions of the Heart Manual, the patient is presented with even greater choice.

The facilitator's role is to:

- Support the patient to identify safe, realistic and achievable goals
- Encourage the patient to self monitor their response to activity, noting any signs and symptoms which may occur
- Provide education regarding the exercise content to both the patient and their family
- Promote appropriate activity throughout the day

The intention is to return the individual to their pre-event vocational and recreational activities while optimising their physical capacity. For some people, achieving full physical recovery may take several months to achieve and is therefore beyond the scope of the Heart Manual 6 week programme. The aim is to guide the patient through the process of goal setting in order to work towards full recovery. The utilisation of additional community or cardiac rehabilitation resources to optimise physical recovery is therefore actively encouraged.

As with many other aspects of the Heart Manual, it would appear inappropriate to offer a one size fits all approach to exercise. The facilitator must therefore: work with the individual to find the most appropriate activity/activities, identify the correct intensity, highlight the frequency and duration to gain the greatest protective benefit, support the achievement of personalised goals and acknowledge and minimise any risk. This approach is often described as four domains, or 'FITT', where FITT stands for:

Frequency - How often is the activity done per day and/ or per week?

Intensity - Refers to the level of exertion. Does the activity make the individual feel warm and slightly out of breath signifying moderate intensity activity, or out of breath and sweating, signifying vigorous activity?

Time - How long is the individual active for?

Type - Does the activity have an influence on health as well as function? What impact does the specific activity have on physical capacity and which muscle groups are involved?

This tailor made approach, focussing on general principles of goal-setting and pacing, and individualising advice on exercise progression, means that the Heart Manual can be suitable for the majority of patients, regardless of what their baseline activity is. The knowledge and skill of the facilitator is critical to this process.

Setting a baseline

When assessing physical capacity it is important to consider the individual's functional capacity prior to their event as well as the physiological impact that the event may have on their ability to exercise. If a 'fit' individual does the same activity as someone who is considered 'unfit', the absolute intensity, if using METs, will be the same but the relative intensity will be much higher for the individual who is less fit. This is particularly important when considering the baseline activity level of those who have been restricted due to physical disability, increased weight or a previous propensity towards a sedentary lifestyle. Offering guidance regarding the most suitable exercise and the intensity level at which the activity should commence must therefore take into consideration:

- Risk stratification
- The individual's objectives, beliefs, knowledge and motivation
- Age
- Gender
- Ethnicity
- Co-existing pathology
- Orthopaedic limitations
- Habitual activity including occupational and leisure pursuits
- Medication

Start by thinking about the goal – what do people want to achieve?

It is important to consider past experiences. Those who regularly participated in physical activity in the past are more likely to adhere to exercise focused goals in the future (Fraser and Spink 2002). Encourage the individual to reflect on what they previously enjoyed doing or focus on what they would like to be able to do in the future. If they have negative experiences of 'exercise' try to think about physical activities which can be blended into a daily routine such as walking or those activities with a social focus such as dancing.

Finding the baseline – how do I get people started?

Setting baselines for the Heart Manual exercises and pacing them up is a really useful way of demonstrating how to manage the 'overactivity-rest' cycle. It enables the individual to take control of their physical recovery by building up their activity while utilising the core principles of goal setting.

The baseline is the amount of physical activity that an individual can do without increasing any symptoms such as breathlessness, chest pain or increased fatigue. The baseline should however be enough to have a training effect. The goal with these exercises is to induce activity to a moderate level. The individual should feel that they are breathing faster and feel warmer but they should not be so breathless that they cannot talk. They should be able to speak normally while exercising.

Begin by demonstrating the exercises, and then ask the patient to perform the same exercise while you observe their technique. Correct if necessary.

Assess how the patient scores the effort involved, ensuring that they are aware of the signs that indicate they are exercising at the correct level.

Reiterate the importance of not working beyond their capacity. Remember encouraging a realistic baseline is more motivating than having to cut back personal goals.

The manual suggests starting with 5 repetitions of each exercise. This may seem very easy for some people but it may also discourage some from starting. As a facilitator your role is to help them to find their baseline.

You will need to consider:

- Previous and present exercise and occupational activity
- Individual goals, such as a long term goal that the person has already set
- How important the individual considers exercise to be and how confident they are at re-initiating physical activity

Even if the individual has been reasonably fit in the near past, the body can de-condition very quickly. It is important to point out that they may not feel the effect of exercise until 24 or even 48 hours after exercise. Therefore remind them that slow and steady wins the race.

If 5 repetitions seem to be too easy, perhaps it is worth considering setting the goal as a period of time rather than repetitions, such as 30 seconds of each exercise, remembering to monitor the pace that they do the exercise. Another way to make it more challenging is to repeat the exercise program. Physical activity doesn't have to be long periods of exercise, as shorter spells of activity could be done on several occasions throughout the day.

For more specific exercise advice or if you are unsure about the suitability of any exercise, it is advisable to contact a local specialist physiotherapist or exercise specialist.

Post PCI (Percutaneous Coronary Intervention) Exercise Information

The demand for PCI has increased dramatically since the 1980's but it is important to remember it is not a cure for CAD and secondary prevention strategies are critical. These patients are different from the rest of the cardiac population as they have a short hospital stay, minimal contact with health professionals and as a result may lack motivation to make lifestyle changes. This has also meant that they are poor attendees in cardiac rehabilitation programmes. Research has shown that one-third of those surveyed following elective and post-MI PCI believed they were cured (Throndson and Sawatzky 2009). These patients also have minimal procedure pain and their quick recovery seems to minimise the perceived severity of their underlying illness.

The benefit of exercise in the PCI population has been substantiated in the research literature with lower re-hospitalisation, a reduced need for further revascularisation, a decrease in the severity of re-stenosis, fewer adverse events and an improvement in quality of life (Throndson and Sawatzky 2009).

The shorter convalescence associated with PCI procedures means that these individuals may return to work while still recovering, leaving them little time to attend a traditional hospital/community based cardiac rehabilitation programme. However Throndson and Sawatzky (p. 20, 2009) note that , 'According to the American College of Sports Medicine's (ACSM) risk stratification criteria, the majority of elective

PCI patients would be considered as low-risk and, therefore, could safely participate in exercise programmes'.

According to guidelines published from the Cardiac Rehabilitation section of the European Association of Cardiovascular Prevention and Rehabilitation (EACPR) (Corra et al. 2010), it is recommended that those post acute coronary syndrome (ACS) and post primary PCI can start physical activity such as walking or low intensity exercise the next day, if the procedure was uncomplicated.

If their exercise capacity has remained the same with no symptoms, a patient can resume routine physical activity for 30-60 minutes, such as brisk walking. If this is not the case they should resume at 50% of their maximal exercise capacity and gradually increase as per the guidance in the manual (Corra et al. 2010).

The EACPR recommend, as the Heart Manual does, at least 30 min aerobic activity 5 days/week. There is, however a lack of studies looking at different exercise regimes in these patients and although the EACPR recommend exercise testing 7-14 days for post ACS and post primary PCI and the next day post elective PCI, this is seldom done (Corra et al. 2010).

However this shows that most patients post elective PCI can continue with their previous exercise levels soon after their procedure, while post primary PCI (STEMI) either formal stress testing or clinical risk stratification including functional capacity testing is usual prior to commencing formal exercise depending on the severity of their MI and intervention carried out.

Post Surgery Exercise Information

There is limited published data on how patients are mobilised and exercised during the post-operative period and therefore on what advice they are given when they leave hospital.

Recent published surveys on physiotherapy treatment in Sweden and Canada (Overend et al. 2010; Westerdahl and Moller 2010) show that there are no hard and fast rules, although all follow similar practices. This is also true for the UK. It is always essential that patients follow whatever specific advice they have been given by clinical staff on their discharge.

Exercise training programmes are seen as a way to tackle risk factor improvements but research shows that the safest way to prescribe this is by sub-maximal exercise testing as soon as possible and maximal exercise test after surgical wound stabilization (Corra et al. 2010). This is however, very seldom done but it is still important to be aware of other factors that would be taken into consideration. Exercise testing would not be done if a patient were experiencing: haemodynamic instability, rhythm disturbance, musculoskeletal (sternal) discomfort or instability. A modified exercise test may however be conducted on those who had incomplete coronary revascularisation and/ or were de-conditioned prior to their procedure.

There are some common principles, advice and precautions followed in the hospital setting, which are worth noting.

- Mobility - all centres encourage graduated increases in mobility and most have done stair climbing before discharge especially if stairs were present at home
- Arm exercises, including shoulder range of movement and lower limb exercises, are given at the majority of cardiothoracic surgical sites
- Sternal precautions - the maximum weight restriction for upper extremity lifting varies from 5lb – 10lb
- Most areas suggest that supported coughing should be practised. Interestingly a small study indicated that lifting 40lbs generates less force on the median sternotomy incision than is generated by a cough

(Overend et al. 2010).

It has been suggested that current activity guidelines for CABG patients are too restrictive (Westerdahl and Moller 2010) with one research paper detailing an example of a patient being exercised at high intensity only 2 weeks post op. (Adams and Berbarie 2013) However, as postoperative sternal instability is a serious complication, care needs to be taken, especially with the at risk patient, such as those who are obese, have pre-existing chronic obstructive airways disease, have had bilateral internal mammary artery grafting or who are diabetic (Diez et al. 2007).

Once patients return home it is important to continue to encourage their participation in the exercises/activity that they started prior to discharge. All of these activities can be enhanced by promoting the principles of self perceived exertion, focusing on

working between ‘Fairly easy’ (11 on the Borg scale) and ‘Somewhat hard (13 on the Borg scale) and progressed using the same principles. These may include:

- Building up on the walking distance and intensity they started in the hospital and recording it in their manual.

- Continuing to work on maintaining a good posture while walking and sitting by lifting their chest and letting their shoulders go back and down.

- Continuing with the arm exercises they were shown, which may include forward and backward shoulder rotations, shoulder shrugs and raising both arms to the front and then out to both sides. All movements should be done without weights, done bilaterally and within a comfortable range.

- If a radial artery has been used as a donor graft, simple forearm and hand exercises should be done to prevent weakness and stiffness.

- If a saphenous vein has been used, individuals should be encouraged to keep their legs elevated when sitting, and to have frequent periods of activity to aid adjustment and recovery of the venous system. Prolonged periods of sitting should be broken up by toe, ankle and quadriceps exercises, especially if there is swelling.

- It is important to be aware of any specific sternal precautions. Complete union will take 8-12 weeks, but gradually increasing the weights lifted in activities around the home should be encouraged in a managed way.

- The Heart Manual exercises can be started safely setting the baseline as described but stretching should be restricted till the leg wound has healed. If wound healing is an issue, the focus should be on prolonging the cool down routine after the exercise phase has been completed.

The Heart Manual Exercises

1. Marching on the spot

Starting position: Standing

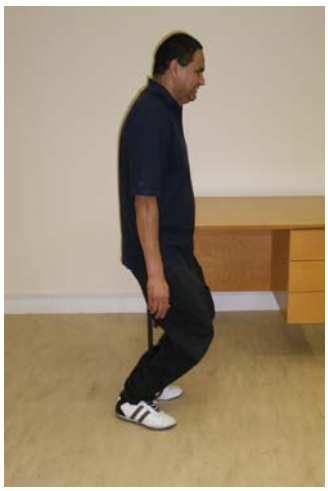
Exercise: Lift each knee in turn to a height that is comfortable. To start with, suggest doing this for a count of 30 seconds, gradually building up 10 seconds at a time as they find it getting easier.

2. Side Tap

Starting position: Standing

Exercise: Start with feet slightly apart and knees soft. Step to the side with one foot and then bring it back in. Repeat this with the other leg.

As your patients progress, they may be able to raise both arms whilst stepping their feet to each side. Ensure that they keep their arms below shoulder level.

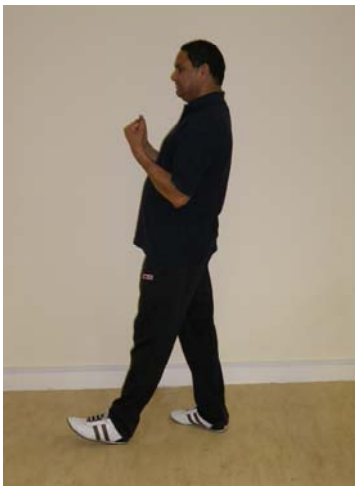


3. Knee Bend

Starting position: Standing sideways next to a table, with one hand resting on it for balance.

Exercise: Bend both knees slowly as far as is comfortable, then return to the starting position. Ensure your patient does not push their knees all the way back.

As your patients progress, they may wish to take the knee bend lower.



4. Heel Digs

Starting position: Standing.

Exercise: Start with feet slightly apart and knees soft. Step one foot forward with toes pulled up in a heel dig and then bring it back. Repeat this with the other leg.

As your patients progress they may be able to add in a bicep curl by bringing both arms up to their shoulders whilst doing each heel dig.

5. Step Ups

Starting position: Standing in front of a small step, with feet hip distance apart. Suggest using a bottom stair or a front or back door step as appropriate.

Exercise: Step up with one foot and then with the other so that both feet are on the step, then return to the starting position. Ensure the patient's whole foot is placed on the step.

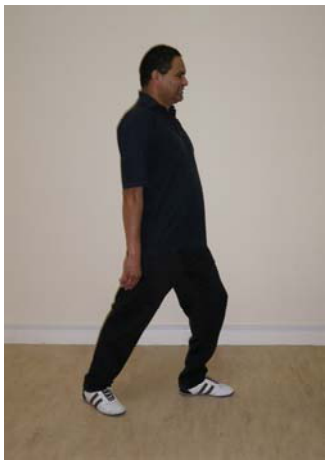
We have removed the 'sitting to standing to sitting' exercise as this is very similar to the knee bends. It may induce breath holding and can also aggravate pre-existing knee problems. The 'arm lift' exercise has also been removed due to concern regarding increasing inter-thoracic hypertension. The two exercises we have added use different leg muscles groups and also include simple arm movements, which help to build cardiovascular fitness.

Seated exercise

You may have patients who are very nervous about starting exercising or who have pre-existing conditions which make these home exercises difficult to do. In these circumstances it may be appropriate to consider initiating a seated exercise programme.

Most of the Heart Manual exercises (excluding 'knee bends') can be done while sitting. It is best to encourage your patient to sit on a firm chair that will not move while performing the activities. A hard backed chair is also preferable as it offers greater support, with high backed or dining room chairs being most suitable. In some cases these individuals may progress over time to doing these exercises while standing using a firm surface for support.

The Stretches



Calf stretch: Place one foot in front of the other, with the front leg bent and the rear leg straight. Gently move the body weight forward over the front leg, keeping the heel of the rear leg on the ground. The stretch should be felt in the calf muscle.

Quadriceps stretch: Bend one knee, grasp the back of your foot and pull gently up towards your bottom. If your patient can't reach their foot suggest trying to grasp their trouser leg instead. Try to keep the thighs parallel. The stretch should be felt in the front of the thigh.

Hamstring stretch: Place one foot in front of the other, with your front leg straight, your rear leg bent and your weight on the rear leg. Place your hands on the back of your thigh for support. Pull up the toes on the front leg so that you are resting on the heel. The stretch should be felt in the back of the thigh.

Shoulder stretch: Place one arm across the chest to the opposite shoulder. Gently stretch the upper arm with the other hand. The stretch should be felt across the shoulder and upper back.

The Heart Manual walking programme

In the same way as the exercise plan has been up dated following the 2011 review, a new version of the walking plan has been provided (pages: 40, 64, 84, 102 and 122). The walking plan now provides a more structured programme while offering different ways of progressing to alternative exercise. The manual now offers motivational tips on how to maintain activities, gives encouragement when adding new activities and suggests ways of dealing with common setbacks.

Pacing up – how do people progress?

It is important to encourage the individual to record their effort score in their walking and exercise record. Like all activities, the aim is to achieve a midway point between 'fairly easy' and 'fairly hard'. If the individual records a score which indicates that the activity has been 'easy' or 'hard' for 2 days in a row, it is generally advised that they be encouraged to either increase or decrease their activity. If however 2 days is not an adequate time to adjust to the change, prolonging the activity at the same level until it becomes easy is advised.

In relation to the exercises, the manual suggests an incremental increasing of 2 repetitions. This may be appropriate in the beginning but an alternative method may be to increase the repetitions in a more proportionate way by thinking about raising the activity level by no more than 20%. This could be recorded as an incremental rise from 10 repetitions to 12 or from 30 seconds to 36 seconds. Recovery does however vary from individual to individual for a wide variety of reasons, and tailored progression is therefore required. However, it is always better to err on the side of caution and progress in a slow steady fashion.

Finding alternatives – what else is available?

Whether taking part in a centre based exercise programme or following the Heart Manual, patients are encouraged to think about additional, long term activities that they can engage in. Encourage them to find out about local resources that may interest them and that are suitable for them. Some may wish to take part in an activity that is led by a professional. This could include an instructor led class, local gym or exercise class suitable for their level of fitness. Alternatively they may wish to take part in a led walking group, bowls, Tai-Chi, Yoga or indeed a local crafting group.

Seeking support - can family or friends help?

The goal here is to get individuals to change their exercise behaviours so that exercise becomes a regular, enjoyable part of their life. To help maintain this long term, family or friends can join in with the individual and help keep them motivated.

There has been research into the role of social support and group cohesion in exercise compliance and this has been shown to encourage compliance with exercise (Fraser and Spink 2002). Cardiac support groups in some areas occasionally offer exercise classes in addition to social support, and patients can be signposted to relevant websites.

Top Tips for Exercising

- Encourage your patients to fill in their daily exercise sheets so that they (and you) can see how they are progressing
- Check that your patients are scoring their exercise to the effort level they are performing to (breathlessness, colour, sweating, and fatigue)
- Remind your patients to warm-up and cool down at each exercise session
- Encourage scheduling a regular time of day to exercise - this will promote adherence
- If your patients stop exercising for any reason (illness or holidays) encourage them to cut back initially and then gradually increase till they are back where they were before
- Remind your patients not to exercise right after eating a meal or just before bed time
- Watch that they are not breath holding – encourage diaphragmatic breathing
- Observe your patients for correct posture and technique and correct as necessary

Long Term Maintenance

Maintaining a beneficial level of physical activity has always been a challenge.
Most of the evidence on the effectiveness of interventions for promoting exercise and encouraging adherence has been disappointing (Buckworth and Dishman 2002, cited in Anshel 2007). It would however appear appropriate to begin by assessing the individual's 'readiness' by reviewing the 'importance' they place on being physically active, while exploring their 'confidence' to maintain the change (see Health Behaviour Change chapter).

Negative attitudes towards exercise stem from many sources. It may arise from being taught sports at school, to experiencing fitness centres which appear to be set up solely for those who are deemed young, fit and thin. By promoting a positive attitude it may be possible to improve participation rates while encouraging long-term exercise habits (Anshel 2007).

Helping to establish the exercise habit by attending a rehabilitation class or completing the Heart Manual programme should set a positive precedent for the future. While long term figures regarding maintenance can be disappointing, the BHF (2015) reported that the percentage of CR patients doing 30 minutes of exercise 5 days a week increased from 33% before completing a CR programme to 56% at 12 weeks after completing a CR programme.

Strategies to aid exercise adherence and compliance

- Use a motivational interviewing approach to find out their beliefs about exercising*
- Use importance and confidence scaling to assess readiness to change*
- Assess possible psychological barriers such as: anxiety, depression, perfectionism and fear of failure
- Explain the health benefits if the person does not know what they are
- Limit side effects by providing instruction and feedback
- Offer educational material to back up advice
- Explore other behaviours that are linked to maintaining health such as weight control
- Be SMART when setting goals*

- Promote social contact and interaction
- Discuss equipment and the environment
- Keep a record
- Self-monitor thoughts, emotions and actions
- Increase the perception of choice - brainstorm options
- Music - a distracter or motivator?
- Modelling - motivation through others performance
- The benefit must outweigh the cost, time and effort = health and wellbeing
- Discuss possible barriers and support in finding solutions

(* See Health Behaviour Change chapter)

Dealing with set backs

Set backs are a normal part of life. The important consideration is working out the cause of the set back and from that, how it could be resolved.

If the individual has a new or active infection or virus they should be encouraged to rest, take appropriate medical advice, and stop exercising. When they feel able, they should start exercising but should cut back to start with and then gradually build back to the level they were at prior to becoming unwell. This can normally be achieved in a fairly short time.

Occasionally people may find that a set back has occurred due to over activity. In this situation, it is worth exploring the reason for the change in behaviour and discuss whether this is likely to influence their ability to maintain their goal. Encouraging an individual to explore the reason for the set back can give them the opportunity to develop an action plan to prevent it recurring in the future.

Exercise guidelines for health and wellbeing

Start Active, Stay Active

Current guidelines recommend that adults accumulate a minimum of 30 minutes of at least moderate intensity activity on 5 days or more per week to reduce the risk of cardiovascular disease (Scottish Intercollegiate Guidelines Network 2002; Cooper et al. 2007). Systematic reviews of evidence has confirmed that 150 minutes of moderate intensity activity is associated with substantial benefits across a number of health outcomes. Improvements in mood, insulin sensitivity and positive changes in glucose and fat metabolism can be recorded up to 24-48 hours post exercise. (SIGN 57, 2002) As all movement contributes to energy expenditure, recommended levels of activity can be achieved either through single sessions or several shorter bouts of activity of 10 minutes or more, making this target more achievable for those who are less able. The activity may be associated with lifestyle, structured exercise, sport or a combination of these (Department of Health 2004). These recommendations focus on prevention and maintenance of wellbeing.

A recent report from the four Home Counties Chief Medical Officers looked at the most recent evidence on ways to achieve the health benefits of an active lifestyle (Department of Health, Physical Activity, Health Improvement and Protection 2011).

The table below (Table 7) lays out some key messages, emphasising the importance of less sedentary behaviour, little is better than none and muscle strengthening for improved balance and falls prevention.

Table 7: Physical activity recommendations for different age groups (Department of Health, Physical Activity, Health Improvement and Protection 2011).

Adults (19-64 years	Older Adults (65+ years)
• Adults should aim to be active daily. One week =150mins (2.5 hours) of moderate intensity activity. Bouts of 10mins or more e.g. 30mins x 5/week	• Older adults who participate in any amount of physical activity gain some health benefits, including maintenance of good physical and cognitive function. Some physical activity is better that none, and more provides greater health benefits.
• Comparable benefits can be achieved through 75mins vigorous intensity activity spread throughout the week or a combination of moderate and vigorous.	• Older adults should aim to be active daily. One week =150mins (2.5 hours) of moderate intensity activity Bouts of 10mins or more e.g. 30mins x 5/week

• Adults should also undertake muscle strengthening activity x 2/week.	• For those who are already regularly active, comparable benefits can be achieved through 75mins vigorous intensity activity spread throughout the week or a combination of moderate and vigorous.
• All adults must minimise the amount of time spent being sedentary for extended periods.	• Older adults should also undertake muscle strengthening activity x 2/week.
	• Older adults at risk of falls should incorporate physical activity to improve balance and co-ordination on at least two days a week.
	• All older adults must minimise the amount of time spent being sedentary for extended periods.

- Muscle strengthening exercises include all physical activity that uses body weight or working against a resistance, and should involve all major muscle groups. This could be as simple as carrying some shopping, or weight shifting exercises such as dancing, which involve stepping or jumping. (DOH 2011) At a basic level, lowering yourself slowly into the chair "slow sitting" can also help to build leg strength.

- The Dept. of Health (2011) have compiled all of this useful information into an info-graphic (Appendix 1) demonstrating the wide range of physical and psychological benefits for adults and older adults which could be a useful educational tool to use with patients. This can be downloaded using the link below:

  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/541233/Physical_activity_infographic.PDF

- In addition a patient factsheet (Appendix 2) with the physical activity guidelines can be downloaded from the link below: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213741/dh_128146.pdf

Reducing sedentary behaviour

Reducing periods of sedentary behaviour is a new recommendation as there is now evidence that sedentary behaviour is an independent risk factor for poor health and any substitution for sedentary time should be encouraged even if it is just low intensity activity. Many older adults spend 10 hours or more each day sitting or lying down (Department of Health, Physical Activity, Health Improvement and Protection 2011).

For some older adults, a moderate intensity level of activity is not immediately achievable due to: low levels of fitness, reduced functional capacity, existing disease or disability. Patients can be reassured that physical activity may be done as part of their daily routine such as shopping or visiting friends but needs to be encouraged and built up. However the important message is that they engage in some physical activity every day. There is value in even small incremental increases, which can help slow or prevent further decline.
Having a cumulative weekly target for moderate intensity activity which can incorporate a variety of moderate/vigorous/strengthening exercise provides people with the flexibility to achieve the target for physical activity. (DOH 2011)

Current figures demonstrating the percentage of adult men and women achieving the recommended target are now more positive, and these figures can be seen in the table below. (Table 8)

Table 8: Percentage adults meeting current physical activity guidelines.
BHF Physical Activity Statistics (2015)

Country	Men	Women
England	67%	55%
Scotland	67%	58%
Wales	37%	23%
Northern Ireland	59%	49%

Frequently Asked Questions

Are there any contraindications to swimming?

When patients set swimming as a goal, it is important to consider the energy requirements of swimming and the body's response to being in water. Energy requirements for swimming can range between 4/5 METs for a slow, competent swim to 9/10 METs for swimming front crawl, whereas a gentle walk can range between 2/3 METs. There are also physiological effects when you go into water that can increase the demand on the heart. It is therefore important to check with their consultant or G.P. before they start swimming. If they are given the all-clear to swim, it is recommended the facilitator help them set realistic baselines (Thow 2006).

Can patients exercise with their arms above their head?

In everyday activities patients have to put their hands above their heads, e.g. hanging up washing or putting things away in cupboards, so it may be appropriate for them to do this as an exercise. However, patients can get short of breath when doing this action and this may lead to other cardiac symptoms. This usually occurs when patients are using their trunk muscles to breath. As these muscles are needed to hold up the arms, they may struggle to perform both actions. If the patient can do these activities while concentrating on breathing with their diaphragm, this can help maintain enough oxygen to the heart without causing any difficulties. It is however essential to set realistic goals with your patients when performing these actions (Fletcher et al. 1996).

Why should patients warm up and cool down and for how long?

Having a 'warm up' period is essential to help prevent any cardiac ischaemia. It also allows the muscles to become ready for the higher demands of the exercise programme. For individuals who are exercising for 30 minutes, a 'warm up' of 15 minute is recommended. If however the individual is exercising for less than 30 minutes their 'warm-up' time should be adjusted accordingly.

The ‘cool down’ phase is designed to allow the individual’s cardio-respiratory system to get back to near resting levels and should include some gentle stretching to help improve flexibility. The amount of time spent cooling down is again dependant on the length and intensity of the exercise programme and should be adjusted accordingly. For a 30 minute programme a 10 minute warm down is recommended (Thow 2006).

If the main exercise is walking, the warm up and cool down can be part of the walk but done at a slower speed (Borg rating 9 -10).

Why should we encourage exercise that includes both the arms and legs?

In everyday activities patients have to use their arms and legs, so it is important that both sets of muscles are exercised. Arm muscles respond in the same way as leg muscles but heart rate and blood pressure response is higher during arm exercise so this needs to be taken into account when setting baselines (Fletcher et al. 1996).

Why are practitioners concerned about encouraging exercise and what does the research say?

There is always concern about advising people to exercise without supervision. This may be because we are unsure of their ability to set sensible and safe goals. This is why it is important to work with the individual to set realistic and appropriate baselines, taking into account all relevant factors such as their past medical history, age, personal preferences and most importantly previous exercise experience.

There are certain forms of exercise that should be avoided if an individual has a history of cardiovascular disease; these are termed “grunt exercises”. Included in these are activities like squash and weight lifting or exercises such as press-ups and full body sit-ups, where the explosive nature of their performance can result in increased blood pressure and a degree of breathe holding.

Looking at the research, if you compare the number of deaths per person hours in the general population, it can range from one fatal event per 887 526 hours to one death per 565 00 person hours and in cardiac patients this was one fatal event per 752 365 patient hours (Doherty 2009)

Should patients be offered strength resistance training?

As we have mentioned, there is a lack of studies comparing elements of the aerobic training regime in cardiac patients and there is even less information on resistance exercise training studies in home-based exercise programmes. It is therefore important that any resistance training is in addition to and not a replacement for aerobic training (Corra et al. 2010). It should not commence until the patient has been taking part in an aerobic programme for 4-6 weeks (Thow 2006).
While no specific time is recommended for strength training, patients should perform to the point at which it would be difficult to do another repetition. (DOH 2011) It has been suggested that 8-12 reps, involving all large muscle groups, twice a week, will provide substantial benefits. (DOH 2011)

It may be appropriate for patients to start on low weights/low intensity resistance exercise and use the Likert scale in the Heart Manual to gradually build up their programme, aiming for between “Fairly Easy” and “Somewhat Hard”. They should also aim to build up to 8-12 repetitions as above, remembering that good technique is essential. As their perceived rate of exertion decreases, they can increase the weight.

Evidence–based practice (EBP) was used as part of a systematic review looking at patients with CAD who suffered MI and/or CABG and who had exercise/rehabilitation including resistance exercises. Eleven articles were found and interventions were supervised and started 3-9 months post event, lasting for a minimum of 3 months (Oliveira et al. 2008). Resistance training was shown to preserve and increase muscle strength and combined with aerobic exercise, has shown an increase in physical capacity, improvement of emotional state and quality of life. The studies did not show any risk to the patients (Oliveira et al. 2008).

If a patient is keen to start strength training, especially if it is an essential part of their rehabilitation such as a back to work programme, it is important that they do so in a safe environment. This could be in a supported programme such as a Phase III or IV programme or through more specialist advice from an exercise physiologist or physiotherapist (British Association of Cardiac Rehabilitation 2000).

Appendices

Appendix 1: Physical activity benefits for adults and older adults. Department Of Health, Physical Activity, Health Improvement and Protection. 2011.

Appendix 2: Physical activity guidelines for older adults (65+ Years) Department Of Health, Physical Activity, Health Improvement and Protection. 2011.

FACTSHEET 5

Physical activity guidelines for

OLDER ADULTS (65+ YEARS)

1. Older adults who participate in any amount of physical activity gain some health benefits, including maintenance of good physical and cognitive function. Some physical activity is better than none, and more physical activity provides greater health benefits.
2. Older adults should aim to be active daily. Over a week, activity should add up to at least 150 minutes (2½ hours) of moderate intensity activity in bouts of 10 minutes or more – one way to approach this is to do 30 minutes on at least 5 days a week.
3. For those who are already regularly active at moderate intensity, comparable benefits can be achieved through 75 minutes of vigorous intensity activity spread across the week or a combination of moderate and vigorous activity.
4. Older adults should also undertake physical activity to improve muscle strength on at least two days a week.
5. Older adults at risk of falls should incorporate physical activity to improve balance and co-ordination on at least two days a week.
6. All older adults should minimise the amount of time spent being sedentary (sitting) for extended periods.

Individual physical and mental capabilities should be considered when interpreting the guidelines.

Examples of physical activity that meet the guidelines

Moderate intensity physical activities will cause older adults to get warmer and breathe harder and their hearts to beat faster, but they should still be able to carry on a conversation. Examples include:

- Brisk walking
- Ballroom dancing

Vigorous intensity physical activities will cause older adults to get warmer and breathe much harder and their hearts to beat rapidly, making it more difficult to carry on a conversation. Examples include:

- Climbing stairs
- Running

Physical activities that strengthen muscles involve using body weight or working against a resistance. This should involve using all the major muscle groups. Examples include:

- Carrying or moving heavy loads such as groceries
- Activities that involve stepping and jumping such as dancing
- Chair aerobics

Activities to improve balance and co-ordination may include:

- Tai chi
- Yoga

Minimising sedentary behaviour may include:

- Reducing time spent watching TV
- Taking regular walk breaks around the garden or street
- Breaking up sedentary time such as swapping a long bus or car journey for walking part of the way

What are the benefits of being active daily?

- Helps maintain cognitive function
- Reduces cardiovascular risk
- Helps maintain ability to carry out daily living activities
- Improves mood and can improve self-esteem
- Reduces the risk of falls

For further information: *Start Active, Stay Active: A report on physical activity for health from the four home countries' Chief Medical Officers* (2011)

DHSSPS

The Scottish Government

Llywodraeth Cymru
Welsh Government

DH Department of Health

References

Adams, J., and Berbarie, R F. 2013. High-intensity cardiac rehabilitation training of a police officer for his return to work and sports after coronary artery bypass grafting. *Procedings,* Baylor University Medical Center, 26 (1) pp 39-41.

Allender, S., Peto, V., Scarborough, P., Boxer, A. and Rayner, M. 2006. *Diet, physical activity and obesity statistic.* Oxford: British Heart Foundation Health Promotion Research Group.

American Association of Cardiovascular and Pulmonary Rehabilitation. 2004. *Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs.* 4th ed. Windsor: Human Kinetics.

American Thoracic Society, 2002. ATS Statement: Guidelines for the Six-Minute Walk Test. *Am J Respir Crit Care Med* 166. pp 111-117.

Anshel, M. 2007. Conceptualizing applied exercise psychology. *The Journal of the American Board of Sport Psychology,* 1 (Article 2).

Berry, C., Balachandran, K.P., L'Allier, P.L., Lesperance, J., Bonan, R. and Oldroyd, K.G. 2007. Importance of collateral circulation in coronary heart disease. *European Heart Journal,* 28(3), pp. 278-279.

Borg, G.A.V. 1982. Psychophysical bases of perceived exertion. *Medicine & Science in Sports & Exercise,* 14(5), pp. 377-381.

British Association of Cardiac Rehabilitation. 2000. *Cardiac Rehabilitation: An Educational Resource.* London: Colourways Ltd.

British Heart Foundation. 2010. *The National Audit of Cardiac Rehabilitation: Annual Statistics Report.* British Heart Foundation.

British Heart Foundation. 2015. *Physical Activity Statistics.* British Heart Foundation.

Byrne, M., Doherty, S., Murphy, A W., McGee, H M., and Jaarsma, T. 2013. The CHARMS Study: cardiac patients' experiences of sexual problems following cardiac rehabilitation. *European Journal of Cardiovascular Nursing.* 12 (6) pp 558-566.

Caspersen, C.J., Powell, K.E. and Christenson, G.M. 1985. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports,* 100, pp. 126-131.

Cooper, A., Skinner, J., Nherera, L., Feder, G., Ritchie, G., Kathoria, M., Turnbull, N., Shaw, G., MacDermott, K., Packham, C., Squires, H., Thomson, D., Timmis, A., Walsh, J., Williamsn, H. and White, A. 2007. *Clinical Guidelines and Evidence Review for Post Myocardial Infarction: Secondary prevention in primary and secondary care for patients following a myocardial infarction.* London: National Collaborating Centre for Primary Care and Royal College of General Practitioners.

Corra, U., Piepoli, M.F., Carre, F., Heuschmann, P., Hoffmann, U., Verschuren, M. and Halcox, J. 2010. Secondary prevention through cardiac rehabilitation: physical activity counselling and exercise training. *European Heart Journal,* 31, pp. 1967-1976.

Dalal, H M., Zawada, A., Jolly, K., Moxham, T., and Taylor, R S. 2010. Home based versus centre based cardiac rehabilitation: Cochrane systematic review and meta-analysis. *BMJ.* 340: b5631.

de Waard, M.C., van der Velden, J., Bito, V., Ozdemir, S., Biesmans, L., Boontje, N.M., Dekkers, D.H.W., Schoonderwoerd, K., Schuurbiers, H.C.H., de Crom, R., Stienen, G.J.M., Sipido, K.R., Lamers, J.M.J. And Duncker, D.J. 2007. Early exercise training normalizes myofilament function and attenuates left ventricular pump dysfunction in mice with a large myocardial infarction. *Circulation research,* 100(7), pp. 1079-1088.

Department Of Health, Physical Activity, Health Improvement and Protection. 2011. *Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers.* 16306. London: Department of Health.

Department of Health. 2004. *At least five a week.* Gateway Ref: 2389. London: Department of Health.

Diez, C., Koch, D., Kuss, O., Silber, R.E., Friedrich, I. and Boergermann, J. 2007. Risk factors for mediastinitis after cardiac surgery - a retrospective analysis of 1700 patients. *Journal of Cardiothoracic Surgery,* 2(23) doi: 10.1186/1749-8090-2-23.

Doherty, P. 2009. ESC Congress. *What every cardiologist needs to know about physical activity: hop, skip or jump?* [conference presentation] August 31. Barcelona. European Society of Cardiology.

Dugdill, L., Stratton, G. and Watson, P., 2009. Developing the evidence base for physical activity interventions. In: Dugdill, L., Crone, D and Murphy, R. eds, *Physical activity and health promotion: evidence-based approaches to practice.* Oxford: Blackwell Publishing Ltd, pp. 60-84.

Durstine, L. and Lyerly, G.W. 2007. No physical activity or exercise is not an option. *Journal of Applied Physiology,* 103(2), pp. 417-418.

Fletcher, G.F.C., Balady, G., Blair, S.N.P.E.D., Blumenthal, J., Caspersen, C., Chaitman, B., Epstein, S., Sivarajan Froelicher, E.S., Froelicher, V.F., Pina, I.L. and Pollock, M.L. 1996. Statement on Exercise: Benefits and Recommendations for Physical Activity Programs for All Americans: A Statement for Health Professionals by the Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology, American Heart Association. *Circulation,* 94(4), pp. 857-862.

Fraser, S.N. and Spink, K.S. 2002. Examining the role of social support and group cohesion in exercise compliance. *Journal of Behavioral Medicine,* 25(3), pp. 233-249.

Haykowsky, M., Scott, J., Esch, B., Schopflocher, D., Myers, J., Paterson, I., Warburton, D., Jones, L. and Clark, A., 2011. A Meta-analysis of the effects of exercise training on left ventricular remodeling following myocardial infarction: start early and go longer for greatest exercise benefits on remodeling. *Trials,* 12(1), pp. 92.

Heran, B.S., Chen, J.M.H., Ebrahim, S., Moxham, T., Oldridge, N., Rees, K., Thompson, D.R. and Taylor, R.S. 2011. Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database of Systematic Reviews,* Art. No: CD001800 (7).

Jolly, K., Lip,GYH., Taylor, R S., Rafferty, J., Mant, J., Lane, D., Greenfield, S., and Stevens, A. 2009. The Birmingham rehabilitation uptake maximisation study (BRUM): a randomised controlled trial comparing home-based with centre-based cardiac rehabilitation. *Heart* 95 pp 36-42.

King, A.C., Blair, S.N., Bild, D.E., Dishman, R.K., Dubbert, P.M., Marcus, B.H., Oldridge, N.B., Paffenbarger, R.S.J., Powell, K.E. and Yeager, K.K. 1992. Determinants of physical activity and interventions in adults. *Medicine & Science in Sports & Exercise,* 24(6) (Supplement), pp. 221-236.

Knaapen, P., Klein, L.J., Nijveldt, R., Germans, T., van Rossum, A. C., and de Cock, C.C. 2006. Coronary collaterals in full effect. *Circulation,* 114(12), pp. e501-e502.

Lee, I.M.B.S., Sesso, H.D., Oguma, Y. and Paffenbarger, R.S.J.D.H. 2003. Relative intensity of physical activity and risk of coronary heart disease. *Circulation,* 107(8), pp. 1110-1116.

McConnell, T.R., Klinger, T.A., Gardner, J.K., Laubach Jr, C.A., Herman, C.E., and Hauck, C.A. 1998. Cardiac rehabilitation without exercise tests for post-myocardial infarction and post-bypass surgery patients. *Journal of cardiopulmonary rehabilitation,* 18(6), pp. 458-463.

McPherson, K., Britton, A. and Causer, L. 2002. *Coronary heart disease - estimating the impact of changes in risk factors.* London: The Stationary Office.

Moore, S.M., Seo, Y. and Rosenthal, L. 2006. Using guidelines in cardiac patients. *Journal of the American Academy of Nurse Practitioners,* 18, pp. 559-565.

Nelson, M.E., Rejeski, W.J., Blair, S.N., Duncan, P.W., Judge, J.O., King, A.C., Macera, C.A. and Castaneda-Sceppa, C. 2007. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Medicine & Science in Sports & Exercise,* 39(8), pp. 1435-1445.

NHS Lothian, 2010. *The Heart Manual (Post MI Edition).* 3rd ed. Edinburgh: Lothian Health Board.

NICE Quality Standard (QS99) September 2015. *Secondary prevention after a myocardial infarction.* National Institute for Health and Care Excellence.

NICE clinical guideline 172. 2013. MI-secondary prevention. *Secondary prevention in primary and secondary care for patients following a myocardial infarction*. National Institute for Health and Care Excellence.

Noble, B.J., Borg, G.A.V., Jacobs, I., Ceci, R. and Kaiser, P. 1983. A category-ratio perceived exertion scale: relationship to blood and muscle lactates and heart rate. *Medicine & Science in Sports & Exercise,* 15(6), pp. 523-528.

Oliveira, J.L.M., Galvao, C.M. and Rocha, S.M.M. 2008. Resistance exercises for health promotion in coronary patients: evidence of benefits and risks. *International Journal of Evidence-Based Healthcare,* 6(4), pp. 431-439.

Overend, T.J., Anderson, C.M., Jackson, J., Lucy, S.D., Prendergast, M. and Sinclair, S. 2010. Physical therapy management for adult patients undergoing cardiac surgery: a Canadian practice survey. *Physiotherapy Canada,* 62(3), pp. 215-221.

POPMA, J.J. and BITTI, J. 2001. Coronary angiography and intravascular ultrasonography. In: Braunwald, E., Zipes, D.P., and Libby, P. eds. *Heart disease: a textbook of cardiovascular medicine.* Philadelphia: W.B. Saunders, pp. 387-418.

Rimer, J., Dwan, K., Lawlor, D.A., Greig, C.A., McMurdo, M., Morley, W. and Mead, G.E., 2012. Exercise for depression. *Cochrane Database of Systematic Reviews,* Issue 7(Art. No. CD004366), DOI: 10.1002/14651858.CD004366.pub5.

Scottish Intercollegiate Guidelines Network. 2002. *Cardiac Rehabilitation: A National Clinical Guideline.* 57. Edinburgh: SIGN.

Seiler, C. 2010. The human coronary collateral circulation. *European Journal of Clinical Investigation,* 40(5), pp. 465-476.

Serfass, R.C. and Gerberich, S.G. 1984. Exercise for optimal health: Strategies and Motivational Considerations. *Preventive Medicine,* 13, pp. 79-99.

Smith, S.C.J., Allen, J., Blair, S.N.P.E.D., Bonow, R.O., Brass, L.M., Fonarow, G.C., Grundy, S.M., Hiratzka, L., Jones, D., Krumholz, H.M., Mosca, L., Pasternak, R.C., Pearson, T., Pfeffer, M.A. and Taubert, K.A. 2006. AHA/ACC Guidelines for secondary prevention for patients with coronary and other atherosclerotic vascular disease: 2006 Update: Endorsed by the National Heart, Lung, and Blood Institute. *Circulation,* 113(19), pp. 2363-2372.

Steinke, E E., Jaarsma, T., Barnason, S A., Byrne, M., Doherty, S., et al 2013.

A Consensus Document From the American Heart Association and the ESC Council

on Cardiovascular Nursing and Allied Professions (CCNAP). Sexual Counselling for

Individuals with Cardiovascular Disease and Their Partners. *European Heart Journal.*

eht270 First published online: 29 July 2013

Steptoe, A., Kearsley, N. and Walters, N. 1993. Acute mood responses to maximal and submaximal exercise in active and inactive men. *Psychology & Health,* 8(1), pp. 89-99.

Sutton, M.G., and Sharpe, N. 2000. Left ventricular remodeling after myocardial infarction: pathophysiology and therapy. *Circulation,* 101(25), pp. 2981-2988.

Thow, M. ed. 2006. *Exercise Leadership in Cardiac Rehabilitation: An Evidence Based Approach.* 1st ed. Chichester: Whurr Publishers Ltd.

Throndson, K. and Sawatzky, J.V. 2009. Improving outcomes following elective percutaneous coronary intervention: the key role of exercise and the advanced practice nurse. *Canadian Journal of Cardiovascular Nursing,* 19(2), pp. 17-24.

Westerdahl, E. and Moller, M. 2010. Physiotherapy-supervised mobilization and exercise following cardiac surgery: A national questionnaire survey in Sweden. *Journal of Cardiothoracic Surgery,* 5(67). DOI:10.1186/1749-8090-5-67.

Whelton, S.P., Chin, A., Xin, X. and He, J. 2002. Effect of Aerobic Exercise on Blood Pressure: A Meta-Analysis of Randomized, Controlled Trials. *Annals of Internal Medicine,* 136(7), pp. 493-503.

