

Coronary heart disease

The benefits of exercise

Background

Cardiovascular disease is the leading cause of death in developed nations, and there is a clear link between cardiovascular disease and physical inactivity.

Objective

This article describes the benefits of exercise for cardiac patients, details how exercise is prescribed in this group, and considers safety and contraindications to exercise in this group.

Discussion

The benefits of exercise, both aerobic and resistance training, in patients with coronary heart disease are well documented. Both modalities are important components of cardiac rehabilitation and can contribute to secondary prevention of heart disease with corresponding improvements in patient survival.

Keywords: heart diseases; rehabilitation; chronic disease, therapy



- exercise is 'the systematic execution of physical activity for a specific purpose'.⁴ Further, the physical activity promoted by the NHF for prevention and treatment of heart, stroke and peripheral vascular disease is that which incorporated large muscle groups, such as walking, cycling and swimming.⁴ It is therefore apparent that these two concepts are very closely related, and the 'moderate intensity physical activity' recommended by the Heart Foundation relates in fact to various types of exercise.

Accordingly, this article will refer to the benefits and prescription of exercise for patients with cardiac disease.

Specific benefits of exercise in CHD

Meta-analyses of the benefits of exercise based cardiac rehabilitation indicate it can reduce total mortality by 20% and cardiac mortality by 26%.⁵ At least one controlled trial demonstrated a significant decrease in myocardial infarction (MI) recurrence following cardiac rehabilitation.⁶ Exercise based rehabilitation also reduces hospital readmissions in patients following myocardial infarction,⁷ coronary artery bypass graft surgery (CABG),⁸ and percutaneous coronary interventions (PCI), including stenting.⁹

Exercise training results in multiple health benefits, many of which are particularly relevant to patients recovering from cardiac illness. The beneficial impact of exercise on pathophysiology, cardiac risk factors, physical function and psychological wellbeing is presented in *Table 1*.

The NHF recommends that:

- people with cardiovascular disease should aim, over time, to include 30 minutes or more of moderate intensity physical activity (eg. brisk walking) on most, if not all, days of the week, and
- doctors should routinely provide brief, appropriate, written physical activity advice to

Cardiovascular disease, coronary heart disease (CHD) and stroke kill more people than any other disease. In Australia, CHD accounts for 17% of all deaths.¹

Physical inactivity and CHD

The link between physical inactivity and CHD is well recognised. The World Health Report 2002 estimated that over 20% of CHD in developed countries is due to lack of physical activity.² In Australia, 54% of people aged 18–75 years do not undertake sufficient physical activity to obtain a health benefit, and nearly a third of these do no physical activity in their leisure time.³

Physical activity versus exercise

Confusion sometimes arises over the terms 'physical activity' and 'exercise', especially as to whether they are in fact interchangeable. According to the National Heart Foundation (NHF) of Australia:

- physical activity is 'any bodily movement produced by skeletal muscles that result in energy expenditure', and

Table 1. Benefits of aerobic exercise^{25–36}

| Variable | Benefit |
|---|-----------|
| Cardiovascular pathophysiology | |
| Maximal cardiac output | Increased |
| Peripheral oxygen extraction | Increased |
| Myocardial oxygen demands | Decreased |
| Fibrinolysis | Increased |
| Blood coaguability | Decreased |
| Endothelial function | Increased |
| Myocardial blood flow | Increased |
| Sympathetic hyperactivity | Decreased |
| Cardiovascular risk factors | |
| Resting blood pressure | Decreased |
| High density lipoprotein cholesterol | Increased |
| Triglycerides | Decreased |
| Body weight control | Increased |
| Insulin resistance | Decreased |
| Physical function | |
| Fitness/strength | Increased |
| Exercise capacity | Increased |
| Performance of activities of daily living | Increased |
| Return to work | Increased |
| Psychological wellbeing | |
| Depression | Decreased |
| Anxiety | Decreased |
| Quality of life | Increased |

Table 2. Borg scale of perceived exertion¹⁴

| | |
|----|--------------------|
| 6 | No exertion at all |
| 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 | Maximal exertion |

Table 3. Patient guidelines

Signs of over exercise

- Angina/chest pain? Stop immediately and take ‘Anginine’ as directed
- Shortness of breath? It is expected that you may feel a little puffed with exercise, but you should not be gasping for breath. You should be able to talk. You can usually recognise this before it becomes severe and therefore slow down
- Heart rate greater than desired maximum heart rate? Slow down or stop if necessary
- Taking longer than 2–5 minutes to recover? Next time do not exercise as hard or for as long
- Cold and clammy? It is normal to be hot and sweaty, but not cold, clammy, or have very heavy perspiration. Lower the intensity of exercise and stop if necessary
- Tired and weak in the evening or next morning after exercise? Next time do not exercise as hard or for as long
- Dizziness, stomach upsets or other signs of being unwell? Don’t exercise

or ≥ 1 mm ST segment depression during exercise testing).¹⁰

Patients can be educated to monitor their own exercise intensity by checking their own pulse, using the Borg scale (Table 2) and/or checking their recovery heart rate; which should return to

people with well compensated clinically stable cardiovascular disease.⁴

The following guidelines are intended to aid the general practitioner in achieving these goals.

Aerobic exercise prescription by the GP

Exercise testing and exercise intensity

Before a cardiac patient commences exercise training, an assessment should be undertaken to establish any potential risks and to prescribe an appropriate exercise regimen. This includes documenting the patient’s medical history and performing a physical examination (eg. blood pressure, pulse, cardiovascular examination). Some authors recommend that an exercise test be performed.^{10,11} However, the NHF states ‘it is not necessary that individuals starting a low to moderate progressive program of physical activity perform an exercise tolerance test’.⁴ In the general practice setting, simple methods to determine the intensity at which a patient should exercise include:

- maximal heart rate – this is determined as either peak heart rate on exercise testing, or 220 minus the patient’s age. Exercise training in patients with cardiac disease aims for 50–70% of this figure, which equates to moderate levels of exercise^{12,13}
- rating of perceived exertion – this is achieved using the Borg scale.¹⁴ This scale of 6–20 allows patients to rate their own exercise intensity, and it is recommended that cardiac patients aim for a rating of 11–13 (Table 2). This level corresponds to approximately 40–60% of VO₂ max, or moderate intensity exercise.^{10,13} This method is particularly useful for patients who have difficulty checking their own heart rate, who are on beta blockers, or who are postcardiac transplant where the heart rate response to exercise is blunted¹⁵
- other – if the patient experiences exertional angina, exercise intensity should be set at around 10 beats/min below the heart rate at which ischaemia is known to occur (eg. angina

Table 4. Benefits of resistance or strength training^{16,17,37–40}

| Variable | Benefit |
|---------------------------------------|-----------|
| Body composition | |
| Bone mineral density | Increased |
| Percent body fat | Decreased |
| Lean body mass | Increased |
| Muscle strength | Increased |
| Glucose metabolism | |
| Insulin response to glucose challenge | Decreased |
| Basal insulin levels | Decreased |
| Insulin sensitivity | Increased |
| Plasma lipids and lipoproteins | |
| HDL cholesterol | Increased |
| LDL cholesterol | Decreased |
| Triglycerides | Decreased |
| Cardiovascular dynamics | |
| V _O ₂ max | Increased |
| Basal metabolic rate | Increased |
| Resting blood pressure | Decreased |
| Health related quality of life | |
| Mood | Increased |
| Self efficacy for exercise | Increased |
| Functional independence | Increased |

within 10 beats of resting heart rate; 2–5 minutes postexercise. Patients should be educated to recognise signs of over exercise (*Table 3*).

Exercise frequency

Ideally, exercise sessions should occur on most, if not all, days of the week. A deconditioned patient may commence with three sessions per week and gradually progress.

Exercise duration

For patients who are deconditioned following a cardiac event, exercise sessions may initially be as short as 5–10 minutes, and gradually increased according to exercise tolerance. As the patient's fitness improves, exercise sessions can be increased every 1–3 weeks up to 30–40 minutes or more, although intensity of exercise may initially need to be reduced when duration is increased. To obtain health benefit, the total daily exercise of 30 minutes can be accumulated in sessions of at least 10 minutes duration (eg. three 10 minute sessions, two 15 minute sessions, or one 30 minute session).

Table 5. Guidelines for resistance training in cardiac patients

| Component | Guideline |
|-------------|--|
| Intensity | To determine the appropriate weight, the patient's repetition maximum (RM) is used (RM = the maximum weight that can be lifted or moved to complete repetition) Initially, weights should be around 30% of RM to ensure correct implementation of each exercise and thus prevent the likelihood of musculoskeletal injury |
| Frequency | 2–3 sessions per week is recommended ^{14,16,17} A minimum of 48 hours rest between each resistance training session is recommended |
| Modality | Can be performed using a range of devices including free weights/dumbbells, ankle weights, pulleys or strength training machines Patients should be educated in correct technique, ie. a slow controlled movement through the full range of motion, with no breath holding or Valsalva manoeuvre One exercise per major muscle group is used, for example: chest press, shoulder press, triceps extension, biceps curl, lower back extension, latissimus dorsi pull down, abdominal crunch, quadriceps extension, leg (hamstring) curl, calf raise |
| Duration | Each exercise is repeated 8–10 times per set initially Weight loads which allow 5–8 repetitions usually result in improved muscular strength and endurance ¹⁶ Initially a single set (maximum two sets) of each exercise is recommended ¹⁶ A rest period of 20–30 seconds between sets is recommended ^{14,40} |
| Progression | Patients should increase the number of repetitions performed in each set and the number of sets (maximum three sets) before increasing resistance or weight When a patient is able to perform three sets of 12–15 repetitions with ease, weight loads can be increased by approximately 5%, and repetitions reduced again As with aerobic training, the Borg scale can be used to monitor exertion during resistance training. Patients should work between 13 and 15 on the scale ('fairly light' to 'somewhat hard') ¹⁶ Blood pressure and heart rate can also be monitored, although this is not always practical, and heart rate may not rise in proportion to myocardial stress |

Exercise modalities

If a GP is prescribing a patient's home program, walking is a preferred modality. It is low impact and safe, utilises large muscle groups, and usually represents a moderate intensity of around 40–70% of VO₂ max.¹⁰ However, other exercises recommended in patients with cardiac disease include cycling or arm ergometry. Choice is usually guided by comorbidities that preclude certain activities (eg. arthritis), patient choice and by available resources. High impact exercises such as jogging on hard surfaces should be avoided to prevent injury.

Resistance exercise

Resistance (or strength) training is now accepted as an important component of exercise for patients with CHD, despite previously held fears that it increased the risk of cardiovascular complications.¹⁶ Benefits of resistance training are listed in *Table 4*. However, aerobic or endurance training produces greater improvements in cardiovascular function and CHD risk factors.¹⁷ Resistance training should be considered an important modality additional to aerobic training.

As with aerobic exercise, resistance training should be considered in terms of frequency, intensity, duration and modalities (*Table 5*).

Safety and contraindications

Exercise training has been demonstrated to be safe for cardiac patients who are appropriately assessed and selected. Mortality rates during cardiac exercise programs range from one per 116 400 to one per 784 000 hours of exercise.^{18,19} The risk of adverse events can be reduced by considering contraindications for participation in aerobic or resistance training as outlined in *Table 6*.

In addition, the following considerations are important:^{13,17,19,20}

- resistance training is contraindicated in the acute setting²¹
- patients post-MI or other cardiac event should undergo at least 2 weeks of aerobic training before commencing resistance training²²
- patients post-CABG can commence aerobic training 1–2 weeks after an uncomplicated operation, but should avoid resistance training and exercises that cause sternal tension for up to 2–3 months postsurgery¹⁰

Table 6. Absolute and relative contraindications to aerobic and resistance training^{17,18}

Absolute

- Unstable coronary heart disease (unstable angina)
- Within 1 week of acute myocardial infarction
- Decompensated heart failure
- Uncontrolled arrhythmias including sinus tachycardia
- Severe pulmonary hypertension (mean pulmonary arterial pressure >55 mmHg)
- Severe and symptomatic aortic stenosis
- Acute myocarditis, endocarditis, or pericarditis
- Acute systemic illness or fever
- Uncontrolled hypertension (BP >180 mmHg systolic; >100 mmHg diastolic)
- Postural hypotension (≥ 20 mmHg drop in systolic BP with symptoms of dizziness or light headedness)
- Aortic dissection
- Marfan syndrome
- Recent embolism
- Thrombophlebitis
- High intensity resistance training (80–100% of RM) in patients with active proliferative retinopathy or moderate to severe nonproliferative diabetic retinopathy

Relative (should consult a physician before participation)

- Major risk factors for CHD
- Diabetes at any age
- Uncontrolled hypertension (systolic BP >160 mmHg; and/or diastolic BP >100 mmHg)
- Low functional capacity (<4 metabolic equivalent levels [METs])
- Musculoskeletal limitations
- Individuals who have implanted pacemakers or defibrillators

- patients with postoperative wound infections should not exercise until they have been treated with antibiotics for at least 1 week; activities which compromise the wound should be avoided until the wound is fully healed
- angioplasty or stent patients who sustained access vessel injury during the procedure and required surgical intervention should avoid exercise training until the surgical incisions are healed; activities which compromise the wound should be avoided
- repetitive actions such as lifting weights can result in pacing lead fractures and dislodgment.²³ Patients with implantable devices such as defibrillators or pacemakers should obtain physician clearance before commencing upper body resistance training
- for patients with implantable defibrillators, the target heart rate for exercise training should be 10–15 beats/min lower than the threshold discharge rate for the defibrillator
- although patients with hypertrophic cardiomyopathy have traditionally been advised to avoid resistance training, a recent American Heart Association statement suggests that low intensity weight training with machines may be permissible in selected individuals²⁴
- patients over 65 years of age generally have a lower exercise capacity than younger patients. A lower level of energy expenditure (eg. 40–50% of VO₂ max) is recommended
- patients with diabetic neuropathy are at greater risk of postural hypotension and joint and muscle injuries due to inadequate proprioception and pain perception, thus greater caution is required when engaging in exercise training

- patients with retinopathy should not engage in high intensity resistance training because of the risk of vitreous haemorrhage and retinal detachment.

Conclusion

Exercise training, both aerobic and resistance, is safe for stable CHD patients provided that they have been properly assessed and the training program is appropriately tailored to individual needs and potentials. As a result, most patients can expect to improve their exercise tolerance, functional ability and quality of life. Additionally, risk of mortality and hospital readmission is also reduced as exercise training enhances cardiovascular function and helps to modify cardiac risk factors.

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