Heart disease, stroke, peripheral arterial disease and exercise
Learning objectives

1. Appreciate the burden of cardiovascular disease [BHF, WHO]

2. Understand the role of physical activity in the prevention and treatment of cardiovascular disease
   NICE Guidance [CG68, CG94, CG108, CG147, CG162, CG172, CG181]

3. Be able to provide safe and effective exercise advice to patients with heart disease, stroke or peripheral arterial disease

4. Know the contraindications to exercise in patients with cardiovascular disease [BACPR]

5. Understand the efficacy and cost effectiveness of cardiac rehabilitation programmes [NICE CMG40]

6. Make Every Contact Count [NICE QS 84]
Annual Cardiovascular Disease (CVD) Mortality

UK

Stroke 39,000 deaths
CHD 69,000 deaths

28% of all UK Deaths

CHD single biggest cause of death

41,000 premature deaths

World

NCDs 42.6 MILLION
21.3 MILLION (50%) FROM CVD

64 MILLION 2015

OTHER DISEASES & INJURIES

NCD = Non Communicable Disease
CHD = Coronary Heart Disease

BHF Cardiovascular disease statistics 2015
WHO/WHF/WSO Global atlas on cardiovascular disease prevention and control 2011
The role of physical inactivity in Cardiovascular Disease and associated costs

Physical inactivity is directly responsible for a high proportion of CVD mortality in the UK and worldwide

<table>
<thead>
<tr>
<th>% due to inactivity</th>
<th>Coronary Heart Disease</th>
<th>All-cause mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>11%</td>
<td>17%</td>
</tr>
<tr>
<td>World Average</td>
<td>6%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Annual NHS CVD burden = 370 million prescriptions = 1.7 million hospital episodes = £11bn

Lee et al., Lancet 2012, Effect of physical inactivity on major NCDs
BHF Cardiovascular disease statistics 2015; Centre for economic and business research 2014
Cardiovascular effects of exercise

**During exercise:**
- SV ↑ initially, but most of the ↑ in cardiac output is reliant on ↑ HR
- Contractility ↑
- Coronary blood flow ↑
- Stroke volume (SV) ↑
- Heart rate (HR) ↓
- Oxygen demand ↓
- Oxygen uptake ↑
- Oxygen utilisation ↑
- Endothelial function ↑
- Plasma volume ↑
- Blood viscosity ↓

**Blood Pressure ↓**
- HR monitors are useful in moderate/vigorous, but not light activity

FYSS 21: Coronary artery disease
Wilson et al. Heart 2015: Basic Science behind the cardiovascular benefits of exercise
Prevention of CVD
Relationship with physical activity

Greatest health benefits
NO physical activity → SOME physical activity

Physical activity is beneficial in the primary and secondary prevention of all CVD

Mortality in patients with CVD ↓20-35%

Adjusted relative risk of coronary heart disease

Tanasescu et al. JAMA 2002: Exercise type and intensity in relation to coronary heart disease
DoH UK 2011: Start Active Stay Active; NICE CG68, CG94, CG172, CG181
Woodcock 2011, Kyu 2016
## Prevention of CVD
Direct benefits and risk reduction due to physical activity

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>PAR</th>
<th>Effects of physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>36%</td>
<td>Cessation adjunct</td>
</tr>
<tr>
<td>Abnormal lipids</td>
<td>49%</td>
<td>↓ triglyceride, total &amp; LDL cholesterol</td>
</tr>
<tr>
<td>Hypertension</td>
<td>18%</td>
<td>30-50% risk reduction</td>
</tr>
<tr>
<td>Type 2 Diabetes</td>
<td>10%</td>
<td>30-40% risk reduction</td>
</tr>
<tr>
<td>Obesity</td>
<td>20%</td>
<td>Weight maintenance</td>
</tr>
<tr>
<td>Psychosocial factors</td>
<td>33%</td>
<td>20-30% ↓ depression, anxiety &amp; stress</td>
</tr>
<tr>
<td>Low fruit &amp; veg</td>
<td>14%</td>
<td>No direct effect of physical activity</td>
</tr>
<tr>
<td>Regular alcohol</td>
<td>7%</td>
<td>No direct effect of physical activity</td>
</tr>
<tr>
<td>Physical inactivity</td>
<td>12%</td>
<td><strong>Direct Benefit</strong></td>
</tr>
</tbody>
</table>

Collectively, these modifiable risk factors account for 90% of the risk of heart attack worldwide.

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**PAR** = Population Attributable Risk

Prevention of CVD
As good as medicines?

Network meta analysis of mortality outcomes in trials comparing drugs and exercise with controls

<table>
<thead>
<tr>
<th>Coronary heart disease</th>
<th>Exercise</th>
<th>Statins</th>
<th>β blockers</th>
<th>ACE inhibitors</th>
<th>Antiplatelets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stroke</strong></td>
<td>Exercise</td>
<td>Anticoagulants</td>
<td>Antiplatelets</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Heart disease</strong></td>
<td>Exercise</td>
<td>ACE inhibitors</td>
<td>Diuretics</td>
<td>β blockers</td>
<td>Angiotensin receptor blockers</td>
</tr>
</tbody>
</table>

Exercise is often as good as medications in the secondary prevention of cardiovascular disease

Naci & Ioannidis BMJ 2013: comparative effectiveness of exercise and drug interventions on mortality
Coronary Artery Disease (CAD) and Exercise

Exercise is indicated in the primary and secondary prevention of CAD

Patients with CAD should undertake baseline stress and fitness tests with ECG monitoring to assess risk and tailor exercise to current physical capacity

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**Exercise is BETTER and CHEAPER than PCI for stable CAD**

- **88% with Exercise (£2328)**
- **70% with PCI (£4722)**

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**References**

Hambrecht et al. Circulation. 2004; PCI compared with exercise training; FYSS 21: Coronary artery disease
Walther et al. Prev Cardio 2008: Regular exercise training compared with PCI
ACSM Position stand: Exercise and coronary artery disease; NICE CG94, CG172, CG181
PCI = Percutaneous Coronary Intervention

---

**Log-Rank 5.2**

**P = 0.023**

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**Patients at Risk**

<table>
<thead>
<tr>
<th></th>
<th>PTCA/Stent Group</th>
<th>Exercise Training Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow up [Months]</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>45</td>
</tr>
</tbody>
</table>
All patients with chronic HF should be offered exercise-based rehabilitation

Meta-analysis showing effects of exercise in patients with heart failure

Quality of life & Exercise tolerance

Hospitalisation

Belardinelli et al JACC 2014: 10 yr exercise training in CHF; Piepoli et al. EJHF 2011: Exercise training in heart failure
Van Tol et al EJHF 2006: Effects of exercise training in heart failure
Hagerman et al. IJC 2005: Hospitalisation in chronic heart failure; NICE CG108
Stroke and Exercise

Exercise significantly reduces mortality following stroke
Anticoagulants and Antiplatelets do NOT

Naci & Ioannidis BMJ 2013: comparative effectiveness of exercise and drug interventions on mortality
NICE CG68; FYSS 47 Stroke; Stoller et al. BMC neurology: Effects of cardiovascular exercise after stroke
Saunders et al. Cochrane 2013: Physical fitness training for stroke patients;

Stroke

- Personalise Goals
- Variable Disability

Deconditioning

- Exercise intolerance
- Reduced function

Vicious cycle

- Increased Disability
- Increased CVD risk
- Reduced QOL

Exercise benefits

- Improves walking & tolerance for ADLs
- Reduces CVD risk directly
- Improved QoL & Self-confidence

ADLs Activities of Daily Living, QoL Quality of Life
Peripheral Arterial Disease and Exercise

Exercise promotes collateral blood flow, improves oxygen extraction and cardiovascular function in Peripheral Arterial Disease.

Patients should exercise to the point of maximal pain.

Walking distance
Walking speed
Perceived walking endurance
Physical activity levels

Amputations
Foot infections
Mortality
Pain

References:
NICE CG147; Parmenter et al. Sports Med 2015: Exercise training for management of PAD
Lane et al. Cochrane 2014: Exercise for intermittent claudication; FYSS 41 Peripheral arterial disease
Vemulapalli et al. 2015 Clin Cardiol network meta-analysis; Gupta & Elkins BJSM 2014: Walking training in intermittent claudication
Cardiac Rehabilitation

~50% of all cardiac complications occur during the first month following a cardiac event [FYSS 21]

Therefore patients need assessment, screening and safe exercise prescription during this time [ACSM]

Cardiac rehabilitation is safe and effective and should start within 10 days of discharge from hospital [NICE CG172]

UK referral rates range from 13-88% with large inequalities and low heart failure access (2%) [NICE CMG 40]

Meta-analysis showing odds ratios for total mortality: exercise based cardiac rehabilitation versus usual care following MI [Lawler 2011]

Mortality ↓

Odds of dying ↓ 20%

Favours cardiac rehabilitation
Favours usual care

Anderson & Taylor, Cochrane overview 2014: Cardiac rehabilitation; Lawler et al. AHJ 2011: Cardiac rehabilitation following MI
ACSM & AHA Joint position statement: Exercise and acute cardiovascular events
BHF Cardiovascular disease statistics 2015; FYSS 21: Coronary artery disease; NICE CG108, CG172, CMG 40
Cardiac Rehabilitation

Overall mortality
CVD mortality
Re-infarction
Hospital admissions
BP, lipids, disability
Time off work

BUT...

Only 14-43% uptake following MI  
Davies et al

Those most likely to benefit have lowest uptake  
Beswick et al 2005

<table>
<thead>
<tr>
<th>Treatment for secondary prevention</th>
<th>Cost of adding 1 year to a patient's life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspirin/B-blocker</td>
<td>&lt;£1000</td>
</tr>
<tr>
<td>Cardiac rehab</td>
<td>£1957</td>
</tr>
<tr>
<td>ACE inhibitor</td>
<td>£3398</td>
</tr>
<tr>
<td>Statin</td>
<td>£4246</td>
</tr>
<tr>
<td>CABG</td>
<td>£3239-4601</td>
</tr>
<tr>
<td>PCI</td>
<td>£3845-5889</td>
</tr>
</tbody>
</table>

CABG = Coronary Artery Bypass
PCI = Percutaneous Coronary Intervention

Anderson & Taylor, Cochrane overview 2014; Cardiac rehabilitation; FYSS 21: Coronary artery disease; NICE CG108, CG172, CMG 40; Anderson et al. Cochrane 2016 Cardiac rehabilitation for CHD; ACSM & AHA Joint statement: Exercise and acute cardiovascular events; Lawler et al. AHJ 2011: Cardiac rehabilitation following MI; Heran et al. Cochrane; Exercise rehabilitation for patients with CHD; Fidan et al. QJM 2007:Economic analysis of treatments; Taylor et al. Cochrane 2014: Exercise rehabilitation for heart failure
# Considerations when exercising on medicines

<table>
<thead>
<tr>
<th>Medication</th>
<th>Exercise related pharmacology</th>
<th>Patient implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>ß-blocker</td>
<td>Maximum heart rate ↓</td>
<td>↓ maximal exercise capacity ↑ muscle fatigue</td>
</tr>
<tr>
<td></td>
<td>Skeletal muscle blood flow ↓</td>
<td></td>
</tr>
<tr>
<td>Diuretics</td>
<td>↑ salt loss (N.B. Hypokalaemia)</td>
<td>↑ risk of dehydration</td>
</tr>
<tr>
<td></td>
<td>↑ urine output</td>
<td>Availability of toilets important</td>
</tr>
<tr>
<td>Calcium channel blocker</td>
<td>Negative chronotropes</td>
<td>↓ maximum capacity</td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>No significant effects on exercise capacity</td>
<td></td>
</tr>
<tr>
<td>Digoxin</td>
<td>↑ contractility and stroke volume</td>
<td>↑ exercise capacity</td>
</tr>
<tr>
<td>Nitrates</td>
<td>Vasodilatation Anti-anginal</td>
<td>Risk of postural hypotension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Can be used prophylactically</td>
</tr>
<tr>
<td>Anticoagulants</td>
<td>Risk of bleeding increased</td>
<td>Tailor advice re: ↓ falls risk etc.</td>
</tr>
<tr>
<td>Statins</td>
<td>No clear evidence supporting reduced performance or ↑ muscle pain</td>
<td>Caution in vigorous endurance sport</td>
</tr>
</tbody>
</table>

**Medicines are not a contraindication to exercise**

*FYSS 21: Coronary artery disease*
*Parker et al. Circulation 2013: Effect of statins on skeletal muscle function*
Absolute Contraindications to Exercise in CVD

1. New or uncontrolled arrhythmia
2. Resting or uncontrolled tachycardia
3. Resting SBP >180mmHg or DBP >100mmHg
4. Symptomatic hypotension
5. Unstable/ crescendo angina
6. Acute or unstable heart failure
7. Unstable diabetes
8. Acute febrile illness

Any patients with unstable or uncontrolled symptoms must be reviewed

Adapted from British Association of Cardiac rehabilitation 2012
ACSM position statement
Safety Considerations in CVD patients

Exclude high-risk patients from vigorous activity

Screen high risk patients before exercise
- Recent cardiac event
- Heart failure, Recent/previous Stroke, PAD
- Re-screen anyone with unstable/uncontrolled symptoms

Stop exercise and promptly evaluate/refer if ANY of these symptoms (inform patients of these)
- chest pain or tightness
- dizziness or faintness
- pain in the arm or jaw
- severe shortness of breath
- an irregular heartbeat
- excessive fatigue

Adapted from British Association of Cardiac rehabilitation 2012; ACSM position statement; Thompson et al. Circulation 2007: Exercise and acute cardiovascular events AHA statement
Exercise Considerations in Cardiovascular Disease

- High intensity exercises carry a higher risk \( \text{ACSM} \)
- Warm up 15 minutes. Cool down 10 minutes
- Avoid lying down until after cool down period
- ICDs have a 10-30s delay between arrhythmia and shock, so give safe exercise advice such as avoid swimming \( \text{FYSS 30} \)
- Avoid dehydration (increased risk of arrhythmia) \( \text{FYSS 21} \)
- Progression (duration & intensity) of exercise should be slow and gradual \( \text{ACSM} \)
- Stroke patients are 3x more likely to fall or suffer hip fractures so make the environment safe \( \text{FYSS 47} \)
- Good footwear and foot care are very important in PAD and/or type 2 diabetes
- Inactive individuals should start with a 2-3 month transition phase of light exercise only \( \text{ACSM} \)

\( \text{ACSM Current comment: Exercise for persons with cardiovascular disease} \)
\( \text{FYSS 21 Coronary artery disease; FYSS 30 Heart rhythm disturbance} \)
\( \text{FYSS 47 Stroke; ACSM 2015: Updated recommendations for Exercise Preparticipation Health Screening} \)
Prescribing physical activity in daily practice for cardiovascular disease prevention using the acronym ACTIVE

- **A**ssess current level of physical activity; pre-exercise safety screening; functional limitations/impairments; patient’s readiness to implement changes; patient’s understanding of physical activity benefits; appropriateness of participation in cardiac rehabilitation.

- **C**reate individualized exercise "prescription" based on patient's goals and needs.

- **T**rack progress with internet/mobile applications, pedometers, and other technological resources and with regular physician check ups to monitor for adverse events or activity intolerance.

- **I**ncrease exercise prescription as tolerated by altering current regimen (e.g. increase frequency, intensity, or duration) and/or adding new activities.

- **V**alidate patient's efforts, addressing new obstacles or concerns.

- **E**mpower patient with self-selected exercise modifications to allow control over his/her health, strengthen commitment, and encourage maintenance of regular physical activity, revisiting prior steps as needed.


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Weekly Physical Activity Recommendations

Sit Less
– excess sedentary behaviour causes death
Walk More
– walking is safe & effective
Tailor advice to the individual

Refer these patients for Cardiac Rehabilitation:
• Recent Myocardial Infarction
• IHD/ Heart failure
• Heart surgery/ Percutaneous coronary intervention
• Implantable Cardiac Defibrillator

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American Heart Association; DoH UK 2011: Start Active Stay Active
Adapted from British Association of Cardiac rehabilitation 2012
Biddle et al. BMC 2016: Too much sitting and all-cause mortality
Learning summary
Heart disease, stroke, peripheral arterial disease and exercise

- Exercise is safe following appropriate screening and assessment
  - Reassure your patients

- Unstable/uncontrolled symptoms require clinical review
  - Educate your patients

- The least active stand to gain the most
  - Empower your patients

- CARDIAC REHABILITATION saves lives, is effective, safe, cheap, underused and undervalued
  - Rehabilitate your patients

- Exercise can be as good as medicines
  - Exercise your patients

- YOUR exercise advice can save lives
  - Make Every Contact Count

References:

British Association of Cardiac Rehabilitation; ACSM position statement
Anderson & Taylor, Cochrane overview 2014: Cardiac rehabilitation; NICE CMG 40 Naci 2013 Heart BMJ Podcast
Supplement: A case study example
Pre-participation Screening
Summary of updated ACSM recommendations

ACSM 2015

ACSM 2015, Updated recommendations for Exercise Preparticipation Health Screening
Resources

• **NICE Guidelines**

• **BACPR**

• **FYSS**  *Physical activity in the prevention and treatment of disease*

• **ACSM Position Stands**
References


References (cont.)


NICE, 2013b. CMG 40 Cardiac rehabilitation services. *NICE Comissioning guides,* (November 2013), pp.1–49.


NICE, 2015. QS 84 Physical activity : encouraging activity in all people in contact with the NHS. *NICE quality standard,* (March).


Sciences, C. et al., 2010. 30. Heart rhythm disturbances. *FYSS.*
References (cont.)