Importance of Exercise and Physical activity in Cardiovascular Disease

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Overview

- Evidence
- Primary and Secondary Prevention
- Chronic Adaptations
- Exercise Programming

British Association for Cardiac Rehabilitation (BACR)

- National organisation for professionals involved in field of cardiac rehabilitation

- Affiliated group of the British Cardiovascular Society (BCS)

The core components are:

1. Lifestyle:
   - I) Physical activity and exercise
   - II) Diet and weight management
   - III) Smoking cessation
2. Education
3. Risk factor management
4. Psychosocial
5. Cardio protective drug therapy and implantable devices
6. Long-term management strategy

"A comprehensive CR team of appropriately qualified core staff including: a cardiac specialist nurse, physiotherapist, dietitian, administrator, and a dedicated clinical lead (cardiologist or GPWSI)"

BACR

Current Guidelines

- BACR Standards and Core Components for Cardiac Rehabilitation (2007)
- National Service Framework (NSF) for coronary heart disease published in 2000
- Cardio and Vascular Coalition (CVC) - Cardiovascular Health Strategy 2010-2020
- Scottish Intercollegiate Guidelines Network (SIGN) 'Cardiac Rehabilitation – a national guideline' endorsed by BACR
- Department of Health 'Exercise Referral Systems: A National Quality Assurance Framework' (2001) document (NQAF)
- BHF draft toolkit for Exercise Referral (2009)

Physical Activity and Exercise

- PHYSICAL ACTIVITY
  Any movement that is produced by the contraction of skeletal muscle

- EXERCISE
  Structured physical activity
  With an aim or goal oriented

- PHYSICAL FITNESS
  The physical attributes required to perform a given task or physical activity

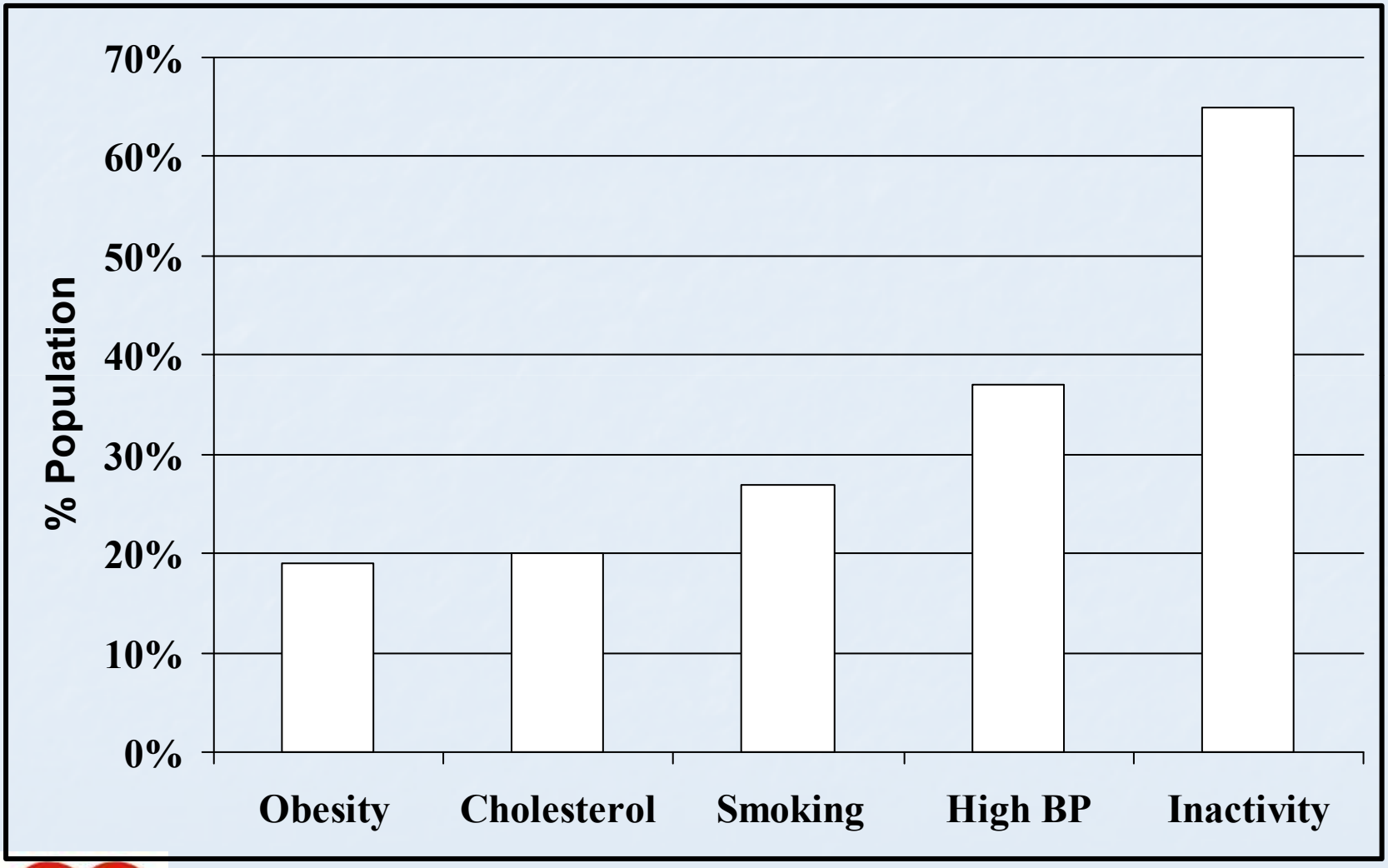
Two key aspects to physical activity and health

1. Simply increasing daily physical activity (energy expenditure) *can enhance health status*

2. Increasing physical activity in terms of both duration and intensity leads to improved physical fitness, which *further enhances health status*

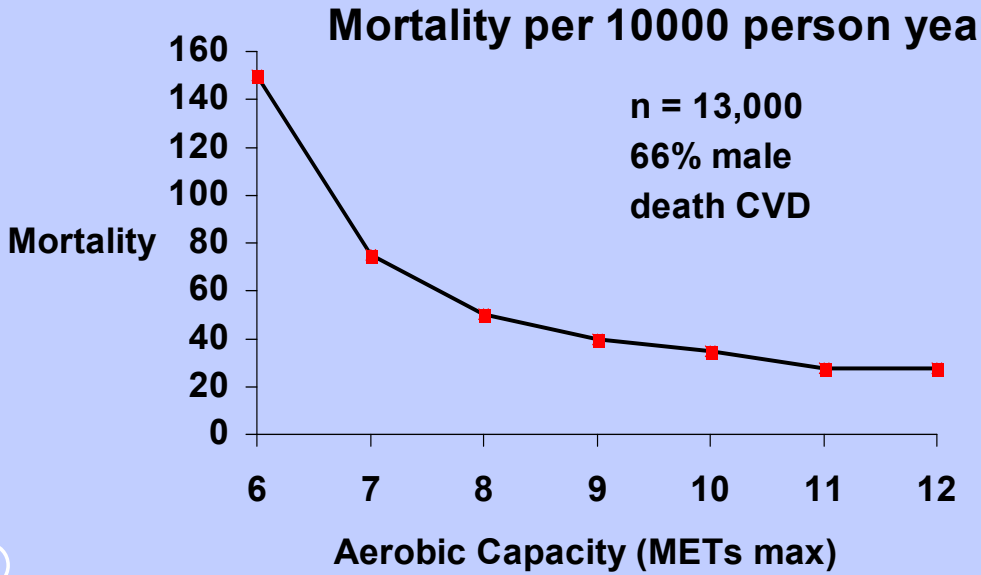
Prevalence of CHD Risk Factors

Britton & McPherson BHF National Heart Forum 2000



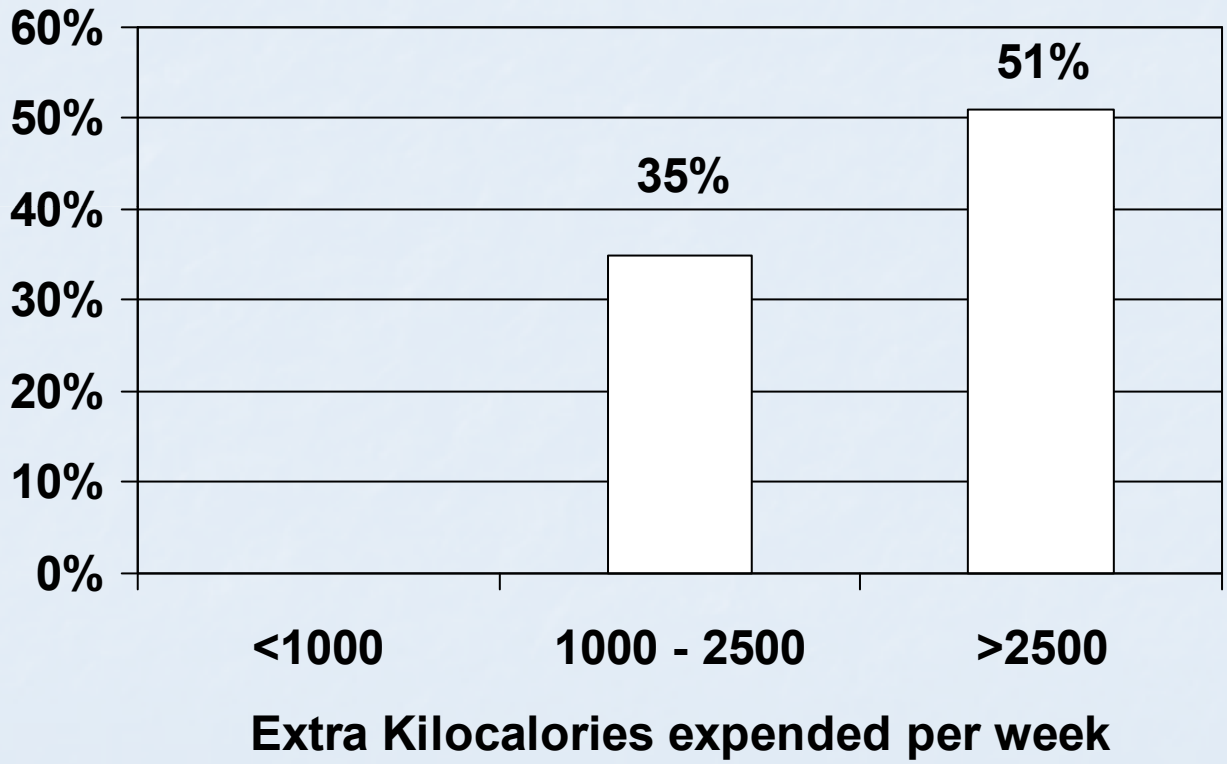
Exercise & mortality rates

Blair et al (1989) JAMA; 262 (17): 2395-2401

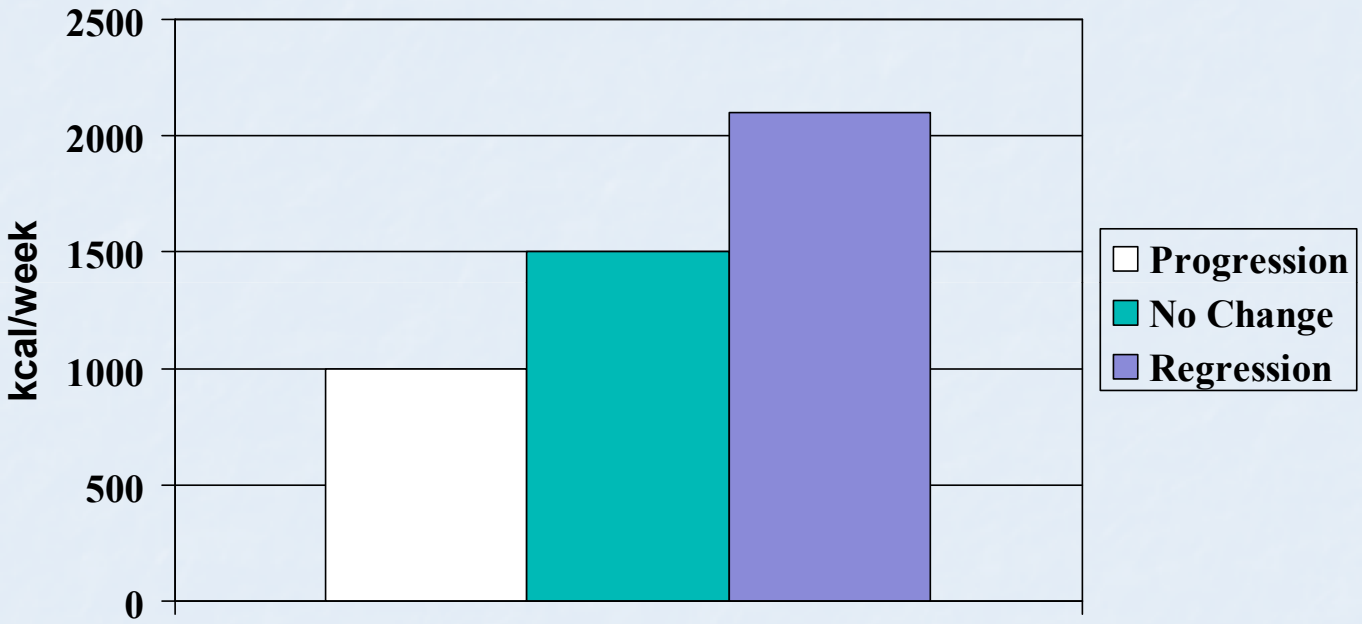


ENERGY EXPENDITURE AND CVD RISK-
% DECREASE IN RISK

Paffenbarger, 1996, *LifeFit, Human Kinetics*, Il



Physical activity & regression of CHD

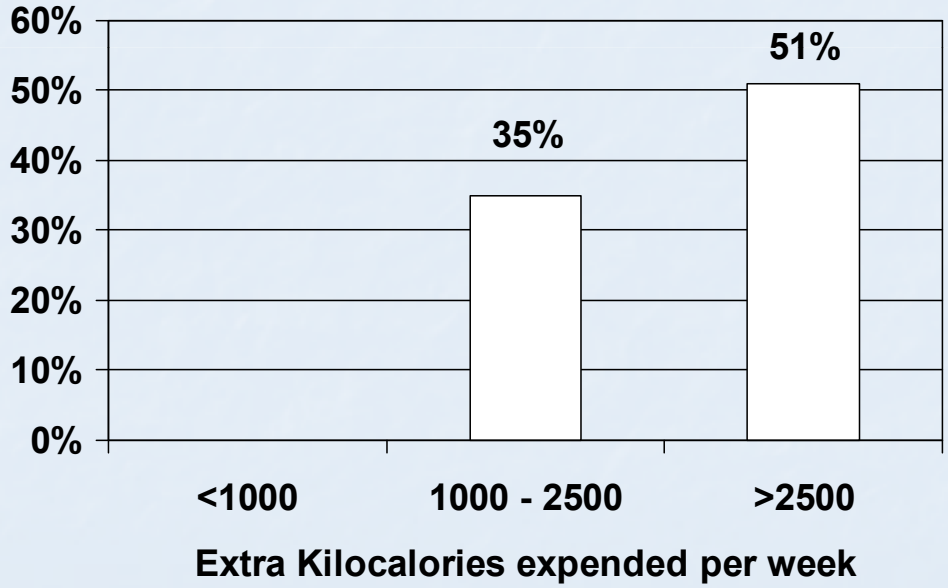


Adapted from Hambrecht et al. 1993 *JACC* 22: 468 – 477

WHY 30 MINUTES?

- ½ hour total activity per day = 150 – 300 Kcals
- 1050 – 2100 extra per week
- Meets risk reduction values described by Paffenbarger et al

ENERGY EXPENDITURE AND CVD RISK - % DECREASE IN RISK



Paffenbarger, 1996, *LifeFit, Human Kinetics*, Il

NB: May not necessarily improve fitness

PRIMARY & SECONDARY PREVENTION

Public health primary prevention message

Some health benefits accrue from daily participation in physical activity which is undertaken at lower levels than those required to confer the traditional physiological training effects of 'exercise'. (Pate et al 1995)

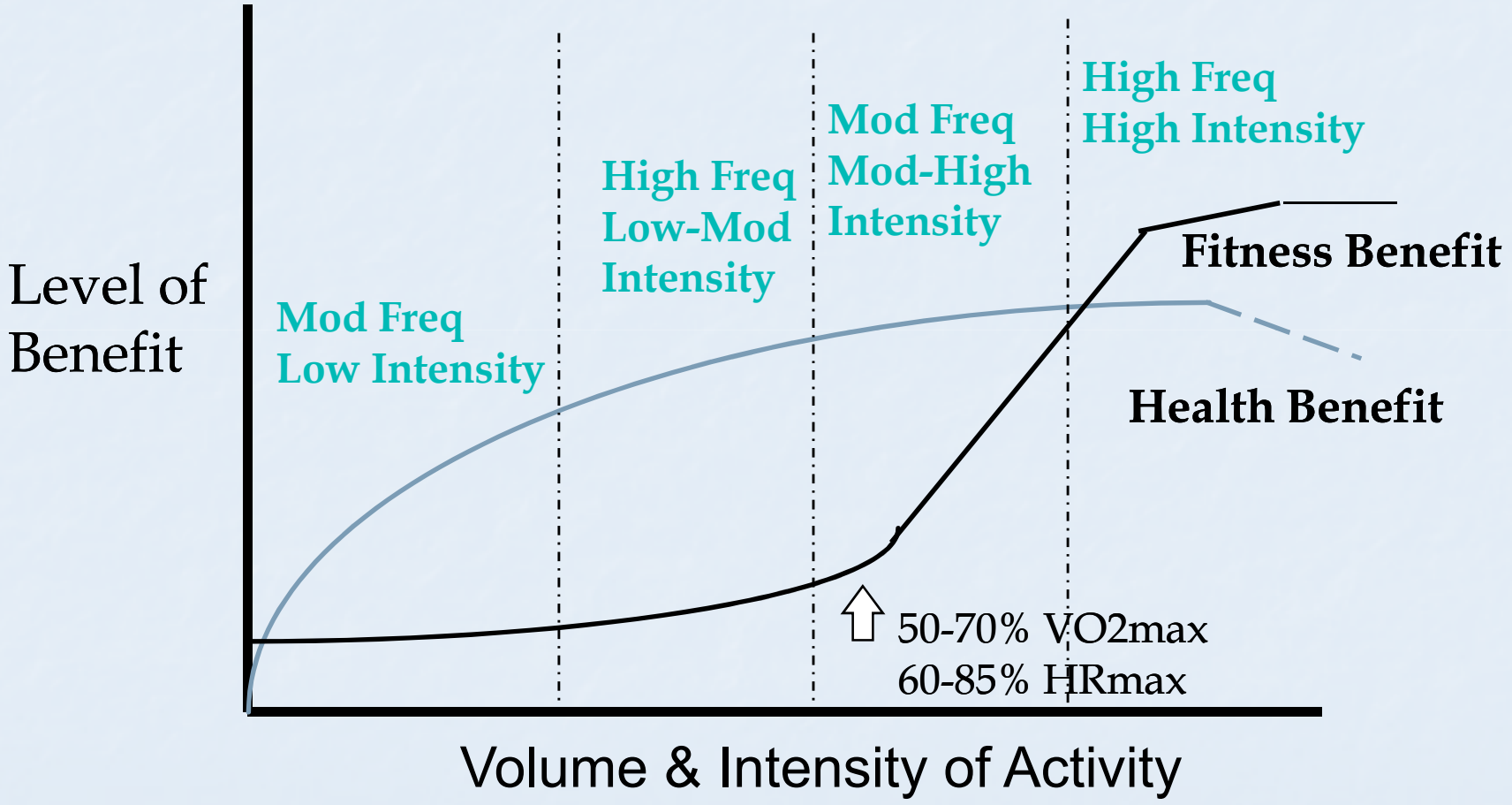
Secondary prevention message

Health and fitness benefits follow a dose-response relationship. i.e. some activity is better than none but in most circumstances (and up to a point) more confers greater benefit

In CAD, cardiac rehabilitation involves encouraging habitual physical activity but also prescribing exercise training which confers measurable physiological changes known to reduce symptoms and mortality

Activity "Dose Response"

Adapted from: U.S. Surgeon Generals Report 1996
Pate et al., *JAMA*; 273: 402-407, 1995



Buckley Holmes & Mapp, 1999

Secondary Prevention

8440 patients MI & revascularisation

Exercise only rehabilitation:

27% reduction in all cause mortality

31% reduction in cardiac mortality

Comprehensive rehab:

13% reduction in all cause mortality

26% reduction in cardiac mortality

(Taylor et al, 2004; Jolliffe et al, 2000) (Cochrane Review)

Secondary Prevention

- Improved symptom control due to:
  - ✓ increased maximal O2 uptake
  - ✓ lower minute ventilation rate at any reference workload
  - ✓ lower myocardial O2 cost at any reference workload
  - ✓ lower HR and SBP at any reference submaximal workload
  - ✓ increased exercise threshold for onset of ischaemia

  No reduction in rate of non fatal reinfarction

Risk Factor modification

Training favourably alters most of the modifiable CHD risk factors:-

- blood pressure is reduced
- total cholesterol is reduced
- high density lipoprotein cholesterol is increased
- glucose metabolism is improved with an increased sensitivity to insulin
- fibrinolytic activity is increased with a reduction in platelet 'stickiness'
- body fat is lost without loss of lean body mass, thereby preserving resting metabolic rate

Evidence base for Physical activity and Exercise

Primary prevention

- ↓ death rates from CAD
- ↓incidence of CVD
- Favourable effect on risk factors

Secondary Prevention

- 31% ↓ cardiac mortality
- Improved symptom control
- Favourable effect on risk factors

Exercise and Physical Activity in Cardiac Patients

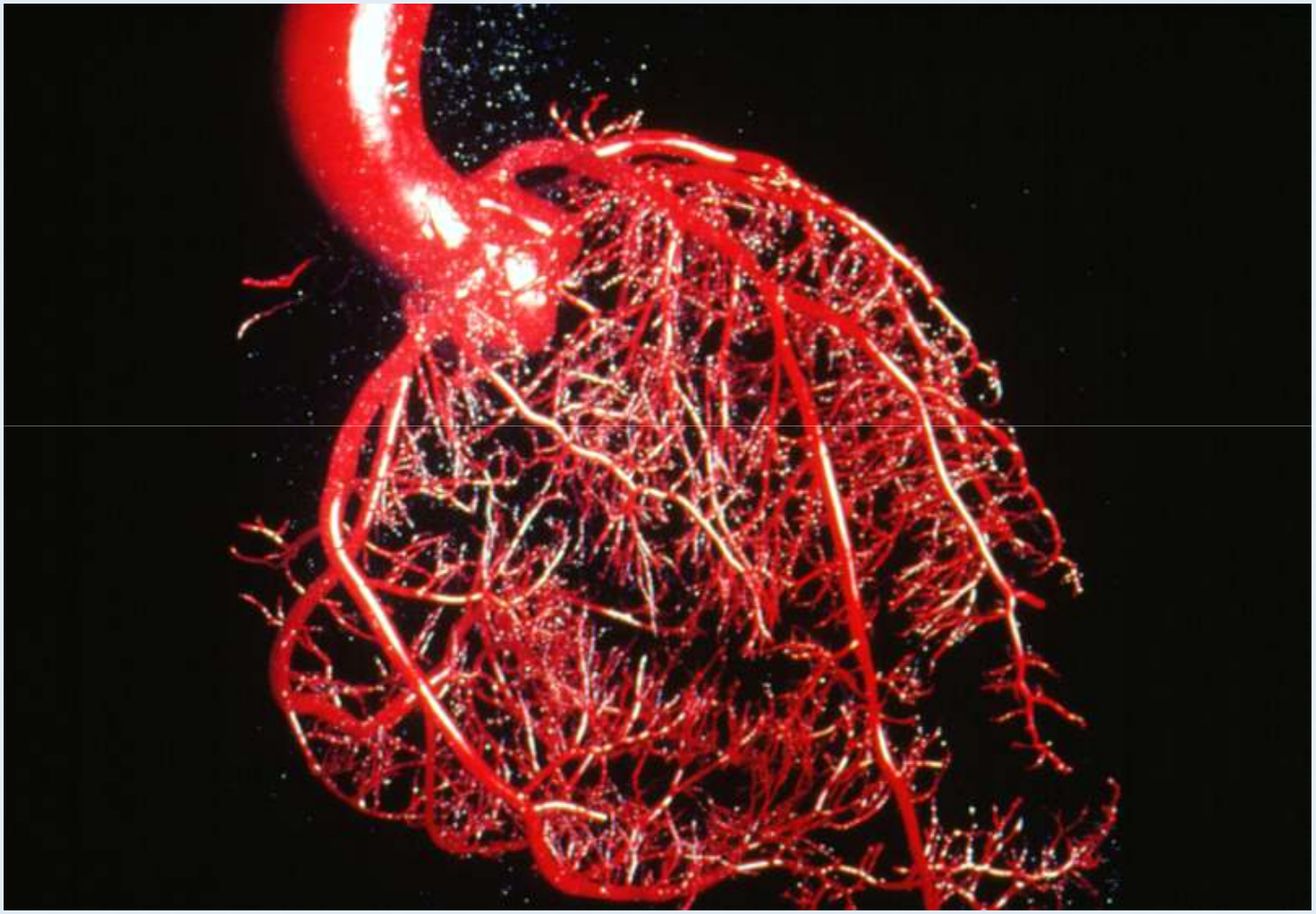
Cardiac Rehabilitation aims to:

- Prescribe and deliver aerobic endurance training that will result in measurable physiological changes known to reduce symptoms and mortality (based on the principle of progressive overload)

Taking into account:

- The prescribed exercise intensity should be above a minimal level required to induce a "training effect" BUT below the intensity that evokes any abnormal clinical signs or symptoms

Coronary Circulation



Rate Pressure Product

HR x SBP = RPP

An indirect measure of myocardial oxygen demand

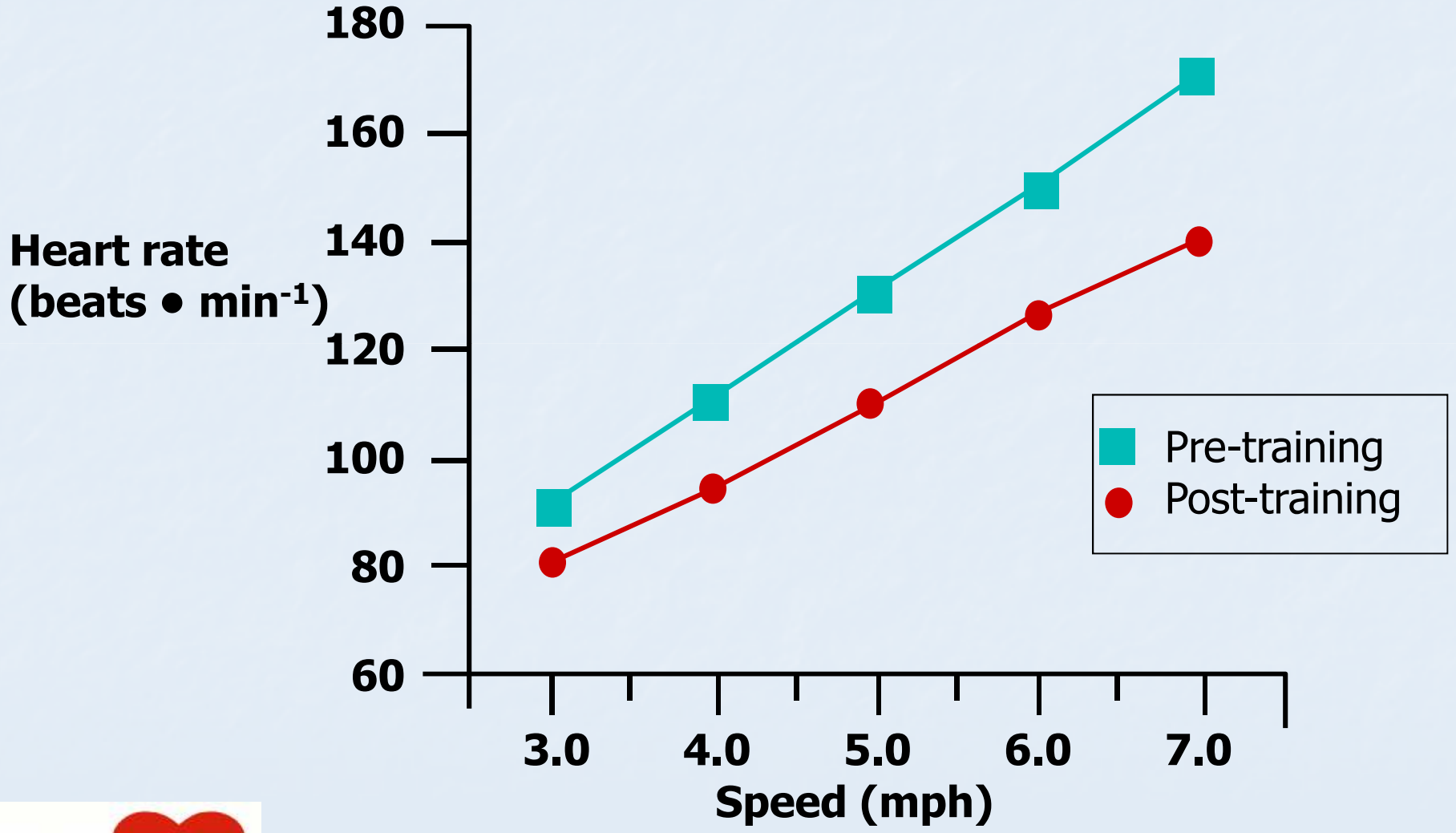
HR 160bpm x SBP 140mmHg = RPP $\frac{22400}{100}$

Chronic Adaptations to Endurance Training

Endurance training results in an increase in VO_2 max due to

- Central changes
- Peripheral changes

Change in submaximal HR with endurance training



Adaptations at sub maximal levels

- **Heart rate** ↓
  - Sympathetic activity
  - Parasympathetic activity (Vagal tone)
- **Circulating catecholamines** ↓
- **Stroke Volume** ↑
  - Greater LV filling
  - Frank Starling mechanism
  - Increase in LV mass
- **Cardiac Output** →

  Must always match metabolic demand, but does so with

  HR ↓ and SV ↑

Adaptations at sub maximal levels

- **Redistribution of blood**
  - Flow to trained skeletal muscle ⇩
  - Other tissues ⇧
- **Blood pressure**
  - Systolic ⇩
  - Diastolic ⇩
  - as much as 10 mmHg for both

Adaptations at sub maximal levels

a-v O_2 difference ↑

Peripheral changes

Coronary Blood Flow ↑

Improved by greater filling time due to extended diastole

Plasma volume ↑

Central Changes

Significant increase in maximum cardiac output is due to an increased stroke volume rather than increased heart rate

Due to :-

- a training-induced increase in left ventricular mass and chamber size
- an increase in total blood volume
- a reduction in total peripheral resistance at maximal exercise

Peripheral Changes

Skeletal muscle improves its capacity to extract and use oxygen by:-

- improved capillarisation around the trained muscle
- increased myoglobin concentration (a protein which carries oxygen within skeletal muscle)
- increased number and size of mitochondria
- increased oxidative enzyme activity within mitochondria

Implications

If HR ↓ and BP ↓ then RPP ↓

Myocardial O_2 demand ↓

Therefore :-

- Ischaemic and angina threshold is extended
- Period of Diastole extended

Allows greater time for blood to flow into the coronary circulation (O_2 supply)

Increase in myocardial efficiency

Before training: Mrs A walked at **3.5mph**
HR = 120bpm & SBP = 140mmHg
Therefore, Mrs A's RPP = 16800

After training: Mrs A walks at **3.5mph**
HR = 110bpm & SBP = 130mmHg
Therefore Mrs A's RPP = 14300

If Mrs A is ischaemic (and gets angina) at RPP = 16800 she will, after training, be able to walk at 3.5mph without symptoms or putting herself at risk

Cardiovascular Endurance Training

- Impacts directly on both myocardial oxygen supply and demand
- Adaptations are conferred by repeated bouts
- Overload principle – so once adaptation exercise prescription has to progress in one or more of frequency, intensity or duration
- RPP is lowered for a given activity –
    - significant impact on ADL's
    - QOL
    - Reducing symptomolgy
    - Reduced mortality risk as reduced arrhythmia risk
- 'Regular' inactivity results in the reverse (progressive increased RPP for a given activity)

Exercise programming:

Guidelines for exercise prescription and physical activity planning in CVD prevention and rehabilitation

What is the goal?

Public health message:

30 minutes of moderate intensity physical activity on at least 5 days of the week.

But *there are significant gains in the prevention and management of CVD by increasing aerobic capacity*

Aims of Exercise component of Cardiac Rehabilitation

- Increase physical capacity and fitness
- Teach self pacing and monitoring of own exercise progression
- Establish and support individualised home activity programme
- Increase confidence and independence
- Teach patient and family overall health benefits of physical activity and exercise

FITT Principle

- **Frequency**
  - 2-3 times weekly
  - 2 rehab classes and 1 home circuit
- **Intensity**
  - Dependent on assessment findings
  - 60-80% of maximal heart rate (40-70% HRR)
  - 3-4 RPE (modified Borg scale), 12-13 RPE (Borg scale)
- **Time**
  - 20-30 minute conditioning phase (plus warm up, cool down)
- **Type**
  - Aerobic, CV endurance training
  - Large muscle groups, Low skill
  - Amenable to standardised prescription, Fun!

Exercise Prescription

Overall aim 3 times per week:

WARM UP:

- 15 minutes
- Within 20 beats of training HR

CONDITIONING PHASE:

- 20-30 minutes
- CV endurance (interval progressing to continuous as able)
- 60-80% of HRmax

COOL DOWN:

- 10 minutes
- Within 10 beats of pre-exercise HR

Achieved in many modes: -

Structured class, structured 1 to 1, structured home programme, structured physical activities.

Assessment

Pre exercise screening:

- Risk stratification
- Stage of change / Interests / Barriers
- Health beliefs
- Ethnicity
- Age, sex
- Functional capacity
- Co-morbidities
- Level of supervision required
- Contraindications to exercise

Warm-up

- **Strenuous exercise without previous warm-up can produce ischaemic ST segment changes and arrhythmias even in healthy adults**

- **15 minutes** minimum duration
- Increase myocardial blood supply
  - Dilation - sympathetic activity / local regulation
  - Increased aortic pressure

Conditioning Component

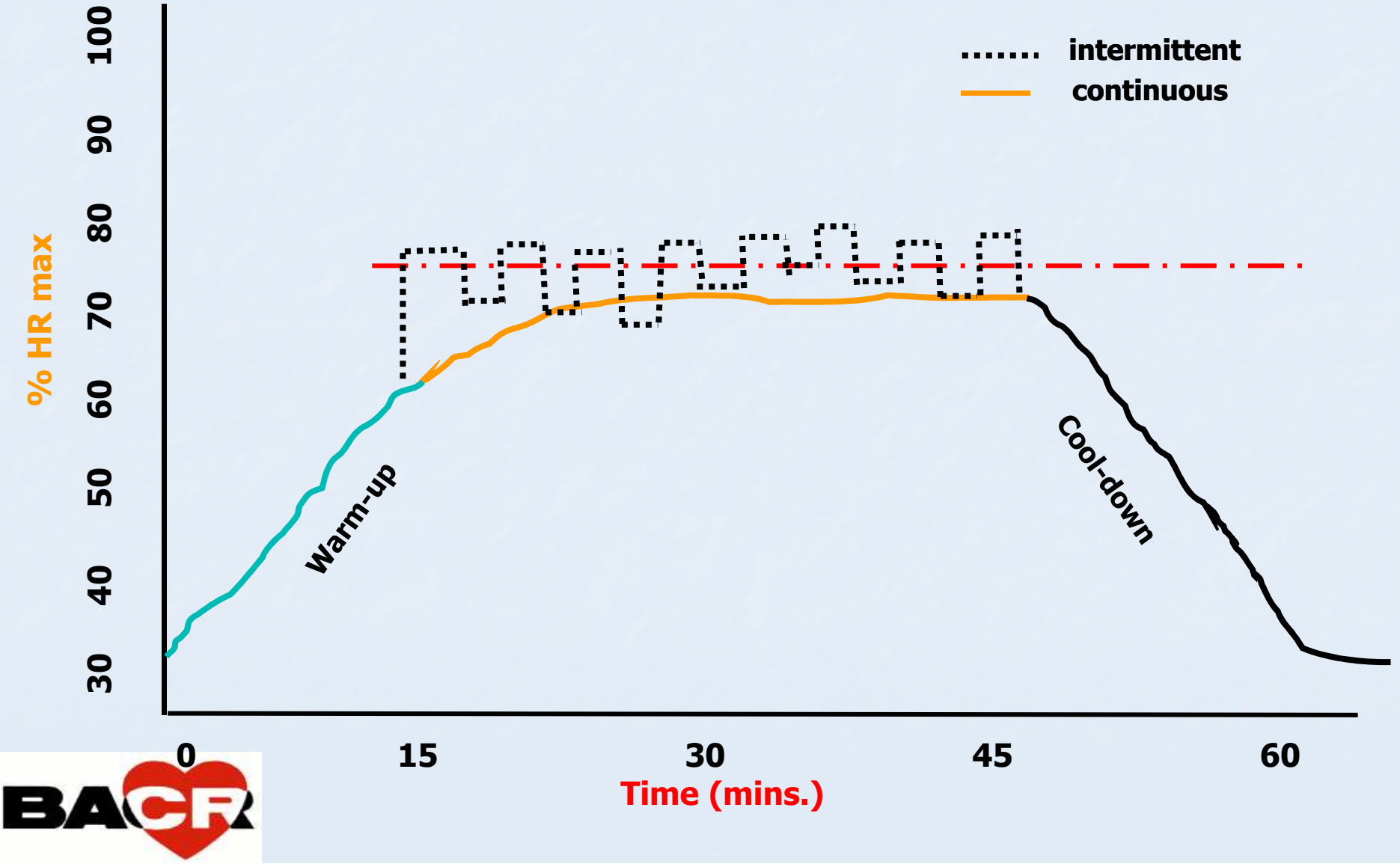
The main objective is to improve cardiorespiratory fitness and therefore the main component is the CV conditioning component which will confer the greatest benefits

Conditioning Component

Continuous approach – training involves uninterrupted activity usually performed at a constant sub max intensity

Interval approach – training that entails bouts of relatively more intense work interspersed with rest or active recovery

Cardiovascular Conditioning
Continuous versus Intermittent Training



Cool Down

Defined as reduction of HR to within 10 bpm of pre-exercise heart rate

- Minimum 10 minutes
- Reduces risk of
  - hypotension
  - arrhythmias
  - elevated heart rates

15 minutes post-exercise supervision recommended

Conclusions

- Physical activity is beneficial to health
- Greater gains are seen with increasing cardiorespiratory fitness
- Progressive endurance training reduces myocardial workload and increases coronary artery blood supply
- Key exercise programming principles:
  - progressive cardiovascular exercise
  - preparatory warm up and post exercise cool down are essential
  - intensity set which is associated with increase in fitness at the lowest risk

MSOffice1

Thank you for listening

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