STATE HIGHER EDUCATION UNIVERSITY
"UZHGOROD NATIONAL UNIVERSITY"
MEDICAL FACULTY №2
INTERNAL DISEASES

Guidelines to practical lessons
OK 42 PHYSICAL REHABILITATION, SPORTS MEDICINE
CARDIAC REHABILITATION
(2 HOURS)

Module 2 “Physical Rehabilitation”

Uzhgorod 2024

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The guideline is composed according to medical students' educational qualification characteristics and professional training programs.

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CARDIAC REHABILITATION

Cardiac rehabilitation (CR) is the process by which persons with cardiovascular disease (including but not limited to patients with coronary heart disease) are restored to and maintained at their optimal physiological, psychological, social, vocational, and emotional status. (American Association of Cardiovascular and Pulmonary Rehabilitation–AACPR). CR is a carefully planned program that combines supervised physical activity, nutritional and weight management, lifestyle modification to help people with heart disease live healthier lives.

CR is supervised and carried out by adequately trained health professionals, including cardiologists. CR starts as soon as possible after the initial cardiovascular (CV) event.

Regular physical activity (PA), including systematic exercise, is an important component of therapy for most cardiovascular diseases (CVDs) and is associated with reduced (CV) and all-cause mortality.

The goals of cardiac rehabilitation are:

- to restore and improve cardiac function;
- to regain strength and improve exercise endurance;
- to increase exercise threshold for the onset of chest pain (angina);
- to decrease symptoms (such as chest pain and shortness of breath);
- to reduce disability;
- to prepare for return to work or activities of daily living;
- to identify and improve cardiac risk factors (decrease cholesterol level, lower blood pressure, improved blood sugar control, manage healthy weight, lower anxiety and depression);
- to increase cardiac conditioning;
- to reduce dependence on cardiac drugs and fewer visits to the doctor and hospital;
- To improve feelings about being able to cope after myocardial infarction or surgery.

These goals are achieved through the use of a prescribed exercise and education program. The primary outcome for patients with cardiac disease is the ability to resume activities of normal life without significant cardiac symptomatology.

Components of comprehensive cardiac rehabilitation are: patient assessment, nutrition counselling, weight management, blood pressure management, lipid management, diabetes management, tobacco cessation, psychosocial management, physical activity counselling, exercise training.

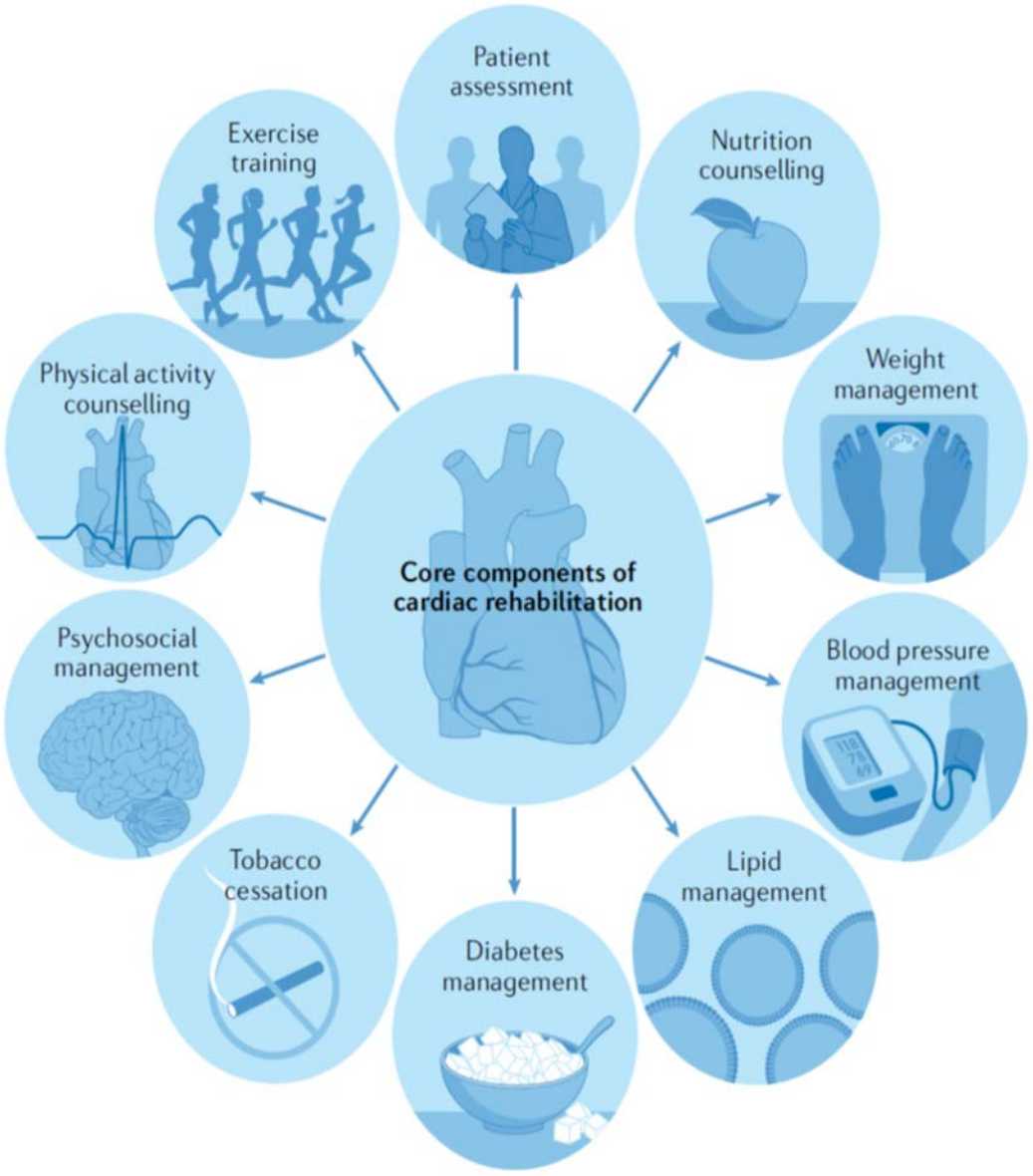


Fig. 1 Components of comprehensive cardiac rehabilitation. [Advances in rehabilitation for chronic diseases: improving health outcomes and function. Richardson C.R., Franklin B., Moy M.L., Jackson E.A., 365, l2191, 2019].

Cardiac rehabilitation programs are generally divided into:

Primary prevention, which includes risk factor modification and education before a cardiac event. As a rehabilitation specialist, it is essential to address lifestyle modification and education as parts of a complete cardiac rehabilitation program. Lifestyle modification is needed to address reversible cardiac risk factors, and education includes teaching patients about all cardiac risk factors. The goal is to achieve a program of cardiac risk factor modification. Primary prevention can also include the use of medications for prevention of cardiovascular disease complications, and includes treatment of hypertension, lowering lipids, and antiplatelet agents.

Secondary prevention, which is cardiac rehabilitation with exercise and risk factor modification after the establishment of cardiac disease, including

myocardial infarction (MI) and other conditions. Secondary risk factor modification programs, which are the more common programs for individuals practicing cardiac rehabilitation, occur after an initial cardiac event. Secondary risk factor modification programs include all the features of the primary prevention programs with the addition of disease-specific education and formal exercise programs.

1. Patient assessment

Risk factors and risk classification

The major risk factors for CVD are cholesterol, high blood pressure (BP), cigarette smoking, diabetes mellitus (DM), and adiposity.

Risk factors for cardiovascular disease divided to:

- ✓ **Irreversible risk factors** are those that cannot be altered and include: male gender, past history of vascular disease, age, and family history of premature Coronary artery disease (CAD) (before age 55 in a parent or sibling).
- ✓ **Reversible risk factors** for cardiac disease include: obesity, sedentary lifestyle, hyperlipidemia (Low HDL cholesterol (<0.9 mmol/L [35 mg/dL]), and other apo-B-containing lipoproteins hypercholesterolemia (>5.20 mmol/L [200 mg/dL]), high lipoprotein A, hypertriglyceridemia (>2.8 mmol/L [250 mg/dL]), cigarette smoking, conditions such as DM, hyperinsulinemia, metabolic syndrome (MS) and hypertension.

Modification of all these risk factors is an essential part of a cardiac rehabilitation program.

Individuals with multiple risk factors are more likely to develop CVD. Preliminary evaluation should consist of a self-assessment relating to symptoms and calculation of systematic coronary risk estimation the updated SCORE algorithm - SCORE2 that is used to estimate an individual's 10-year risk of fatal and non-fatal CVD events (myocardial infarction, stroke) people aged 40-69 years with risk factors that are untreated or have been stable for several years, and systematic coronary risk estimation 2-older persons (SCORE 2 OP). Based on this assessment the individual CV risk can be categorized from low to very high risk.

Individuals who are habitually active and at low or moderate risk should not have any restrictions for exercise including competitive sports. Sedentary individuals and individuals at high or very high risk may engage in low-intensity exercise without further evaluation.

Sedentary individuals and/or those at high or very high-risk planning to undertake high-intensity exercise as well as selected individuals planning to undertake moderate-intensity exercise should undergo a physical examination, 12-lead ECG, and exercise stress test. The aim of the exercise test is to identify prognostically important CAD and to assess the presence of exercise-induced arrhythmias.

Individuals with symptoms, abnormal findings on physical examination, abnormal ECG, or abnormal exercise test should be investigated further according to current ESC

2. Nutrition counselling

Recommendations for nutrition and alcohol

- Dietary habits influence CV risk, mainly through risk factors such as lipids, BP, body weight, and DM. A healthy diet is recommended as a cornerstone of CVD prevention in all individuals
- It is recommended to adopt a Mediterranean or similar diet to lower risk of CVD.
- It is recommended to replace saturated with unsaturated fats to lower the risk of CVD.
- It is recommended to reduce salt intake to lower BP and risk of CVD.
- It is recommended to choose a more plant based food pattern, rich in fibre, that includes whole grains, fruits, vegetables, pulses, and nuts.
- It is recommended to restrict alcohol consumption to a maximum of 100 g per week.
- It is recommended to eat fish, preferably fatty, at least once a week and restrict (processed) meat.
- It is recommended to restrict free sugar consumption, in particular sugar-sweetened beverages, to a maximum of 10% of energy intake

Healthy diet characteristics

- Adopt a more plant- and less animal-based food pattern
- Saturated fatty acids should account for <10% of total energy intake, through replacement by PUFAs (polyunsaturated fatty acid), MUFAs (monounsaturated fatty acid), and carbohydrates from whole grains
- Trans unsaturated fatty acids should be minimized as far as possible, with none from processed foods
- <5 g total salt intake per day (The DASH (Dietary Approaches to Stop Hypertension) trial showed a dose response relation between sodium reduction and BP reduction. Optimal intake might be as low as 3 g/day.
- 30-45 g of fibre of per day, preferably from whole grains
- >200 g of fruit per day (>2-3 servings)
- >200 g of vegetables per day (>2-3 servings)
- Red meat should be reduced to a maximum of 350 - 500 g a week, in particular processed meat should be minimized
- Fish is recommended 1-2 times per week, in particular fatty fish
- 30 g unsalted nuts per day
- Consumption of alcohol should be limited to a maximum of 100 g per week
- Sugar-sweetened beverages, such as soft drinks and fruit juices, must be discouraged

3. Weight management

Diet, exercise, and behaviour modification are the main therapies for overweight and obesity. Energy restriction is the cornerstone of management. PA is essential to maintain weight loss and prevent rebound weight gain.

A person with a body mass index (BMI) >30 kg/m2 or (preferentially) a waist circumference >94 cm for males and >80 cm for females (both for European Caucasians) is considered obese.

European guidelines for obese individuals recommend that a minimum of 150 min/week of moderate-intensity endurance exercise (at least 30 min, 5 7 days per week) training should be combined with three weekly sessions of resistance exercise. Such intervention leads to a reduction in intra-abdominal fat mass, increments in muscle and bone mass, attenuation in the weight loss-induced decline of resting energy expenditure, reduction in BP and chronic inflammation, and improvement in glucose tolerance, insulin sensitivity, lipid profile, and physical fitness. There is also a positive influence on the long-term maintenance of weight reduction, general well-being and self-esteem, and reduction in anxiety and depression.

Therefore, it may be reasonable to consider that obese individuals should limit high-volume weight-bearing exercises on a hard surface (i.e. <2 h/day) until a considerable reduction in body weight is achieved. Moreover, if high-volume exercise (>2 h/day) is desired, a sufficient recovery time should be allowed for between periods of exercise (optimally 48 h). It is important to emphasize that good physical and muscular fitness and neuromuscular coordination may protect obese individuals from musculoskeletal injuries, hence non-weight-bearing exercises such as cycling or swimming may be beneficial.

Medications approved in Europe as aids to weight loss (orlistat, naltrexone/bupropion, high-dose liraglutide) may supplement lifestyle change to achieve weight loss and maintenance. A very effective treatment option for extreme obesity or obesity with comorbidities is bariatric surgery.

4.Blood pressure management

Lifestyle interventions are recommended for people with high-normal BP or higher. A person with a persistent systolic BP (SBP) >_140 mmHg and/or diastolic BP (DBP) >_90 mmHg is considered hypertensive.

Hypertensive individuals should participate in at least 30 min of moderate-intense dynamic aerobic exercise (walking, jogging, cycling, or swimming) for 5 7 days per week. Additional resistance training is highly effective in reducing BP further and resistance training ≥ 3days per week is also advised.

Among adults with well-controlled hypertension but high risk and/or target organ damage, high-intensity resistance exercise is not recommended. Individuals with symptoms suggestive of CAD require further assessment and optimization of medical therapy before participation in sports. If arterial hypertension is poorly controlled (resting SBP > 160 mmHg), exercise should be postponed until the BP is controlled.

Categories for conventionally measured seated office blood pressure

Category	SBP (mmHg)		DBP (mmHg)
Optimal	<120	and	<80
Normal	120-129	and/or	80-84
High-normal	130-139	and/or	85-89
Grade 1 hypertension	140-159	and/or	90-99
Grade 2 hypertension	160-179	and/or	100-109
Grade 3 hypertension	≥180	and/or	≥110
Isolated systolic hypertension	≥140	and	<90
Definitions of hypertension according to office, ambulatory, and home blood pressure			
Office BP	≥140	and	≥90
Ambulatory BP	≥135	and/or	≥85
Daytime (or awake) mean	≥120	and/or	≥70
Night-time (or asleep) mean	≥130	and/or	≥80
Home BP mean	≥135	and/or	≥85

Clinical evaluation and risk stratification in hypertensive patients

- ✓ Assess risk factors for atherosclerotic cardiovascular disease (ASCVD) (using SCORE chart), or the presence of cardiac, vascular, or renal disease,
- ✓ Routine tests for patients with hypertension should be done: hemoglobin and/or hematocrit, fasting blood glucose and/or HbA1c, blood lipids: total cholesterol, LDL-C, HDL-C, triglycerides, blood potassium and sodium, blood uric acid, blood creatinine and eGFR, blood liver function tests, urine analysis: microscopic; urinary protein by dipstick or, ideally, albumin-to-creatinine ratio (ACR), 12-lead ECG,
- ✓ Detect evidence of hypertension-mediated organ damage (HMOD), e.g. LV hypertrophy, renal disease, or retinopathy,
- ✓ Consider potential secondary causes of hypertension, e.g. renovascular disease, hyperaldosteronism, or pheochromocytoma. Also, carefully evaluate substance abuse (e.g.cocaine), drugs that may increase BP (e.g. cyclosporine, sympaticomimetics), liquorice, etc,
- ✓ Echocardiography is recommended in patients with ECG abnormalities, and should be considered when the result will influence clinical decision-making. Fundoscopy is recommended in grade 2 or 3 hypertension and in all patients with DM.

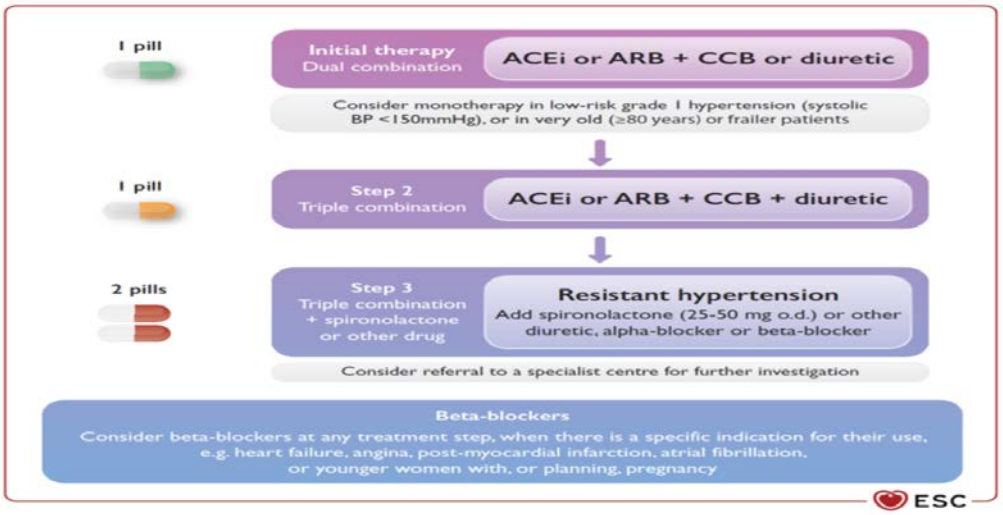
Non-pharmacological measures should be considered as the first step in the management of hypertension, including: restriction of salt intake and alcohol consumption, weight reduction if applicable, balanced diet (e.g. Mediterranean diet, DASH diet), and cessation of smoking.

If such lifestyle changes do not lower BP after 3 months, antihypertensive drugs should be commenced if SBP remains >140 mmHg. BP-lowering drug treatment is recommended in many adults when office BP is >140/90 mmHg and in all adults when BP is >160/100mmHg. Antihypertensive therapy alongside lifestyle intervention should be considered in all individuals aged >65 years but <80 years, provided it is well tolerated.

When drug treatment is used, the aim is to control BP to target within 3 months. The first step in all groups is a reduction to systolic blood pressure <140 mmHg and diastolic BP (DBP) <80 mmHg. The recommended ultimate SBP treatment target range for younger patients (18-69 years) is 120-130 mmHg. The ultimate target SBP for patients aged >70 years is <140 mmHg and down to 130 mmHg if tolerated.

A simple drug treatment algorithm should be used to treat most patients, based on combinations of a renin angiotensin system (RAS) blocker with a CCB or thiazide/thiazide-like diuretic, or all three. Beta-blockers may also be used where there is a guideline-directed indication.

Many patients with hypertension will be at sufficient risk to benefit from statin therapy for primary prevention. Antiplatelet therapy is indicated for secondary prevention.



Core drug treatment strategy for hypertension. This algorithm is appropriate for most patients with hypertension-mediated organ damage,diabetes mellitus, cerebrovascular disease, and peripheral artery disease. ACE = angiotensin-converting enzyme; AF = atrial fibrillation; ARB = angiotensin receptor blocker; BP = blood pressure; CCB = calcium channel blocker; HF = heart failure; o.d. = omni die (once a day).

5. Lipid management

Physical activity has favourable effects on lipid metabolism by reducing serum triglycerides by up to 50% and increasing high-density lipoprotein (HDL) cholesterol by 5 - 10%. Exercise may also reduce LDL cholesterol by up to 5% and shift the more atherogenic small, dense LDL fraction towards larger LDL particles in a dose dependent fashion. These metabolic improvements can be achieved through 3.5 - 7 h of moderately vigorous PA per week or 30 - 60 min of exercise on

most days.

In individuals with hypertriglyceridaemia or hypercholesterolaemia, a higher intensity of exercise is recommended, as this may improve the lipid profile and reduce CV risk.

Pharmacological intervention, particularly with statins, is superior to exercise and lifestyle intervention alone for reducing LDL cholesterol and improving prognosis.

Physically active individuals with dyslipidaemia may experience muscle pain and soreness or tendinopathy accompanied by elevated muscle enzymes. In these cases, measures such as stopping medication temporarily followed by repeat challenge with another statin drug, with or without an alternate day regimen, or introducing other lipid-lowering agents such as ezetimibe or proprotein convertase subtilisin/kexin type 9 (PCSK-9) inhibitors should be considered. Individuals who develop rhabdomyolysis due to a statin should be prescribed an alternative lipid-lowering agent.

Lowering LDL-C with statins, ezetimibe, and—if needed and cost-effective—PCSK9 inhibitors, decreases the risk of ASCVD proportionally to the absolute achieved reduction in LDL-C.

It is recommended that a high-intensity statin is prescribed up to the highest tolerated dose to reach the LDL-C goals set for the specific risk group.

An ultimatec LDL-C goal of <1.4 mmol/L (55 mg/dL) and LDL-C reduction of >50% from baseline should be considered in apparently healthy persons<70 years at very high risk.

An ultimatec LDL-C goal of <1.8 mmol/L (70 mg/dL) and LDL-C reduction of >50% from baseline should be considered in apparently healthy persons <70 years at high risk.

In patients with established ASCVD, lipid-lowering treatment with an ultimatec LDL-C goal of <1.4 mmol/L (55 mg/dL) and a >50% reduction in LDLC vs. baseline is recommended.

If the goals are not achieved with the maximum tolerated dose of a statin, combination with ezetimibe is recommended.

For primary prevention patients at very high risk, but without FH, if the LDL-C goal is not achieved on a maximum tolerated dose of a statin and ezetimibe, combination therapy including a PCSK9 inhibitor may be considered.

For secondary prevention patients not achieving their goals on a maximum tolerated dose of a statin and ezetimibe, combination therapy including a PCSK9 inhibitor is recommended.

For very-high-risk FH patients (that is, with ASCVD or with another major risk factor) who do not achieve their goals on a maximum tolerated dose of a statin and ezetimibe, combination therapy including a PCSK9 inhibitor is recommended.

If a statin-based regimen is not tolerated at any dosage (even after

rechallenge), ezetimibe should be considered.

If a statin-based regimen is not tolerated at any dosage (even after rechallenge), a PCSK9 inhibitor added to ezetimibe may be considered.

If the goal is not achieved, statin combination with a bile acid sequestrant may be considered.

6. Diabetes management

Lifestyle management is a first priority for ASCVD prevention and management of DM. Most persons with DM are obese, so weight control is crucial. Several dietary patterns can be adopted, where the predominance of fruits, vegetables, wholegrain cereals, and low-fat protein sources is more important than the precise proportions of total energy provided by the major macronutrients. Salt intake should be restricted. Specific recommendations include limiting saturated and trans fats and alcohol intake, monitoring carbohydrate consumption, and increasing dietary fibre. A Mediterranean-type diet, where fat sources are derived primarily from monounsaturated oils, is protective against ASCVD.

A combination of aerobic and resistance exercise training is effective in preventing the progression of type 2 DM and for the control of glycaemia. Lifestyle intervention lowers future microvascular and macrovascular risks as well as mortality in the longer term. Lifestyle changes including smoking cessation, a low saturated fat, high-fibre diet, aerobic PA, and strength training are recommended.

Reduction in energy intake is recommended to patients, to help achieve lower body weight or prevent or slow weight gain.

For those motivated to try, considerable weight loss with use of low-calorie diets followed by food reintroduction and weight-maintenance phases early after diagnosis can lead to DM remission and should be considered

A target HbA1c for the reduction of CVD risk and microvascular complications of DM of <7.0% (53 mmol/mol) is recommended for the majority of adults with either type 1 or type 2 DM.

For patients with a long duration of DM and in old or frail adults, a relaxing of the HbA1c targets (i.e. less stringent) should be considered.

A target HbA1c of <_6.5% (48 mmol/mol) should be considered at diagnosis or early in the course of type 2 DM in persons who are not frail and do not have ASCVD.

Metformin is recommended as first-line therapy, following evaluation of renal function, in the majority of patients without previous atherosclerotic cardiovascular disease (ASCVD), CKD, or heart failure (HF). In persons with type 2 DM with ASCVD, metformin should be considered, unless contraindications are present.

In patients with type 2 DM and target organ damage the use of an SGLT2 inhibitor (sodium-glucose cotransporter) or GLP-1RA (glucagon-like peptide-1 receptor agonist) with proven outcome benefits may be considered to reduce future

CV and total mortality.

Physical inactivity is a major cause of type 2 diabetes mellitus (T2DM). Diabetes is also independently associated with an accelerated decline in muscular strength and, partly because of hyperglycaemia, may lead to reduced joint mobility.

Aerobic exercise in patients with T2DM improves glycaemic control and reduces visceral fat and insulin resistance. Exercise also has beneficial effects on BP and lipid profile, and leads to modest weight loss. Both aerobic and resistance training promote prolonged adaptations in skeletal muscle, adipose tissue, and the liver associated with enhanced insulin action.

In patients with pre-diabetes or metabolic syndrome, both aerobic and resistance exercise may prevent the development of overt diabetes.

Intensity of exercise seems to be of greater importance than the volume of exercise; individuals who exercise at moderate or high intensity have a lower risk of developing metabolic impairment compared with those who have a similar energy expenditure at a lower intensity.

The effects on muscle insulin sensitivity are observed with a relatively low volume of exercise (400 kcal/week) in previously sedentary adults, but increase with higher volumes of exercise.

Diabetes is a cause of coronary microvascular dysfunction (CMD), which is associated with lower exercise capacity and adverse outcomes and can be improved by exercise training.

During an acute bout of exercise, glucose uptake in the muscles is increased for up to 2 h afterwards through mechanisms that are independent of insulin. The exercise-induced hypoglycaemic effect can be diminished by performing resistance training or interval training in patients with type 1 diabetes. There is a dose response relationship between intensity and volume of exercise and duration of glucose uptake by skeletal muscle that may last up to 48 h after exercise.

These factors must be considered in individuals with diabetes who are undertaking intensive exercise or competitive sports in order to avoid hypoglycaemia.

Among individuals with diabetes mellitus, resistance training >_3 times per week in addition to moderate or vigorous aerobic exercise (at least 30 min, 5-7 days per week) is recommended to improve insulin sensitivity and achieve a better CVD risk profile

7. Tobacco cessation

Stopping smoking is potentially the most effective of all preventive measures, with substantial reductions in (repeat) myocardial infarctions or death. Stopping smoking rapidly reduces CVD risk and is the most cost-effective strategy for ASCVD prevention.

Smokers who quit may expect an average weight gain of 5 kg, but the health

benefits of tobacco cessation outweigh risks from weight gain.

Drug support for stopping smoking should be considered in all smokers who are ready to undertake this action. Evidence-based drug interventions include nicotine-replacement therapy (NRT), bupropion, varenicline, and cytisine (not widely available). All forms of NRT (chewing gum, transdermal nicotine patches, nasal spray, inhaler, sublingual tablets) are effective.

Electronic cigarettes (e-cigarettes) simulate combustible cigarettes by heating nicotine and other chemicals into a vapour. E-cigarettes deliver nicotine without most of the tobacco chemicals, and are probably less harmful than tobacco.

8. Psychosocial management

Mood-management therapies may improve outcomes in patients with current or past depression. Mental healthcare improves stress symptoms and quality of life, reduces the risk of suicide, and may improve CV outcomes.

9. Physical activity counselling

According to 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice it is recommended for adults of all ages to strive for at least 150 - 300 min a week of moderate intensity or 75 - 150 min a week of vigorous intensity aerobic PA, or an equivalent combination thereof, to reduce all-cause mortality, CV mortality, and morbidity. It is recommended that adults who cannot perform 150 min of moderate-intensity PA a week should stay as active as their abilities and health condition allow. PA accumulated in bouts of even <10 min is associated with favorable outcomes, including mortality. Performing resistance exercise, in addition to aerobic activity, is recommended on 2 or more days per week.

It is recommended to reduce sedentary time to engage in at least light activity throughout the day to reduce all-cause and CV mortality and morbidity.

Examples of moderate-intensity aerobic activities: brisk walking (at least 2.5 miles per hour), water aerobics, dancing (ballroom or social), gardening, tennis (doubles), biking slower than 10 miles per hour.

Examples of vigorous-intensity aerobic activities: hiking uphill or with a heavy backpack, running, swimming laps, aerobic dancing, heavy yardwork like continuous digging or hoeing, tennis (singles), cycling 10 miles per hour or faster, jumping rope

Resistance exercise in addition to aerobic PA is associated with lower risks of total CV events and all-cause mortality. The suggested prescription is one to three sets of 8-12 repetitions at the intensity of 60-80% of the individual’s 1 repetition maximum at a frequency of at least 2 days a week in a variety of 8-10 different exercises involving each major muscle group.

For older adults or deconditioned individuals, it is suggested to start with one set of 10-15 repetitions at 40-50% of 1 repetition maximum. In addition, older adults are recommended to perform multicomponent PA that combines aerobic, muscle-strengthening, and balance exercises to prevent falls.

10.Exercise training

PA should be individually assessed and prescribed in terms of frequency, intensity, time (duration), type, and progression. Exercise for cardiovascular conditioning should be isotonic, rhythmic, and aerobic; should use large muscle masses and should not involve a large isometric component. In addition to aerobic activity, resistance exercise (using light weights) may be added on an individual basis.

The most benefit from physical activity we can get doing it regular - at least 30 minutes of physical activity on 5 or more days per week. These 30 minutes does not include warm up and cool down phases. Weekly physical activity plan could include activities such as housework, gardening or walking to the shop. Also, 30 minutes activity session could be splitted up to 15 minutes of physical activity twice a day.

1. **Warm up** – gradually increasing heart rate - 15 minutes. Warm up gradually increasing the workload of the heart, it is able to adapt slowly to increasing demand. It helps to reduce the risk of angina. Walking, marching on the spot, or low-level cycling are suitable ways to raising the pulse and should be done about 5 minutes. Next 5 minutes of warm up should be stretching. It is important to remember to keep feet moving in between the stretches so that body remains warm up. Stretching activities could include upper back stretch, chest stretch, lower back and waist mobility, calf and hamstring stretch, front of thigh stretch. The final 5 minutes of warm up should be pulse raising activities (walking, marching on the spot, or low-level cycling) at a slightly higher intensity than he first 5 minutes.

2. **Main exercise** – maintain target heart rate - 15-40 minutes

3. **Cool down** – gradually decrease heart rate – 10-15 minutes. The goal is to bring the body back to its resting state. Cool down reduces the risk of fainting or dizziness and heart rhythm disturbances that could happen if stop exercising suddenly. Stretching during the cool down helps to reduce muscle soreness.

PA can be expressed in absolute or relative terms. Absolute intensity is the amount of energy expended per minute of activity, assessed by oxygen uptake per unit of time (mL/min or L/min) or by metabolic equivalent of task (MET). An absolute measure does not consider individual factors such as body weight, sex, and fitness level. Relative intensity is determined based on an individual's maximum (peak) effort, e.g. percentage of cardiorespiratory fitness (%VO2 max), percentage of maximum (peak) heart rate (%HRmax) or using rating of perceived exertion according to the Borg scale. Less fit individuals generally require a higher level of effort than fitter people to perform the same activity. A relative intensity measure is necessary to provide an individualized PA prescription.

Exercise level could be monitored by heart rate, effort score (Borg scale) or talk test (if person is able to speak in complete sentence while exercising and is only a little out of puff, then working at the correct level. If person is gasping or short of breath, then he is working too hard and needs to slow down).

Classification of physical activity intensity and examples of absolute and relative intensity levels.

Absolute intensity			Relative intensity		
Intensity	MET	Examples	%HRmax	RPE (Borg scale score)	Talk test
Light	1.1-2.9	Walking <4.7 km/h, light household work	57-63	10-11	
Moderate	3-5.9	Walking at moderate or brisk pace (4.1-6.5 km/h), slow cycling (15 km/h), painting/decorating, vacuuming, gardening (mowing lawn), golf (pulling clubs in trolley), tennis (doubles), ballroom dancing, water aerobics	64-76	12-13	Breathing is faster but compatible with speaking full sentences
Vigorous	≥6	Race-walking, jogging, or running, cycling >15 km/h, heavy gardening (continuous digging or hoeing), swimming laps, tennis (singles)	77-95	14-17	Breathing very hard, incompatible with carrying on a conversation comfortably

%HRmax = percentage of measured or estimated maximum heart rate (220-age); MET = metabolic equivalent of task; RPE = rating of perceived exertion (Borg-scale 6-20); VO2 = oxygen consumption.
aMET is estimated as the energy cost of a given activity divided by resting energy expenditure: 1 MET = 3.5 mL oxygen kg-1 min-1 VO2.

Phases of cardiac rehabilitation

Cardiac rehabilitation occurs in four phases:

Phase I (Inpatient Period). This stage of rehabilitation can last from as short as one day to as long as 14 to 21 postoperative or post-event days for cardiovascular patients undergoing invasive procedures or suffering from acute events. The goal of Phase I cardiac rehabilitation is to ensure members are physically and mentally able to be discharged. In addition to providing a structured progressive ambulation program, specially trained healthcare personnel teach the member how to recognize cardiac symptoms and respond appropriately; explain the doses, effects, and side effects of the medications; educate member on stress management; and discuss cardiovascular disease risk factors. Patients are encouraged to perform range-of-motion exercises, sit in a chair, or take walks around their rooms or hospital floors while they are still hospitalized. This phase is divided into the acute and subacute phases.

Acute

During the acute period, when the patient is still in the coronary care unit (CCU), the goal is to prevent deterioration. Activities of 1–2 METS are performed Passive ROM (1.5 mets): Upper extremity ROM (1.7 mets), Lower extremity ROM (2.0 mets)
Avoid: isometrics (increases heart rate), valsalva (promotes arrhythmia), raising the legs above the heart (can increase preload)

Subacute

During this phase of rehabilitation, the patient is transferred to the telemetry or

medical ward. Early ambulation is encouraged, and the patient should be performing activities at about the 3–4 MET level. ROM exercise: intensity can be gradually increased by increasing the speed and/or duration.

Phase II (Immediate Outpatient Period)

This period is the convalescent stage following a hospital discharge. The length is partly determined by risk satisfaction and monitoring need. By definition this period is the most closely monitored phase of rehabilitation. This is the supervised ambulatory outpatient phase; it lasts about 3–6 months. ECG stress is typically performed during this phase to guide further rehabilitation. The goal is to establish exercise practices for members which are safe and effective for their cardiac health to strengthen their cardiac health beyond supervised rehabilitation.

The exercise program in phase 2 includes low-impact aerobic activities (walking, recumbent training, cycling, stationary bicycle ergometry with leg only, arm only, or arm-leg combinations), treadmill walking, arm ergometry, and rowing and strength training and typically has a 5- to 10-minute warm-up followed by training for 30 to 45 minutes, concluding with a cool-down period in 2 to 3 times sessions per week for 12 to 18 weeks.

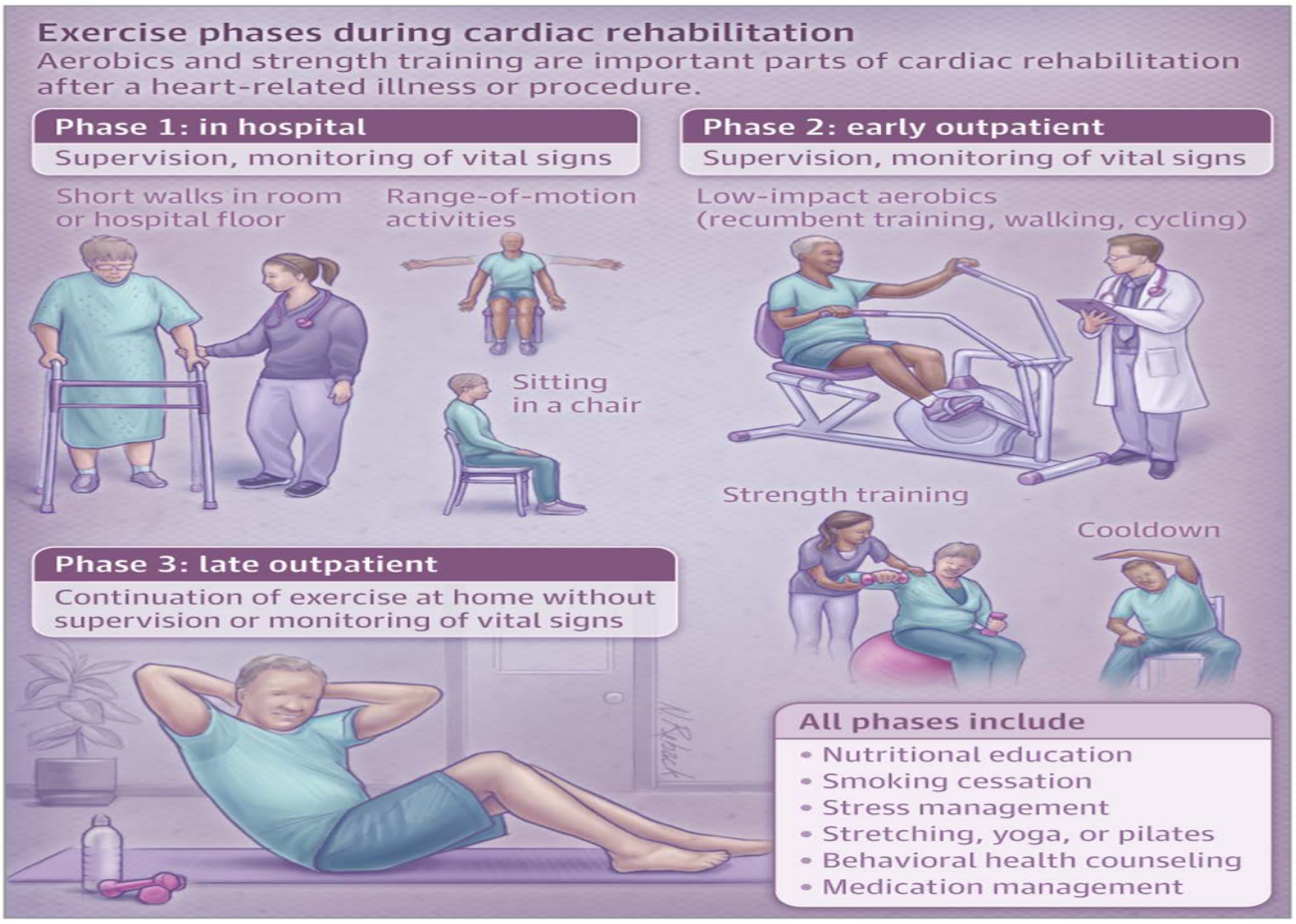
Phase 2 programs include educational sessions to address nutrition, smoking, blood glucose control, managing medication regimens for blood pressure and cholesterol, and achieving or keeping a healthy weight and depression management.

Phase III and Phase IV (Intermediate and Maintenance Periods) - Long-Term Rehabilitation

Phase III - is an extended outpatient period that may be divided into two components, intermediate and maintenance. The intermediate stage follows immediate outpatient cardiac rehabilitation for up to 12 months after a cardiac event, that is, when the patient is not intensely monitored and/or supervised but is still involved in regular endurance exercise training and lifestyle change.

The member performs an adequate warm-up session before exercises, which may include walking, bicycling, jogging, swimming, calisthenics, weight training, and endurance sports, depending upon the maximum exercise capacity and the personal preferences of the patient.

Phase IV is a long-term change in lifestyle that begins in and then follows the earlier stages of cardiac rehabilitation. The goal is to improve physical fitness and decrease risk factors for cardiovascular disease.



Jayson R. Baman, MD, Shaundeep Sekhon, MD; Kameswari Maganti, MD. JAMA. 2021;326(4):366. doi:10.1001/jama.2021.5952

Outcomes of cardiac rehabilitation:

1. Improved exercise tolerance
2. Improvement of symptoms
3. Decreased angina
4. Decreased heart failure in patients with left ventricular systolic dysfunction
5. Improved measures of myocardial ischemia (MI)
6. Decreased rates of depression, improved psychosocial well-being and quality of life
7. Improved blood lipid levels
8. Stress reduction
9. Decreased cigarette smoking
10. Decreased hospitalizations
11. Decreased cardiovascular mortality

Indications for inpatient Cardiac Rehabilitation:

1. Patients who have had myocardial infarction in the last 12 months
2. Coronary artery bypass surgery (CABG) or angioplasty patients
3. Coronary patients with or without residual ischemia
4. Current stable angina
5. Stable Heart failure and arrhythmias

6. Patients with dilated cardiomyopathy
7. A variety of patients with nonischemic heart disease
8. Patients with concomitant pulmonary disease
9. Patients who have received a pacemaker or an automatic implanted cardioverter- defibrillator
10. Patients who have had heart-valve repair or replacement
11. Aneurysm, aneurysm resection, organ transplantation
12. Peripheral arterial disease

Absolute Contraindications for Entry into Inpatient and Outpatient Exercise Training:

1. Unstable angina
2. Resting systolic blood pressure > 200 mm Hg or resting diastolic blood pressure > 110 mm Hg
3. Moderate to severe aortic stenosis
4. Acute systemic illness or fever
5. Uncontrolled atrial or ventricular arrhythmias
6. Uncontrolled tachycardia (> 100 bpm)
7. Symptomatic congestive heart failure
8. Third-degree heart block without pacemaker
9. Active pericarditis or myocarditis
10. Recent embolism
11. Thrombophlebitis
12. Resting ST displacement (> 3 mm) (as seen on ECG)
13. Uncontrolled diabetes
14. Orthopaedic problems that would prohibit exercise

NYHA CARDIAC FUNCTIONAL CLASSIFICATION

Class I NY Heart Association

Patient's cardiac disease does not limit physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea, or anginal pain.

Patients can perform to completion any activity requiring > or = 7 mets: (Can carry 24 lbs. up 8 steps, can carry objects that weigh 80 lbs, do outdoor work (shovel snow, spade soil), do recreational activities (skiing, basketball, squash, handball, jog at 5 mph)

Class II NY Heart Association

Patient's cardiac disease results in slight limitation on physical activity. They are comfortable at rest. Ordinary physical activity results in fatigue, palpitation, dyspnea, or anginal pain.

Patient can perform to completion any activity requiring > or = 5 mets,

but cannot and does not perform to completion of activities requiring > or = to 7 mets: sexual intercourse to completion without interruption, garden, rake, weed, roller-skate, walk at 4 mph on level ground

Class III NY Heart Association

Patient's cardiac disease results in marked limitation of physical activity. They are comfortable at rest. Less than ordinary physical activity causes fatigue, palpitation, dyspnea, or anginal pain.

Patient can perform to completion any activity that requires > or = 2 mets and < 5 mets: shower without interruption, strip and make bed, Clean windows, Walk 2.5 mph, Bowl, golf, Dress without stopping

Class IV NY Heart Association

Patient's cardiac disease results in inability to carry on any physical activity without discomfort. Symptoms of cardiac insufficiency or of the angina syndrome may be present even at rest. If any physical activity is undertaken, discomfort is increased.

Patient cannot or does not perform to completion activities requiring > or = 2 mets. Cannot carry out activities in Class I – III.

EXERCISE RECOMMENDATIONS IN INDIVIDUALS WITH CHRONIC HEART FAILURE.

Exercise intervention should only be initiated in a clinically stable individual after medical therapy for HF has been optimized. Key components before commencing an exercise programme and sports participation include:

1. Exclusion of contraindications to exercise: Contraindications to initiating an exercise programme in chronic HF include hypotension or hypertension at rest or during exercise, unstable cardiac disease, deteriorating symptoms of HF, myocardial ischaemia despite therapy (exercise may be permitted up to ischaemic threshold), or severe and suboptimally treated pulmonary disease.
2. Performing a baseline assessment: A thorough cardiological evaluation is required, including assessment of comorbidities and HF severity (e.g. by assessment of blood natriuretic peptides and echocardiography). A maximal exercise test (preferably CPET) is important to assess functional capacity, exercise-induced arrhythmias or haemodynamic abnormalities and for prescription of exercise intensity, based on VO2peak, or on resting andmaximal heart rate during exercise [e.g. HRR or Borg's rating of perceived exertion (RPE)].
3. Optimizing medical therapy

The exercise session should be individually tailored for several weeks, according to symptoms and objective findings during exercise testing such as maximal exercise capacity, heart rate response, or arrhythmias. In atrial fibrillation (AF), exercise can only be monitored by power or Borg's RPE.

Aerobic exercise is recommended for stable patients (New York Heart

Association (NYHA) class I-III). In patients in NYHA functional class III, exercise intensity should be maintained at a lower intensity (<40% of VO2peak), according to perceived symptoms and clinical status during the first 1-2 weeks. This should be followed by a gradual increase in intensity to 50-70% VO2peak, and if tolerated, up to 85% VO2peak as the primary aim.

Inspiratory muscle training improves VO2peak, dyspnoea, and muscle strength, and it typically involves several sessions per week with intensity ranging from 30% to 60% of maximal inspiratory pressure, and duration from 15-30 min for an average of 10-12 weeks.

	Aerobic exercise	Resistance exercise
Frequency	3-5 days/week Optimally daily	2-3 days/week; balance training daily
Intensity	40-80%VO_{2peak}	Borg RPE<15 (40-60% of 1RM)
Duration	20-60 min	10-15 repetitions in at least 1 set of 8-10 different upper and lower body exercises
Mode	Continuous or interval	
Progression	A progressively training regimen should be prescribed with regular follow-up controls (at least every 3-6 month) to adjust the duration and the level of the exercise to the reached level of tolerance	A progressively training regimen should be prescribed with regular follow-up controls (at least every 3-6 month) to adjust the duration and the level of the exercise to the reached level of tolerance

CARDIAC REHABILITATION OF THE POST-MI PATIENT

Acute Phase (Phase I).

Phase I is the acute phase, immediately following the MI up to discharge. Phase I rehabilitation is characterized by early mobilization. The major goal of the phase I program is to condition the patient to perform activities up to four METs, which is within the range of most daily activities at home after discharge. Generally, patients are encouraged to be sitting out of bed and in a chair as soon as medically stable, usually by day 1 to 2 (steps 1 to 5). By day 2 to 3, short distance ambulation can be initiated, and bathroom privileges are full (steps 6 to 9). Around day 3, the patient is introduced to the home exercise program, and stairs and increased durationof ambulation are encouraged (steps 10 to 13). After successful completion of a low level ETT for risk stratification on day 4 to 5, the patient completes learning the home program and is discharged (step 14).

Wenger Protocol

1 Passive range of motion (ROM), ankle pumps, introduction to the program, self-feeding

2 As above, also dangle at side of bed

3 Active assisted ROM, sitting upright in a chair, light recreation, and use of bedside commode

4 Increased sitting time, light activities with minimal resistance, patient education

5 Light activities with moderate resistance, unlimited sitting, seated ADL activities

6 Increased resistance, walking to bathroom, standing ADL, up to 1 h long group meetings

7 Walking up to 100 ft, standing, warm-up exercises

8 Increased walking, walk down stairs (not up), continued education

9 Increased exercise program, review energy conservation, and pacing techniques

10 Increase exercises with light weights and ambulation, begin education on home exercise program

11 Increased duration of activities

12 Walk down two flights of stairs, continue to increase resistance in exercises 13 Continue activities, education and home exercise program teaching

14 Walk up and down two flights of stairs, complete instruction in home exercise program and in energy conservation and pacing techniques

The educational program relating to risk factor modification should be introduced at this time, especially as many patients are ready to listen to advice in their acute hospitalization. A further modification of the classical program is that now most patients are rapidly evaluated for revascularization procedures, and often will start their rehabilitation after a catheterization or a bypass surgery. With or without revascularization, the acute mobilization should be done with cardiac monitoring and under the supervision.

The post-MI HR rise with activity should be kept to within 20 bpm of baseline and the systolic BP rise within 20 mm Hg of baseline. Any decrease of systolic BP of 10 mm Hg or moreshould be considered worrisome and the exercise halted.

Subacute Inpatient Rehabilitation Phase (Phase IB). The guidelines for exercise are often the same as they are for the strict phase I patients, but the period of recovery is longer.

Patients at High Risk During Cardiac Rehabilitation

Ischemic risk

1. Postoperative anginaLV ejection fraction <35%
2. NYHA grade III or IV CHF
3. Ventricular tachycardia of fibrillation in the postoperative period
4. SBP drop of ten points or more with exercise

5. Excessive ventricular ectopy with exercise
6. Incapable of self-monitoring
7. Myocardial ischemia with exercise

Arrhythmic risk

1. Acute infarction within 6 wk
2. Active ischemia by angina or exercise testing
3. Significant left ventricular dysfunction (LVEF <30%)
4. History of sustained ventricular tachycardia
5. History of sustained life-threatening supraventricular arrhythmia
6. History of sudden death, not yet stabilized on medical therapy
7. Initial therapy of patients with automatic implantable cardioverter defibrillator (AICD)
8. Initial therapy of a patient with a rate adaptive cardiac pacemaker

Exercise intensity is generally limited to a target heart rate which is known to be safe. The level of exercise is usually done at a level of approximately 70% maximum heart rate or a MET level of 5. For a person more than 40 years old this generally represents a maximum heart rate of 130 bpm or five METs, and for an individual less than 40 years old, 140 bpm or seven METs.

Phase II (Immediate Outpatient Period) Training Phase

Phase II is the convalescent phase, which is done at home and continues the program started in phase I until the myocardial scar has matured.

The training phase of the cardiac rehabilitation program is started after a symptom limited full level ETT or completion of a revascularization procedure and return to full activities.

For patients who are in the low risk group, a program designed to achieve 85% of the maximum heart rate is generally regarded as safe. For individuals who are at greater risk, exercise programs at lower target HRs.

In order to assist in increasing access to cardiac rehabilitation, creative programs have been developed, including at home programs for low-risk post-MI patients, both community-based and home-based programs. A key to success in home-based programs is assuring that patients are able to perform self-monitoring during their exercise program. Just as in the supervised programs, all exercise session should begin with a stretching session, followed by a warm up session, the training exercise, and end with a cool down period. It is important to remember that conditioning benefit is related to the specificity of training, and that the conditioning applies to the specific muscles exercised.

Phase III is the training phase; this usually starts after 4–6 weeks, and is the classic exercise program of conditioning and education.

Despite usually receiving the least attention, the maintenance phase of a cardiac conditioning program is the most important part of the program. If the patient stops exercising, the benefits gained from phase II can be lost in a few weeks. In order to facilitate compliance with maintenance exercise, the program

needs to integrate the actual exercises into the patient's lifestyle. There also needs to be an emphasis on secondary prevention measures and how to integrate these changes into the patient's lifestyle.

For moderate level exercises, patients should be told to perform their ongoing exercises at the target heart rate for at least 30 minutes three times a week.

For low-level exercise, patients need to perform exercise five times a week. ECG monitoring is not necessary during the maintenance phase.

Phase IV is the maintenance phase, and is devoted to keeping the aerobic conditioning gains made in phase III. Risk-factor modifications are taught and reemphasized throughout all phases. If the patient stops exercising, the benefits gained from phase III can be lost in a few weeks. The actual exercises need to be integrated into the patient's lifestyle and interests to assure compliance. The secondary prevention measures also need to be integrated into the patient's lifestyle. The ongoing exercises should be performed at the target HR for at least 30 minutes, three times a week, if at a moderate level. If at a low level, exercises need to be performed five times a week. During the maintenance phase, electrocardiogram monitoring is not necessary.

Patient Guidelines for exersing:

1. Wear proper clothing: good shoes, loose-fitting garments, garments appropriate to the ambient temperature.
2. Follow exercise guidelines: 5–10 min low intensity warm-up, 20–30 min exercise at full intensity 5–10 min low intensity cool down
3. Stop exercising for adverse symptoms: cardiac symptoms (chest pain,shortness of breath lightheadedness), general symptoms (joint pains, faintness with exercise)
4. No exercise while ill, wait for 2 d after illness has passed No exercise in environmental extremes,
5. Avoid extreme heat and humidity, Avoid extreme cold
6. Exercise indoors in winter: Wear warm clothing Use a face mask
7. Exercise early in the morning or in the evening
8. No exercise after eating, Wait 2 h after meals

Absolute contraindications to exercise testing and training for patients with MI include:

1. acute MI,
2. unstable angina,
3. moderate to severe aortic stenosis,
4. resting systolic blood pressure above 200 mmHg or diastolic pressure above 110 mmHg,
5. uncontrolled arrhythmias, tachycardia above 100 beats/minute,
6. third-degree heart block (without pacemaker),

7. resting ST displacement >3 mm.
8. active pericarditis or myocarditis,
9. recent embolism or thrombophlebitis,
10. uncontrolled diabetes.

Relative contraindications include:

1. significant arterial or pulmonary hypertension,
2. moderate valvular or myocardial heart disease,
3. electrolyte abnormalities,
4. left main coronary obstruction,
5. hypertrophic cardiomyopathy
6. psychiatric disease.

CARDIAC REHABILITATION FOR PATIENTS WITH ANGINA PECTORIS

Indication: **stable anginal syndrome.**

The goal of rehabilitation in angina is to use the training effectively to improve the efficiency of exercise performance below the anginal threshold. The primary goal of rehabilitation in this group of patients is aimed at increasing the work capacity.

The benefit from exercise in angina is derived from the combination of the fact that the actual MVO2 (and thus the maximum HR) at which angina occurs will not change with conditioning, while the work done to achieve the anginal heart rate will increase substantially. Reduction of atherosclerotic lesions and increased cardiac collateralization that is cardioprotective and symptom reducing.

The rehabilitation program can begin at phase II-III, and the primary and/or secondary prevention program is very important.

CARDIAC REHABILITATION AFTER REVASCULARIZATION PROCEDURES POST–CORONARY ARTERY BYPASS GRAFTING

Many patients who undergo CABG or percutaneous revascularization procedures often have not had a recent MI and make excellent candidates for cardiac rehabilitation.

For patients who have had CABG, the exercise test can be safely performed at 3 to 4 weeks after surgery. The purpose of the exercise test is to determine the maximal functional capacity, maximal HR, exercise blood pressure response, exercise-induced arrhythmias, and anginal threshold. The initiation of a cardiac rehabilitation program also allows for the initiation of the education program to help modify risk factors.

Cardiac rehabilitation after CABG can be thought of as being similar to the post- MI rehabilitation program.

Phase I is the immediate postoperative period. The in-hospital first stage is usually in the first week or so postoperatively, as patients are usually sent home

within a week. The phase I program has three stages: (a) intensive mobilization in the immediate postoperative period; (b) progressive ambulation and daily exercises; (c) discharge planning and exercise prescription for the maintenance stage.

Unless the patient has an unstable postoperative course, or severe heart failure, intensive mobilization begins in the intensive care unit on postoperative day 1. The program starts with sitting upright, active leg exercises, and mobilization out of bed.

Early intervention has several benefits including decreasing the deleterious effects of bed rest (DVT, PE, pulmonary complications and cardiac deconditioning). The program then rapidly progresses with supervised ambulation for distances of 150 to 200 ft, advancing to most patients beginning independent ambulation by the third day.

The phase II program for a post-CABG patient is usually conducted at home or as an outpatient. Patients usually are stratified to low, moderate, or high intensity programs depending on their level of capacity.

A low-intensity program is a progressive walking program with 2 to 4 MET energy expenditures and a target HR of 65% to 75% of maximum HR.

Moderate-intensity programs are usually a progressive walk to walk-jog program from 3 to 6.5 MET, with target HRs of 70% to 80% of maximum HR.

High-intensity programs progress from walk-jog state to jogging from 5 to 8.5 MET with a target HR of 75% to 85% maximum HR.

Benefits of Cardiac Rehabilitation After Bypass Surgery:

1. Increased ischemic threshold
2. Improved left ventricular function
3. Increased coronary collaterals
4. Ameliorated serum lipids
5. Decreased serum catecholamines
6. Decreased platelet aggregation and increased fibrinolysis
7. Improved psychological status

CARDIAC REHABILITATION FOR PATIENTS WITH CARDIOMYOPATHY

Due to poor LV function, these patients have increased complications with a higher risk of sudden death, depression, and chronic cardiac disability.

Due to decreased CO, heart failure patients demonstrate inconsistent responses to exercise.

The normal physiological response to exercise is often absent, and there can be a decline in ejection fraction, a decrease in SV, with resultant exertional hypotension, and syncope. In the most severe cases, CO may not increase sufficiently to generate a dynamic exercise response at all.

low endurance and fatigue are frequently seen and prolonged postexercise fatigue is common, often lasting for hours to days after achieving a high aerobic

workload.

These limitations to exercise are often exacerbated in patients with CHF when atrial fibrillation, fluid overload, or medication noncompliance is also present.

Contraindications to cardiac rehabilitation:

1. unstable angina,
2. decompensated CHF,
3. and unstable arrhythmias

Due to the poor adaptation to exercise seen in CHF patients, long warm-ups and cool-down periods are required with exercise being performed with a limited workload. It is important to remember that dynamic exercise is preferable to isometric exercise, with a target HR of 10 bpm below any significant endpoint found with cardiopulmonary exercise testing, such as exertional hypotension, marked dyspnea, or sustained arrhythmia.

Because of possible increased diastolic pressure with subsequent increase in cardiac afterload, isometric exercise should be avoided where possible and limited to 2-minute intervals for those exercises performed.

Self-monitor CHF patients include closely following body weight (to observe for fluid accumulation) and blood pressure and HR responses to exercise.

CARDIAC REHABILITATION FOR PATIENTS WITH VALVULAR HEART DISEASE

In valvular heart disease, the major problem is often deconditioning along with CHF. In patients receiving surgical correction of the valvular disease, a post-CABG- type program is used.

Training can increase the physical work capacity, decrease rating of perceived exertion (RPE) on the Borg scale, and decrease the RPP by 15%. An issue that is present in many patients after valve replacement is the presence of anticoagulation postoperatively for patients with mechanical valves. When patients are on anticoagulant therapy, the exercise program has to avoid high-impact exercises to avoid hemarthrosis and bruising and include a component of education regarding injury avoidance.

List of questions.

1. Cardiac rehabilitation, goals, components of comprehensive cardiac rehabilitation, primary and secondary prevention. Outcomes of cardiac rehabilitation.
2. Patient assessment. Risk factors and risk classification.
3. Nutrition counselling. Recommendations for nutrition and alcohol, healthy diet characteristics. Tobacco cessation as part of cardiac rehabilitation.
4. Weight management as part of cardiac rehabilitation.
5. Blood pressure management as part of cardiac rehabilitation.
6. Lipid management as part of cardiac rehabilitation.
7. Diabetes management as part of cardiac rehabilitation.
8. Physical activity and exercise training as part of cardiac rehabilitation.
9. Phases of cardiac rehabilitation.
10. Indications and contraindications for cardiac rehabilitation.
11. Exercise recommendations in individuals with chronic heart failure.
12. Cardiac rehabilitation of the post-MI patients.
13. Cardiac rehabilitation for patients with angina pectoris.
14. Cardiac rehabilitation after revascularization procedure post-coronary artery bypass grafting.
15. Cardiac rehabilitation for patients with cardiomyopathy.
16. Cardiac rehabilitation for patients with valvular heart disease.

Multiple choice questions

1. Primary prevention is:

A. Include risk factor modification
B. Include risk factor modification after the establishment of cardiac disease
C. Include education before a cardiac event
D. Include cardiac rehabilitation with exercise after the establishment of cardiac disease

2. Secondary prevention is:

A. Include risk factor modification
B. Include risk factor modification after the establishment of cardiac disease
C. Include education before a cardiac event
D. Include cardiac rehabilitation with exercise after the establishment of cardiac disease

3. Irreversible risk factors are:

A. male gender
B. diabetes mellitus
C. sedentary lifestyle
D. past history of vascular disease
E. hypertriglyceridemia, hyperlipidemia

F. cigarette smoking
G. age
H. family history of premature CAD (before age 55 in a parent or sibling)
I. obesity
J. hypercholesterolemia
K. hyperinsulinemia
L. metabolic syndrome
M. hypertension

4. Reversible risk factors are:

A. male gender
B. diabetes mellitus
C. sedentary lifestyle
D. past history of vascular disease
E. hypertriglyceridemia, hyperlipidemia
F. cigarette smoking
G. age
H. family history of premature CAD (before age 55 in a parent or sibling)
I. obesity
J. hypercholesterolemia
K. hyperinsulinemia
L. metabolic syndrome
M. hypertension

5. Phases of cardiac rehabilitation are:

A. Immediate Outpatient, Intermediate and Training Periods
B. Inpatient, Acute, Subacute, Intermediate and Maintenance Periods
C. Inpatient, Immediate Outpatient, Intermediate and Maintenance Periods

6. Cardiac rehabilitation used for:

A. Improved exercise tolerance
B. Increased myocardial ischemia
C. Risk factor modification
D. Increased angina
E. Decreased cardiovascular mortality
F. All mentioned above

7. Indications for Cardiac Rehabilitation are:

A. Patients who have had myocardial infarction
B. Unstable angina
C. Hypertension
D. Stable angina

E. Uncontrolled atrial or ventricular arrhythmias
F. Heart failure and arrhythmias
G. Uncontrolled tachycardia (> 100 bpm)
H. Resting systolic blood pressure > 200 mm Hg or resting diastolic blood pressure > 110 mm Hg
I. Symptomatic congestive heart failure
J. Coronary patients with or without residual ischemia

8. Contraindications for Cardiac Rehabilitation are:
A. Acute systemic illness or fever
B. Aneurysm, aneurysm resection, organ transplantation
C. Resting systolic blood pressure > 200 mm Hg or resting diastolic blood pressure > 110 mm Hg
D. Patients with dilated cardiomyopathy
E. Uncontrolled tachycardia (> 100 bpm)
F. Symptomatic congestive heart failure
G. Patients with concomitant pulmonary disease
H. Patients who have received a pacemaker or an automatic implanted cardioverter-defibrillator
I. Unstable angina

9. During the acute period of cardiac rehabilitation
A. Patient should be performing activities at about the 3–4 MET level
B. Patient should avoid isometrics exercises
C. Patient should be performing activities at about the 1–2MET level
D. Patient should be performing isometrics exercises

10. If patients can up 8 steps, can carry objects that weigh 80 lbs, do outdoor work and do recreational activities (skiing, basketball, squash, handball, jog at 5 mph) to which class of NYHA cardiac functional classification he depends?
A. CLASS I
B. CLASS II
C. CLASS III
D. CLASS IV

11. If patient’s cardiac disease results in marked limitation of physical activity, they are comfortable at rest and can perform to completion any activity that requires > or = 2 mets and < 5 mets to which class of NYHA cardiac functional classification he depends?
A. CLASS I
B. CLASS II
C. CLASS III
D. CLASS IV

12. If patient’s cardiac disease results in slight limitation on physical activity, they are comfortable at rest and ordinary physical activity results in fatigue, palpitation, dyspnea, or anginal pain to which class of NYHA cardiac functional classification he depends?

A. CLASS I
B. CLASS II
C. CLASS III
D. CLASS IV

13. If patient’s cardiac disease results in inability to carry on any physical activity without discomfort, symptoms of cardiac insufficiency or of the angina syndrome may be present even at rest to which class of NYHA cardiac functional classification he depends?

A. CLASS I
B. CLASS II
C. CLASS III
D. CLASS IV

14. When does post-MI patients are encouraged to be sitting out of bed and in a chair?

A. At once
B. On 1-2 day
C. On 3-4 day
D. On 5-6 day

15. When does short distance ambulation can be initiated, and bathroom privileges are full in post-MI patients?

A. At once
B. On 1-2 day
C. On 2-3 day
D. On 5-6 day

16. Which activities depend to moderate-intensity aerobic activities:

A. brisk walking (at least 2.5 miles per hour),
B. running
C. swimming laps,
D. water aerobics,
E. dancing (ballroom or social),
F. jumping rope,
G. gardening,
H. digging,
I. tennis (doubles),

J. hiking uphill or with a heavy backpack,
K. biking slower than 10 miles per hour.

17. Which activities depend to vigorous-intensity aerobic activities:
A. brisk walking (at least 2.5 miles per hour),
B. running
C. swimming laps,
D. water aerobics,
E. dancing (ballroom or social),
F. jumping rope,
G. gardening,
H. digging,
I. tennis (doubles),
J. hiking uphill or with a heavy backpack,
K. biking slower than 10 miles per hour.

18. How many Functional Class of Angina you know?
A. I
B. II
C. III
D. IV
E. V
F. VI

19. Indications for Cardiac rehabilitation for patients with Angina Pectoris are?
A. stable anginal
B. acute MI,
C. unstable angina
D. resting ST displacement >3 mm

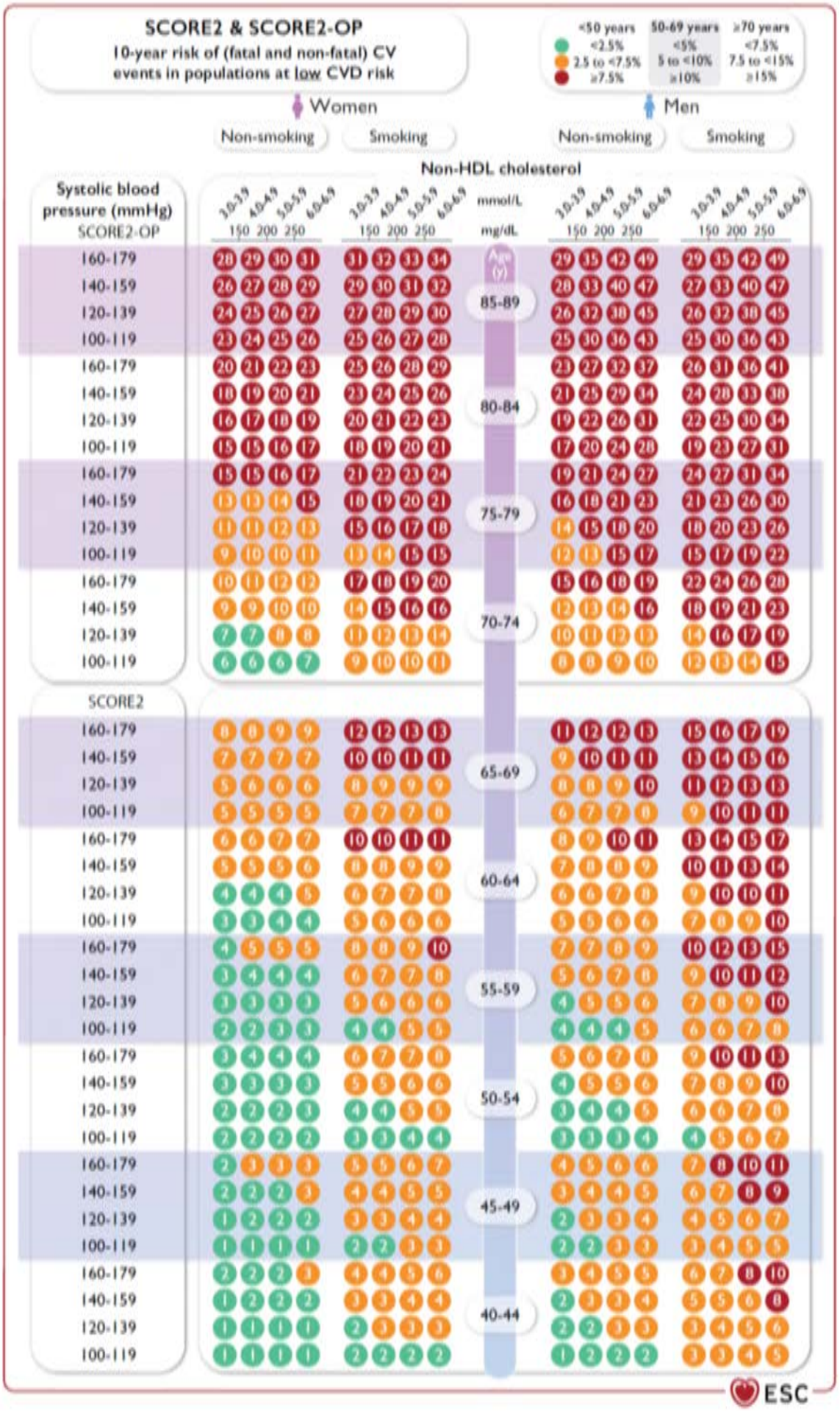
20. The goal of rehabilitation in angina is:
A. To improve the efficiency of exercise performance below the anginal threshold.
B. To increase the work capacity
C. To decrease blood pressure
D. To decrease heart rate
E. All mentioned above

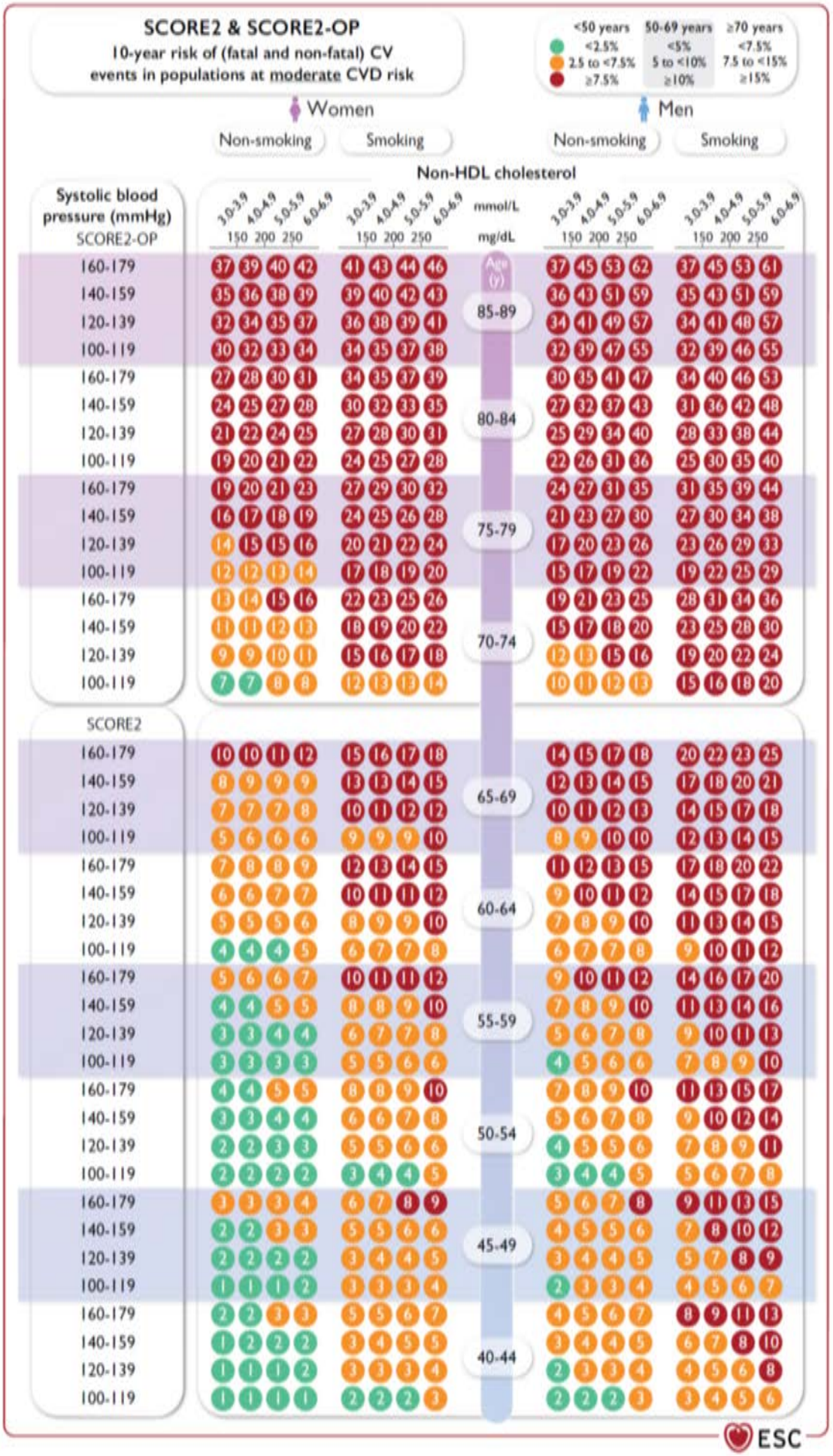
21. What is the maximal rise in HR and SBL should be in the post-MI patients?
A. The post-MI HR rise with activity should be kept to within 10 bpm of baseline and the systolic BP rise within 10 mm Hg of baseline.

B. The post-MI HR rise with activity should be kept to within 20 bpm of baseline and the systolic BP rise within 20 mm Hg of baseline.
C. The post-MI HR rise with activity should be kept to within 20 bpm of baseline and the systolic BP decrease within 10 mm Hg of baseline.

22. Which statement is true?
A. exercise should include 15 min low intensity warm-up, 20–30 min exercise at full intensity 5 min low intensity cool down phase.
B. exercise should include 5–10 min low intensity warm-up, 20–30 min exercise at full intensity 5–10 min low intensity cool down phase.
C. exercise should include 40 min exercise at full intensity every day.

1 AC	6 ACE	11 C	16 ADEGIK	21 B
2 BD	7 ACDFJ	12 B	17 BCFHS	22 B
3 ADGH	8 ACEFI	13 D	18 D	23
4BCEFISKLM	9 BC	14 B	19 A	24
5 C	10 A	15 C	20 AB	25


SCORE2 & SCORE2-OP
10-year risk of (fatal and non-fatal) CV events in populations at low CVD risk
<50 years
<2.5%
2.5 to <7.5%
≥7.5%
50-69 years
<5%
5 to <10%
≥10%
≥70 years
<7.5%
7.5 to <15%
≥15%
Women
Men
Non-smoking
Smoking
Non-smoking
Smoking
Non-HDL cholesterol
Systolic blood pressure (mmHg)
SCORE2-OP
SCORE2
3.0-3.9
4.0-4.9
5.0-5.9
6.0-6.9
mmol/L
mg/dL
150 200 250
Age (y)
160-179
140-159
120-139
100-119
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44


SCORE2 & SCORE2-OP
10-year risk of (fatal and non-fatal) CV events in populations at moderate CVD risk
<50 years
<2.5%
2.5 to <7.5%
≥7.5%
50-69 years
<5%
5 to <10%
≥10%
≥70 years
<7.5%
7.5 to <15%
≥15%
Women
Men
Non-smoking
Smoking
Non-smoking
Smoking
Non-HDL cholesterol
Systolic blood pressure (mmHg)
SCORE2-OP
SCORE2
3.0-3.9
4.0-4.9
5.0-5.9
6.0-6.9
mmol/L
mg/dL
150 200 250
Age (y)
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
160-179 37 39 40 42 41 43 44 46 37 45 53 62 37 45 53 61
140-159 35 36 38 39 39 40 42 43 36 43 51 59 35 43 51 59
120-139 32 34 35 37 36 38 39 41 34 41 49 57 34 41 48 57
100-119 30 32 33 34 34 35 37 38 32 39 47 55 32 39 46 55
160-179 27 28 30 31 34 35 37 39 30 35 41 47 34 40 46 53
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160-179 19 20 21 23 27 29 30 32 24 27 31 35 31 35 39 44
140-159 16 17 18 19 24 25 26 28 21 23 27 30 27 30 34 38
120-139 14 15 15 16 20 21 22 24 17 20 23 26 23 26 29 33
100-119 12 12 13 14 17 18 19 20 15 17 19 22 19 22 25 29
160-179 13 14 15 16 22 23 25 26 19 21 23 25 28 31 34 36
140-159 11 11 12 13 18 19 20 22 15 17 18 20 23 25 28 30
120-139 9 9 10 11 15 16 17 18 12 13 15 16 19 20 22 24
100-119 7 7 8 8 12 13 13 14 10 11 12 13 15 16 18 20
160-179 10 10 11 12 15 16 17 18 14 15 17 18 20 22 23 25
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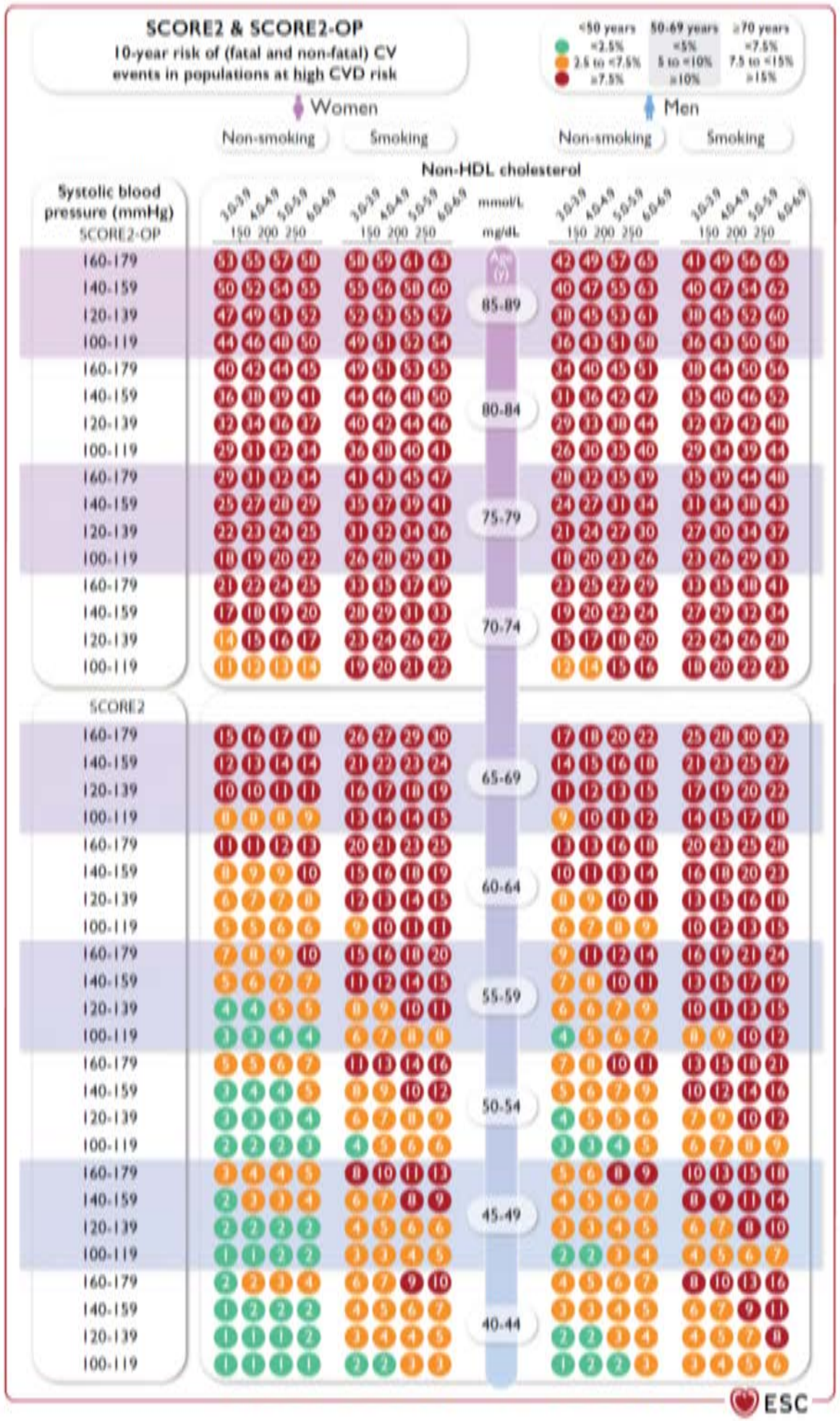
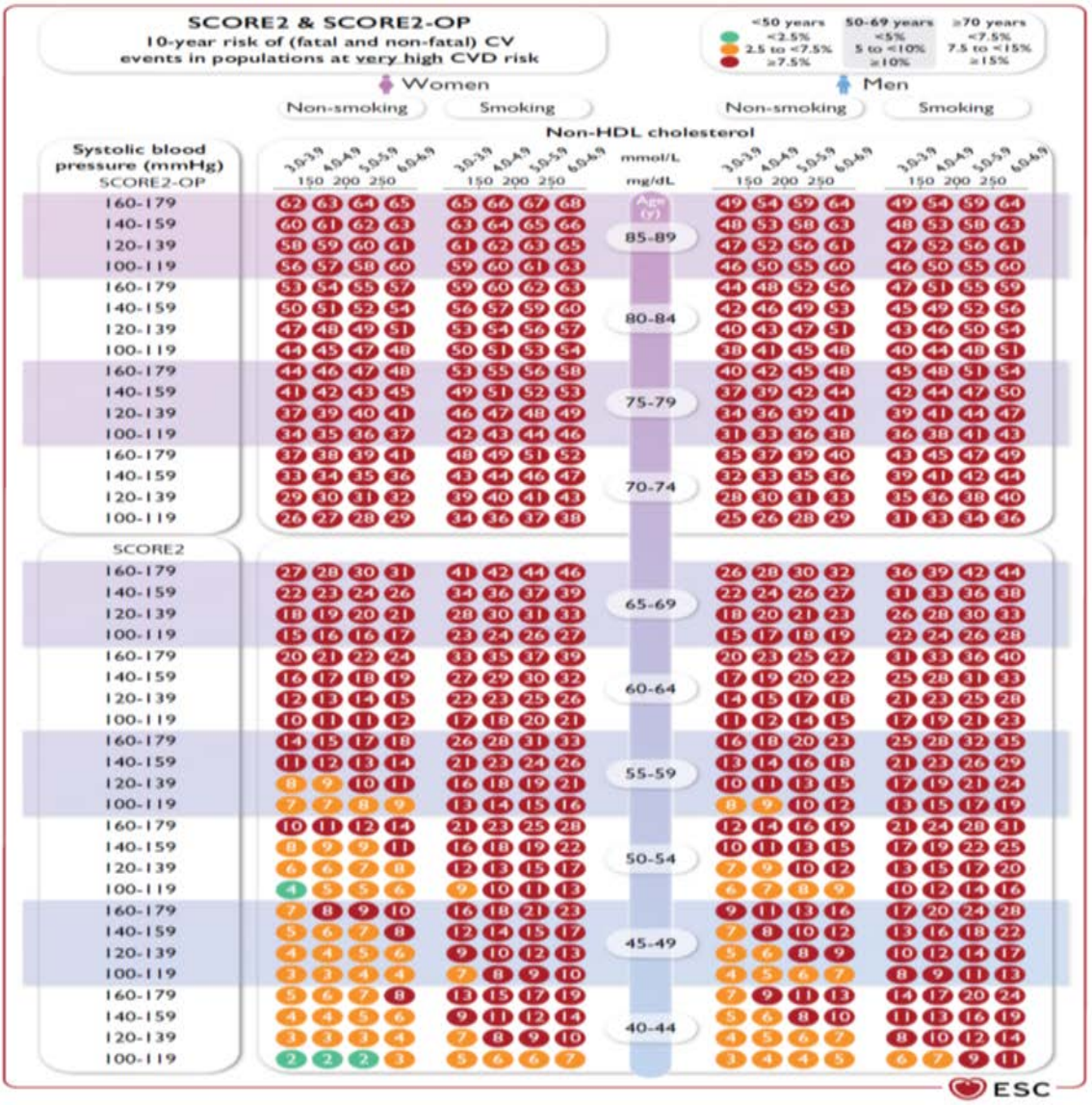

SCORE2 & SCORE2-OP
10-year risk of (fatal and non-fatal) CV events in populations at high CVD risk
<50 years
<2.5%
2.5 to <7.5%
≥7.5%
50-69 years
<5%
5 to <10%
≥10%
≥70 years
<7.5%
7.5 to <15%
≥15%
Women
Men
Non-smoking
Smoking
Non-smoking
Smoking
Non-HDL cholesterol
Systolic blood pressure (mmHg)
SCORE2-OP
SCORE2
Age (y)
mmol/L
mg/dL
150 200 250
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44



Systematic Coronary Risk Estimation 2 and Systematic Coronary Risk Estimation 2-Older Persons risk charts for fatal and non-fatal (myocardial infarction, stroke) cardiovascular disease. ASCVD = atherosclerotic cardiovascular disease; CV = cardiovascular; CVD = cardiovascular disease; SBP = systolic blood pressure; HDL-C = high-density lipoprotein cholesterol; SCORE2 = Systematic Coronary Risk Estimation 2; SCORE2-OP = Systematic Coronary Risk Estimation 2-Older Persons; TFYR = The Former Yugoslav Republic; UK = United Kingdom. For apparently healthy people aged 40-69 years, the SCORE2 algorithm is used to estimate 10-year risk of fatal and non-fatal (myocardial infarction, stroke) CVD. For apparently healthy people >70 years of age, the SCORE2-OP is used..

Low-risk countries: Belgium, Denmark, France, Israel, Luxembourg, Norway, Spain, Switzerland, the Netherlands, and the UK.

Moderate-risk countries: Austria, Cyprus, Finland, Germany, Greece, Iceland, Ireland, Italy, Malta, Portugal, San Marino, Slovenia, and Sweden. High-risk countries: Albania, Bosnia and Herzegovina, Croatia, Czech Republic, Estonia, Hungary, Kazakhstan, Poland, Slovakia, and Turkey.

Very-high-risk countries: Algeria, Armenia, Azerbaijan, Belarus, Bulgaria, Egypt, Georgia, Kyrgyzstan, Latvia, Lebanon, Libya, Lithuania, Montenegro, Morocco, Republic of Moldova, Romania, Russian Federation, Serbia, Syria, TFYR (Macedonia), Tunisia, Ukraine, and Uzbekistan.

Table 5 Cardiovascular disease risk categories based on SCORE2 and SCORE2-OP in apparently healthy people according to age

	<50 years	50–69 years	≥70 years[a]
Low-to-moderate CVD risk: risk factor treatment generally not recommended	<2.5%	<5%	<7.5%
High CVD risk: risk factor treatment should be considered	2.5 to <7.5%	5 to <10%	7.5 to <15%
Very high CVD risk: risk factor treatment generally recommended[a]	≥7.5%	≥10%	≥15%

CVD = cardiovascular disease.

[a]In apparently healthy people ≥70 years old, the treatment recommendation for lipid-lowering drugs is Class IIb ('may be considered').

The division of the population into three distinct age groups (<50, 50–69, and ≥70 years) results in a discontinuous increase in risk thresholds for low-to-moderate, high, and very high risk. In reality, age is obviously continuous, and a sensible application of the thresholds in clinical practice would require some flexibility in handling these risk thresholds as patients move towards the next age group, or recently passed the age cut-off. *Figure 5* illustrates how a continuous increase in age relates to increasing risk thresholds, and may be used as a guide for daily practice.

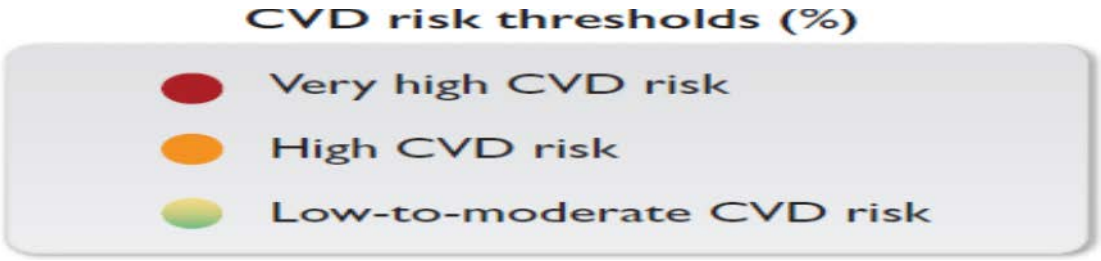


TABLE With Sample METS

Energy Costs of Activities of Daily Living	METs		
Sittingatrest	1	Walking 3.5 mph	3.5–4
Dressing	2–3	Walking 4 mph	5–6
Eating	1–2	Climbing up stairs	4–7
Hygiene(sitting)	1–2	Bed making	2–6
Hygiene (standing)	2–3	Carrying 18 lb upstairs	7–8
Sexual intercourse	3–5	Carrying suitcase	6–7
Showering	4–5	Housework (general)	3–4
Tub bathing	2–3	Mowing lawn (push power mower)	3–5
Walking 1 mph	1–2	Ironing	2–4
Walking 2 mph	2–3	Snow shoveling	6–7
Walking 3 mph	3–3.5		

Energy Costs of Avocational Activities	METs		
Backpacking (45 lb)	6–11	Running 12 min/mile	8–9
Baseball (competitive)	5–6	Running 11 min/mile	9–10
Baseball (noncompetitive)	4–5	Running 9 min/mile	10–11
Basketball (competitive)	7–12	Skiing cross-country 3 mph	6–7
Basketball (noncompetitive)	3–9	Skiing cross-country 5 mph	9–10
Card playing	1–2	Skiing downhill	5–9
Cycling 5 mph	2–3	Skiing water	5–7
Cycling 8 mph	4–5	Swimming (backstroke)	7–8
Cycling 10 mph	5–6	Swimming (breaststroke)	8–9
Cycling 12 mph	7–8	Swimming (crawl)	9–10
Cycling 13 mph	8–9	Television	1–2
Karate	8–12	Tennis (singles)	4–9

Energy Costs of Vocational Activities	METs		
Assembly line work	3–5	Painting	4–5
Carpentry (light)	4–5	Sawing hardwood	6–8
Carry 20–44 lb	4–5	Sawing softwood	5–6
Carry 45–64 lb	5–6	Sawing (power)	3–4
Carry 65–85 lb	7–8	Shoveling 10 lb, 10/min	6–7
Chopping wood	7–8	Shoveling 14 lb, 10/min	7–9
Desk work	1.5–2	Shoveling 16 lb, 10/min	9–12
Digging ditches	7–8	Tools (heavy)	5–6
Handyman	5–6	Typing	1.5–2
Janitorial (light)	2–3	Wood splitting	6–7
Lift 100 lb	7–10		

Adapted from Dafoe WA. Table of energy requirements for activities of daily living, household tasks, recreational activities, and vocational activities. In: Pashkow FJ, Dafoe WA, eds. *Clinical Cardiac Rehabilitation: A Cardiologist's Guide*. Baltimore, MD: Wiiliams and Wilkins; 1993:359–376.

RATE OF PERCEIVED EXERTION (RPE)

BORG RPE	MODIFIED RPE	BREATHING	TRAINING ZONE	% of MHR*	EXERCISE TYPE
6	0	No Exertion	1	50%-60%	Warm up
7		Very Light			
8	1				
9					
10	2	Deeper but comfortable breathing. Able to hold a conversation.	2	60%-70%	Recovery
11					
12	3				
13		Aware that breathing is harder; able to talk but difficult to hold conversation	3	70%-80%	Aerobic
14	4				
15	5	Starting to breathe hard and getting uncomfortable	4	80%-90%	Anaerobic
16	6				
17	7	Deep and forceful breathing. Uncomfortable and not wanting to talk	5	90-100%	$V0^2$ Max
18	8				
19	9	Extremely hard			
20	10	Maximum exertion			

* % of maximum heart rate

Reference:

1. 2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease: The Task Force on sports cardiology and exercise in patients with cardiovascular disease of the European Society of Cardiology (ESC). European Heart Journal, Volume 42, Issue 1, 1 January 2021, Pages 17–96, https://doi.org/10.1093/eurheartj/ehaa605
2. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice: Developed by the Task Force for cardiovascular disease prevention in clinical practice with representatives of the European Society of Cardiology and 12 medical societies with the special contribution of the European Association of Preventive Cardiology (EAPC). European Heart Journal, Volume 42, Issue 34, 7 September 2021, Pages 3227–3337, https://doi.org/10.1093/eurheartj/ehab484
3. Advances in rehabilitation for chronic diseases: improving health outcomes and function. Richardson C.R., Franklin B., Moy M.L., Jackson E.A., 365, l2191, 2019.
4. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription, 6th ed. Philadelphia: Lippincott, Williams and Wilkins, 2000.
5. Bartels MN. Cardiac rehabilitation. In: Grabois M, ed, Physical Medicine and Rehabilitation: The Complete Approach. Chicago: Blackwell Science,2000.
6. Essential physical medicine and rehabilitation / [edited] by Grant Cooper; foreword by Nancy E. Strauss. 351p,2006.
7. Howley ET. Type of activity: resistance, aerobic and leisure versus occupational physical activity. Med Sci Sports Exerc 2001;33: S364369; discussion S419-320.
8. Jayson R. Baman; Shaundeep Sekhon; Kameswari Maganti. Author Affiliations Article Information JAMA. 2021;326(4):366. doi:10.1001/jama.2021.5952
9. Medical rehabilitation—Handbooks, manuals, etc. I. Weiss, Lyn D. II. Weiss, Jay, MD. III. Pobre, Thomas. IV. Series: Oxford American handbooks. 482 p
10. NICE. Chronic heart failure in adults: diagnosis and management: NICE guideline [NG106]. https://www.nice.org.uk/guidance/ng106 (2018).
11. Physical medicine and rehabilitation: principles and practice / editor-in-chief, Walter R. Frontera; editor emeritus, Joel A. DeLisa; editors, Bruce M. Gans, Nicolas E. Walsh, Lawrence R. Robinson; associate editors, Jeffrey Basford [et al.]. —5th ed.
12. Sports medicine—Handbooks, manuals, etc. I. Bytomski, Jeffrey R. II. Moorman, Claude T. III. MacAuley, Domhnall. IV. Title: Handbook of sports medicine. 839 p
13. The role of cardiac rehabilitation in improving cardiovascular outcomes. Rod S. Taylor, Hasnain M. Dalal, Sinéad T. J. McDonagh. Nature Reviews. Cardiology. https://doi.org/10.1038/s41569-021-00611-7
14. https://www.who.int/
15. http://www.hopkinsmedicine.org/johns_hopkins_healthcare/downloads/Updated_Policies/cms_03_02_cardiac_rehabilitation_mca_2016.pdf

Exercise physiologist. Cardiac rehabilitation. Oxford Radcliffe Hospital NHS Trust. Oxford OX3 9DU. Version 5, September 2009. Review September 2012. OMI 1031.1. Blackbird Lays, 27p.