運動處方
Exercise Prescription

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運動處方
Exercise Prescription

醫生手冊
Doctor's Handbook

衞生防護中心
Centre for Health Protection

衞生署
Department of Health

Acknowledgements

Special thanks must be given to the Exercise Prescription Development Committee for developing and endorsing these guidelines

Hong Kong College of Family Physicians

Physical Fitness Association of Hong Kong, China

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Hong Kong College of Cardiology

基層醫療概念模式及
預防工作常規專責小組
Task Force on Conceptual Model and Preventive Protocols

Statement Of Intent

This document is considered as the commonly accepted practice in the primary care settings and is not intended to be construed as a standard practice of individual patient care. Standards of care are determined on the basis of all the facts and circumstances involved in a particular case and are subject to change as scientific knowledge and technology advance and patterns of care evolve. The management must be made by the appropriate primary care practitioners responsible for clinical decisions regarding a particular treatment procedure or care plan. The management should only be arrived at following discussion of the options with the patient, covering the diagnostic and treatment choices available.

Message from Dr. PY LAM,

Director of Health

Participation in physical activity can be considered a 'vital sign' as it reflects an individual's level of physical and mental well-being. Providing guidance and motivation, including advice on exercise, to patients is part of a doctor's clinical duties. I am glad to see primary care doctors playing an active role in this area. I highly recommend this Handbook to fellow colleagues as it not only provides the latest scientific evidence and recommendations that are relevant to the subject but also provides the techniques and skills required to motivate patients to lead an active life and enjoy better health.

Message from Dr. CHOI Kin,

President, Hong Kong Medical Association

The Hong Kong Medical Association has worked with the Department of Health in the Exercise Prescription Project over the past few years. The project provided doctors with the necessary knowledge to prescribe exercise for their patients safely and with rationale. To increase physical activity participation for better health, I sincerely hope the new government will align its policy with provision of greater accessibility to recreational and sports facilities for enjoyment of people from all walks of life.

Message from Dr. Henry YEUNG Chiu-fat,

President, Hong Kong Doctors Union

In medicine, prevention is better than cure. The preventive and therapeutic benefits of exercise are universally accepted, especially for heart diseases, diabetes, hypertension, to name just a few. Giving out a prescription of EXERCISE which is more than just tablets will definitely help your patients. Now we can boast about practising holistic medicine and put our belief into practice. With a well written Exercise Prescription Doctor's Handbook to assist us, doctors will once more be firmly the cornerstone of healthcare. Thumbs up for the Handbook!

Message from Dr. CHEUNG Hon-ming,

President, Association of Licentiates of Medical Council of Hong Kong

Diseases like hypertension, diabetes mellitus and cardiovascular diseases have been shown to be associated with sedentary life style. Physical exercise is an important component of healthy life style. Adequate and appropriate physical exercise is indispensable to the health of the body. The Exercise Prescription Project developed by the Department of Health in conjunction with the other professional organizations serves as a good reference to healthcare providers to advocate and advise their patients and the public at their contact points.

Message from Prof. Sian GRIFFITHS,

Chairperson, Task Force on Conceptual Model and Preventive Protocols under the Working Group on Primary Care

Changing populations' lifestyles is not an easy task. The Exercise Prescription Project established in 2005 aims to promote physical activities in a collaborative manner. Medical practitioners can contribute through integrating physical activities as one of their components with their clinical consultation, as suggested by the British Medical Journal in the October 2011 Editorial. The School of Public Health and Primary Care of the Chinese University of Hong Kong has played an important role in providing public health education. Empowering the generation with knowledge is crucial in promoting physical activities. Tackling the problem with the right strategy and educating the medical professionals, our students and the public would be the most effective way in modifying populations' lifestyle behaviors.

Message from Dr. Ruby LEE,

President, Hong Kong College of Family Physicians

Regular physical activity has been found to be effective in the prevention, control, and rehabilitation of non-communicable diseases. On behalf of the Hong Kong College of Family Physicians, I would like to express my heartiest congratulations to the Exercise Prescription Development Committee in developing and updating this Exercise Prescription Doctor's Handbook which contains important and interesting training material and reference for primary care practitioners. With increasing evidence of the health benefit of physical activity, it will certainly contribute to better patient care.

Preface

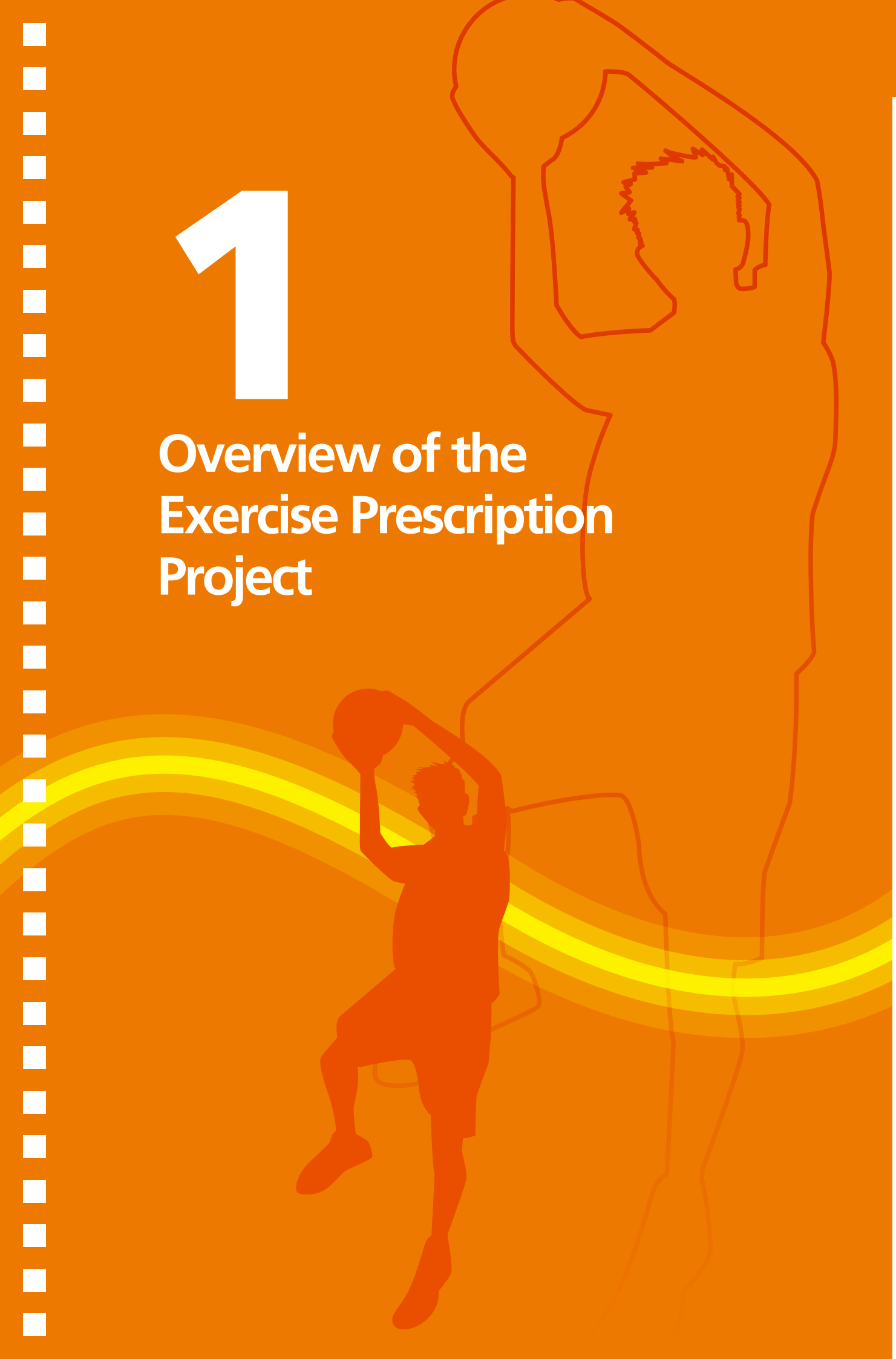
The rising trend of overweight and obesity has largely been attributed to the way we choose to live our lives, through unhealthy dietary habits and lack of physical activity. The good news is, medical research has revealed that with a lifestyle embracing healthy diet, physical activity and avoidance of tobacco smoke, over 80% of heart diseases, type 2 diabetes and one third of cancer cases can be prevented.

What if there were one prescription that is not only safe and cheap but could prevent and treat dozens of diseases, such as diabetes, hypertension and obesity? Would you prescribe it to your patients? Certainly. Groundbreaking research has shown that exercise, at the correct frequency, intensity and duration, not only improves quality of life but decreases the incidence of disease, chronic ill health and obesity. At a time when the local community is faced with an impending health crisis from non-communicable disease, the Department of Health (DH) and the Hong Kong Medical Association are re-launching the Exercise Prescription Project (EPP), and with the support of many partner organisations, inviting you to co-write this part of history of medical care in Hong Kong.

Join us as we embark on a territory-wide movement to promote exercise as a form of prescription for disease prevention and management. Our mission is to put exercise in the forefront and centre in the care plan designed by doctors for their patients. The effective tackling of the issue of physical inactivity in our population would require concerted efforts from society as a whole and collaboration amongst the Government, public and private organisations, academic and professional bodies, media and members of the public. Your support is therefore pivotal.

The professional manuals of Exercise Prescription Project, consisting of science-based recommendations and resources for healthcare practitioners as well as members of the public, were first developed in 2005 with the concerted effort of many parties. In the light of growing interest in primary care and increasing evidence of the health benefit of physical activity, it is timely for this manual to be reviewed, updated and re-launched. It is our hope that primary care practitioners will find this doctor's handbook useful in every day patient care.

1 Overview of the Exercise Prescription Project



1 Overview of the Exercise Prescription Project

Background

Physical inactivity has been identified by the World Health Organization (WHO) as the fourth leading risk factor for global mortality which accounts for 5.5% of deaths globally (1). Physical inactivity is also well-known to be one of the major risk factors for heart diseases, cerebrovascular disease, diabetes mellitus, hypertension, some types of cancers and obesity in both men and women at any age (1). In Hong Kong, the Behavioural Risk Factor Survey conducted by the Department of Health (DH) in April 2010 found that a mere 45.4% of the 2013 respondents had done moderate physical activities for at least 10 mins a day in the week prior to the survey. This level of physical activity was clearly not enough for optimal health gain (2).

Studies have shown that interventions to promote regular physical activity are cost-effective in the prevention and control of non-communicable diseases (3). One of the most consistent predictors of greater levels of physical activity has been higher levels of self-efficacy, which reflects confidence in the ability to exercise, and level of social support. Other predictors include accessibility to exercise equipment and perceived satisfaction with exercising (4). The role of primary care practitioners on health promotion is well recognised. In Hong Kong, primary care practitioners are providing an easily accessible, credible and meaningful source of professional advice, social support and encouragement for people to participate in more physical activities. The Thematic Household Survey revealed that on average a person in Hong Kong would visit a doctor 4 times a year (5). Furthermore, the core concept of prescribing exercise, namely providing patients with written personalised health advice on doing regular exercise, has been tested in many primary care settings both overseas and locally with favourable outcomes (6).

Since 2005, the Government has collaborated with various professional bodies and non-governmental organisations to implement the Exercise Prescription Project (EPP) as a measure to tackle the high prevalence of physical inactivity among the local population.

Project Aim

EPP aims to promote physical activities among members of the public through conjoint efforts of the Government, medical practitioners, professionals and community groups in Hong Kong.

Project Objectives

EPP facilitates the inclusion of exercise by medical practitioners as an integral part of the care plan for patients in the prevention, management and rehabilitation of non-communicable diseases.

Project Approach

Through organising a series of capacity building programmes, EPP empowers doctors with the knowledge and technique of prescribing exercise in the clinical settings. By doing so, it is hoped that growing numbers of individuals will be engaged in regular physical activities.

Outcome

The Hong Kong Medical Association (HKMA) has since 2005 organised five 8-module certification courses (each lasting four half-days) to build capacity of some 400 health care professionals. Evaluation results showed that a larger proportion of doctors receiving training were able to offer general advice on exercise as well as prescribe exercise to their clients. In addition, participating doctors were better able to provide written instruction, stage-matched advice and relevant health education materials in every day practice. A substantial decrease was also seen among those who perceived insufficient skills or lack of motivation as barriers in exercise prescription.

In the light of growing interest in primary care and increasing evidence of the health benefit of physical activity, the training materials and training programmes have been reviewed, revised and relaunched. These should contribute to better patient care.

References

1. World Health Organization. *Global health risks: mortality and burden of disease attributable to selected major risks*. Geneva: World Health Organization; 2009.
2. Department of Health. *Behavioural Risk Factor Survey (April 2010).* Hong Kong SAR: Department of Health; 2010.
3. Roux L, Pratt M, Tengs TO, Yore MM, Yanagawa TL, Van Den Bos J, Rutt C, Brownson RC, Powell KE, Heath G, Kohl HW 3rd, Teutsch S, Cawley J, Lee IM, West L, Buchner DM. Cost effectiveness of community-based physical activity interventions. *Am J Prev Med* 2008; Dec;35(6):578-88.
4. Williams DM, Lewis BA, Dunsiger S, Whiteley JA, Papandonatos GD, Napolitano MA, Bock BC, Ciccolo JT, Marcus BH. Comparing psychosocial predictors of physical activity adoption and maintenance. *Ann Behav Med* 2008; Oct;36(2):186-94.
5. Census and Statistics Department. *Thematic Household Survey Report No. 45*. Hong Kong SAR: Census and Statistics Department; 2010.
6. Petrella RJ, Lattanzio CN. Does counseling help patients get active? Systematic review of the literature. *Can Fam Physician* 2002; Jan;48:72-80.

2

Benefits of Physical Activity

2 Benefits of Physical Activity

A large amount of studies clearly demonstrates that participating in regular physical activity provides many health benefits. These benefits occur in generally healthy people, in people at risk of developing chronic diseases, and in people with current chronic conditions or disabilities. These benefits are summarised in Table 2.1 which is adopted from the Physical Activity Guidelines Advisory Committee of the United States (1).

Although some health benefits seem to begin with as little as 60 mins (1 hour) a week, research shows that a total amount 150 mins (2 hrs and 30 mins) a week of moderate-intensity aerobic activity, such as brisk walking, consistently reduces the risk of many chronic diseases and other adverse health outcomes (1-3). Table 2.2 further gives an overview of research findings on the general relationship between physical activity and health (1).

Table **2.1** Health Benefits Associated With Regular Physical Activity*

Adults and Older Adults#	
Strong evidence	• Lower risk of premature death • Lower risk of coronary heart disease • Lower risk of stroke • Lower risk of high blood pressure • Lower risk of adverse blood lipid profile • Lower risk of type 2 diabetes • Lower risk of metabolic syndrome • Lower risk of colon cancer • Lower risk of breast cancer • Prevention of weight gain • Weight loss, particularly when combined with reduced calorie intake • Improved cardiorespiratory and muscular fitness • Prevention of falls • Reduced depression • Better cognitive function (for older adults)
Moderate to strong evidence	• Better functional health (for older adults) • Reduced abdominal obesity
Moderate evidence	• Reduced symptoms of depression • Lower risk of hip fracture • Lower risk of lung cancer • Lower risk of endometrial cancer • Weight maintenance after weight loss • Increased bone density • Improved sleep quality

Children and Adolescents	
Strong evidence	• Improved cardiorespiratory and muscular fitness • Improved bone health • Improved cardiovascular and metabolic health biomarkers e.g. blood pressure and BMI • Favourable body composition
Moderate evidence	• Reduced symptoms of depression

The term "Older Adult" is defined here as people ≥65 years and people 50 to 64 years with clinically significant conditions or physical limitations that affect movement, physical fitness or physical activity.

Table **2.2** Physical Activity and Health - Major Research Findings

- Regular physical activity reduces the risk of many adverse health outcomes (See Table 2.1 for more details).
- Most health benefits occur with at least 150 mins a week of moderate-intensity physical activity, such as brisk walking. Additional benefits occur with more physical activity.
- For most health outcomes, additional benefits occur as the amount of physical activity increases through higher intensity, greater frequency, and/or longer duration.
- Some physical activity is better than none.
- Both aerobic (endurance) and muscle-strengthening (resistance) physical activity are beneficial.
- Health benefits occur for children and adolescents, young and middle-aged adults, older adults, and those in every studied racial and ethnic group.
- The health benefits of physical activity occur for people with disabilities.
- At the population level, benefits of physical activity far outweigh the possibility of adverse outcomes.

References

1. Physical Activity Guidelines Advisory Committee (PAGAC). *Physical Activity Guidelines Advisory Committee Report 2008*. Washington: DC, US Department of Health and Human Services; 2008.
2. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW, Thompson PD, Bauman A; American College of Sports Medicine; American Heart Association. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 2007;Aug;28;116(9):1081-93.
3. World Health Organisation. *Global Recommendations on Physical Activity for Health*. Geneva: World Health Organisation;2010.

3 Pre-participation Health Screening

3 Pre-participation Health Screening

For some medical conditions, there may be relatively higher health risks associated with physical activity. Although the risk of acute musculoskeletal injury during exercise is well recognised, the major concern for primary care practitioners remains the increased risk of sudden cardiac death and acute coronary events for high risk individuals. Hence, before prescribing exercise, a pre-participation health screening and a risk stratification process should be carried out to identify high risk individuals on one hand while not creating a significant barrier to exercise participation on the other hand. The identification of risk factors for adverse exercise-related events can be achieved through a two-tier approach including a self-guided screening and/or a professionally guided screening.

Self-guided Screening for Physical Activity

The first line of risk evaluation can be carried out in form of a self-guided screening (by the exercising individual or by allied health professionals). For instance, subjects may follow the recommendation of the Surgeon General's Report on Physical Activity and Health (1996): "previously physically inactive men over age 40 and women over age 50, and people at high risk for cardiovascular disease (CVD) should first consult a physician before embarking on a programme of vigorous physical activity to which they are unaccustomed" (1). Subjects may also use some validated questionnaires such as the American Heart Association (AHA) / the American College of Sports Medicine (ACSM) Health/ Fitness Facility Pre-participation Questionnaire (Figure 3.1) or the revised Physical Activity Readiness Questionnaire (PAR-Q) (Figure 3.2) before participation. These questionnaires are simple and easy-to-use by the lay person to determine if his or her risk is such that a primary care practitioner should be consulted before initiating physical activity, particularly if the intended exercise intensity is vigorous.

Figure 3.1 American Heart Association/ American College of Sport Medicine Health/ Fitness Facility Pre-participation Screening Questionnaire*

Section I

History

You have had :

- A heart attack
- Heart surgery
- Cardiac catherization
- Coronary angioplasty (PCI)
- Pacemaker/ implantable cardiac defibrillator/ rhythm disturbance
- Heart valve disease
- Heart failure
- Heart transplantation
- Congenital heart disease

Symptoms

- You experience chest discomfort with exertion
- You experience unreasonable breathlessness
- You experience dizziness, fainting, blackouts
- You take heart medications

Other health issues

- You have musculoskeletal problems
- You have concerns about the safety of exercise
- You take prescription medication(s)
- You are pregnant

If you have marked any of the statements in section I, consult your healthcare provider before engaging in exercise. You may need to use a facility with a medically qualified staff

Section II : cardiovascular risk factors

- You are a man older than 45 years
- You are a woman older than 55 years or you have had a hysterectomy or you are postmenopausal
- You smoke
- Your blood pressure is > 140/90 or you do not know your blood pressure
- You take blood pressure medication
- Your cholesterol level is > 240mg/dl (6.2mmol/L) or you do not know your cholesterol level
- You have a close relative who had a heart attack before the age of 55 (father or brother) or 65 years (mother or sister)
- You are diabetic or take medicine to control your blood sugar
- You are physically inactive (i.e. you get <30min of physical activity at least 3 days/ week)
- You are >20 pound overweight

If you have marked 2 or more of the statements in this section, consult your health care provider before engaging in exercise. You might benefit by using a facility with a professionally qualified exercise staff to guide your exercise program

None of the above (section 1 and 2) is true

You should be able to exercise safely without consulting your healthcare provider in almost any facility that meets your exercise program needs

* Adopted from Balady GJ, Chaitman B, Driscoll D, Foster C, Froelicher E, Gordon N, Pate R, Rippe J, Bazzarre T. Recommendations for cardiovascular screening, staffing, and emergency policies at health/fitness facilities. *Circulation*. 1998 Jun 9;97(22):2283-93.

Figure 3.2 Physical Activity Readiness Questionnaire (PAR-Q)

體能活動適應能力問卷
PAR-Q

體能活動適應能力問卷與你

（一份適用於15至69歲人士的問卷）

經常進行體能活動不但有益身心，而且樂趣無窮，因此，愈來愈多人開始每天多做運動。對大部分人來說，多做運動是很安全的。不過，有些人則應在增加運動量前，先行徵詢醫生的意見。

如果你計劃增加運動量，請先回答下列7條問題。如果你介乎15至69歲之間，這份體能活動適應能力問卷會告訴你應否在開始前諮詢醫生。如果你超過69歲及沒有經常運動，請徵詢醫生的意見。

普通常識是回答這些問題的最佳指引。請仔細閱讀下列問題，然後誠實回答：

請答「是」或「否」

是	否	
☐	☐	1. 醫生曾否說過你的心臟有問題，以及只可進行醫生建議的體能活動？
☐	☐	2. 你進行體能活動時會否感到胸口痛？
☐	☐	3. 過去一個月內，你曾否在沒有進行體能活動時也感到胸口痛？
☐	☐	4. 你曾否因感到暈眩而失去平衡，或曾否失去知覺？
☐	☐	5. 你的骨骼或關節（例如脊骨、膝蓋或髖關節）是否有毛病，且會因改變體能活動而惡化？
☐	☐	6. 醫生現時是否有開血壓或心臟藥物（例如 water pills）給你服用？
☐	☐	7. 是否有其他理由令你不應進行體能活動？

如果你的答案是：

一條或以上答「是」

在開始增加運動量或進行體能評估前，請先致電或親身與醫生商談，告知醫生這份問卷，以及你回答「是」的問題。

- 你可以進行任何活動，但須在開始時慢慢進行，然後逐漸增加活動量；又或你只可進行一些安全的活動。告訴醫生你希望參加的活動及聽從他的意見。
- 找出一些安全及有益健康的社區活動。

全部答「否」

如果你對這份問卷的全部問題誠實地答「否」，你有理由確信你可以：

- 開始增加運動量 - 開始時慢慢進行，然後逐漸增加，這是最安全和最容易的方法。
- 參加體能評估 - 這是一種確定你基本體能的好方法，以便你擬定最佳的運動計劃。此外，亦主張你量度血壓；如果讀數超過144/94，請先徵詢醫生的意見，然後才逐漸增加運動量。

→

延遲增加運動量：

- 如果你因傷風或發燒等暫時性疾病而感到不適 - 請在康復後才增加運動量；或
- 如果你懷孕或可能懷孕 - 請先徵詢醫生的意見，然後才決定是否增加運動量。

請注意：如因健康狀況轉變，致使你隨後須回答「是」的話，便應告知醫生或健身教練，看看應否更改你的體能活動計劃。

適當使用體能活動適應能力問卷：
The Canadian Society for Exercise Physiology、Health Canada及其代理人毋須為進行體能活動的人承擔責任。如填妥問卷後有疑問，請先徵詢醫生的意見，然後才進行體能活動。

不得更改問卷內容。歡迎複印整份問卷（必須整份填寫）

註：如一名人士在參加體能活動或進行體能評估前已獲得這份問卷，本部分可作法律或行政用途。

本人已閱悉、明白並填妥本問卷。本人的問題亦已得到圓滿解答。

姓名：_____
簽署：_____
家長或監護人簽署：_____
（適用於18歲以下的參加者）

身份證明文年號碼：_____
日期：_____
見證人：_____

備註：　如果在上述問卷中有一個或以上「是」的答案，即表示你的身體狀況可能不適合參與有關活動。故為安全起見，請你先行諮詢醫生的意見，證明你的身體狀況適宜參與有關活動。

此問卷由填寫當天計12個月內有效。如因健康狀況轉變，致使你隨後對上述的任何問題答「是」的話，則本問卷即告無效。

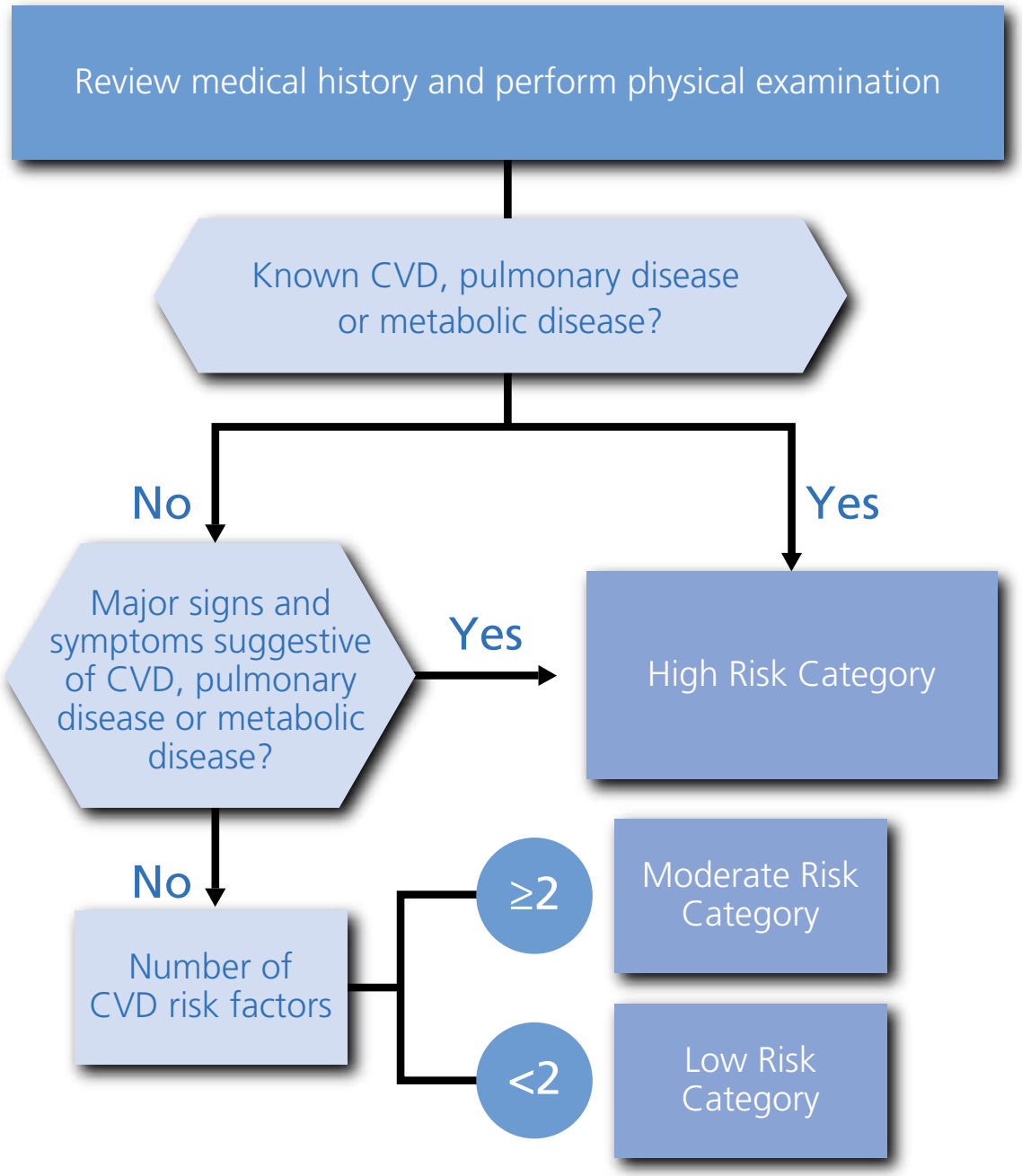
Professionally Guided Screening for Physical Activity

A more advanced and thorough assessment can be carried out by the primary care practitioner into an individuals' CVD risk factors, signs and symptoms, and to identify a broader scope of chronic diseases that may need special attention before exercise participation.

ACSM proposed a risk stratification scheme (summarised in Figure 3.3) which assigns participants into one of its three risk categories (Table 3.1) according to specific criteria (Tables 3.2-3.4). Once the risk category has been established, appropriate recommendations before initiating an exercise or substantially progressing the intensity and volume of an existing exercise may be made regarding the necessity for further medical workups and diagnostic exercise testing.

The ACSM recommendations on exercise testing are summarised in Table 3.5. It should be noted that the methodology of pre-participation risk assessment is both complex and controversial, and other organisations such as the European Society of Cardiology, the American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation also published their own guidelines for risk stratification (2-5). Many of them rely on expert consensus in the absence of existing scientific evidence. Primary care practitioners should choose the most applicable tools and instruments for their own settings and populations when making decisions about the level of screening before exercise participation (2,6). Alternatively, primary care practitioners may also ascertain a global coronary and cardiovascular risk score for their patients, such as the Framingham Risk Score or the Systematic Coronary Risk Evaluation (SCORE), for combining the individual's risk factor measurements into a single quantitative estimate of the absolute risk of atherosclerotic cardiovascular death within 10 years (7-8).

Figure **3.3** Logic Model for the ACSM Risk Stratification Scheme*



* Adopted from the Preparticipation Health Screening and Risk Stratification. In Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010.

Table 3.1 The ACSM Risk Stratification Categories*

Low risk	• Asymptomatic men and women who have < 2 CVD risk factor from Table 3.2
Moderate risk	• Asymptomatic men and women who have ≥ 2 CVD risk factors from Table 3.2
High risk	• Individual who has known CVD, pulmonary disease, or metabolic disease listed in Table 3.3 , OR ≥ 1 signs and symptoms listed in Table 3.4

* Adopted from the Preparticipation Health Screening and Risk Stratification. In Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010.

Table 3.2 Cardiovascular Disease Risk Factors for Use with the ACSM Risk Stratification*

+ve risk factors	Defining Criteria
Age	• Men ≥ 45 OR Women ≥ 55
Family history	• Myocardial infarction, coronary revascularisation or sudden death < 55 years old in father or other male first-degree relative OR < 65 years old in mother or other female first-degree relative
Cigarette smoking	• Current smoker OR Ex-smoker < 6 months OR Exposure to environmental tobacco smoke
Sedentary lifestyle	• Not participating in at least 30 mins of moderate intensity physical activity on at least 3 days of the week for at least 3 months
Obesity #	• Body Mass Index ≥ 25kg/m^2 OR • Waist circumference ≥ 90cm (men) OR ≥ 80cm (women)
Hypertension	• Systolic blood pressure ≥ 140 mmHg OR Diastolic blood pressure ≥ 90 mmHg (confirmed by measurements on at least 2 separate occasions), OR • On antihypertensive medication
Dyslipidaemia	• Total serum cholesterol ≥ 5.2 mmol/L OR • HDL cholesterol < 1 mmol/L OR • LDL cholesterol ≥ 3.4 mmol/L OR • On lipid-lowering medication

Pre-diabetes (confirmed by measurements on at least 2 separate occasions)	• Impaired fasting glucose (i.e. fasting blood glucose level is 5.6 - 6.9 mmol/L) OR • Impaired glucose tolerance (i.e. 2-hour post-prandial blood glucose level is 7.8-11 mmol/L)
-ve risk factors	**Defining Criteria**
High serum HDL cholesterol+	HDL cholesterol > 1.6 mmol/L

* Modified from the Preparticipation Health Screening and Risk Stratification. In Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010.

\+ If HDL is high, subtract one risk factor from the sum of positive risk factors.

\# The above BMI classification is promulgated by the World Health Organisation (Western Pacific Region Office) for reference by Asian adults and is not applicable to children under the age of 18 or pregnant women.

Table **3.3** Cardiovascular Disease, Pulmonary Diseases and Metabolic Diseases Suggesting High Risk for Physical Activity*

Cardiovascular Disease	• Cardiac diseases • Cerebrovascular disease • Peripheral vascular disease
Pulmonary Disease	• Chronic obstructive pulmonary disease • Asthma • Interstitial lung disease
Metabolic Disease	• Diabetes mellitus • Significant thyroid disorder • Significant renal disease • Significant liver disease

* Modified from the Preparticipation Health Screening and Risk Stratification. In Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010.

Table **3.4** Major Signs and Symptoms Suggestive of Cardiovascular Disease, Pulmonary Disease or Metabolic Disease*^

Clinical Features Suggesting High Risk for Physical Activity
• Pain, discomfort in the chest, neck, jaw, arms or other areas that may be due to ischaemia
• Shortness of breath at rest or with mild exertion
• Dizziness or syncope
• Orthopnea or paroxysmal nocturnal dyspnea
• Ankle oedema
• Palpitations or tachycardia
• Intermittent claudication
• Known heart murmur
• Unusual fatigue or shortness of breath with usual activities

* Adopted from the Pre-participation Health Screening and Risk Stratification. In Walter R Thompson; Neil F Gordon; Linda S Pescatello. ACSM's guidelines for exercise testing and prescription. 8th ed. American College of Sports Medicine; 2010.

^ These signs or symptoms must be interpreted within the clinical context in which they appear because they are not all specific for significant cardiovascular, pulmonary, or metabolic disease.

Table **3.5** The ACSM recommendations on exercise testing based on the ACSM risk stratification*#

Risk Category	Recommendation for low-moderate intensity physical activity	Recommendation for vigorous intensity physical activity
Low	• Further medical workup and exercise testing are NOT necessary	• Further medical workup and exercise testing are NOT necessary
Moderate+	• Further medical workup and exercise testing are NOT necessary	• Further medical workup and exercise testing are both RECOMMENDED
High^	• Further medical workup and exercise testing are both RECOMMENDED	• Further medical workup and exercise testing are both RECOMMENDED

* Modified from the Preparticipation Health Screening and Risk Stratification. In Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010.

\# Further medical workups refer to additional medical assessments that may be needed for developing a safe and effective exercise programme. These assessments may include but not limited to ambulatory electrocardiography, Holter monitoring, echocardiography, pulmonary function tests, and serum chemistries.

\+ For stable hypertensive patients with presence of target organ damages, medical clearance and exercise testing are also recommended before moderate intensity physical activity. For further details, please refer to Chapter 7 Recommendations for Prescribing Exercise to Patients with Hypertension.

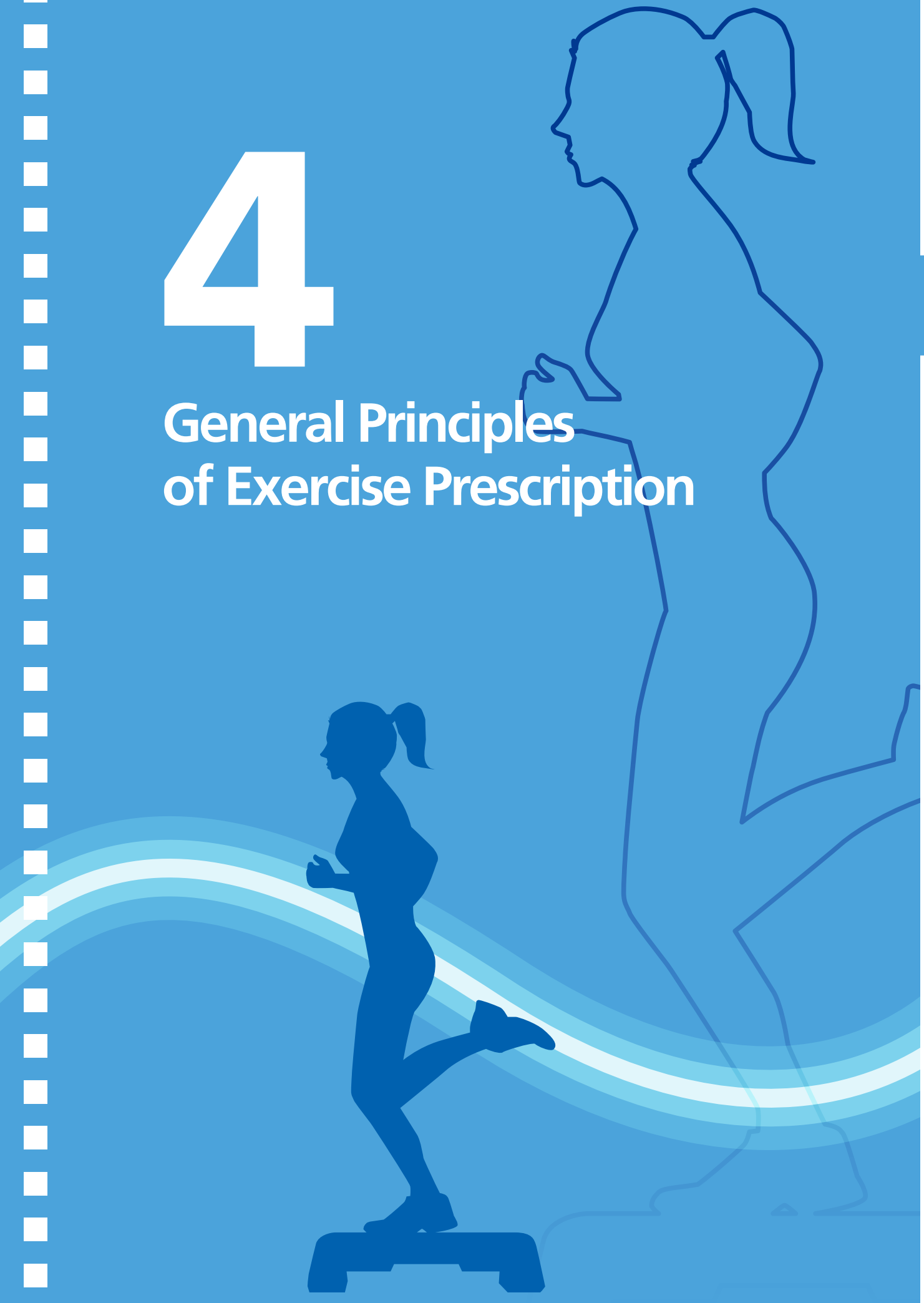
^ For diabetic patients with <10% risk of cardiac event over a 10-year period, exercise testing may NOT be necessary before engaging in low to moderate intensity physical activity. Primary care practitioners may use the Framingham Risk Score or the Systematic Coronary Risk Evaluation (SCORE) to ascertain a global coronary and cardiovascular risk score for their diabetic patients to estimate the absolute risk of atherosclerotic cardiovascular death within 10 years (7-8). For further details, please refer to Chapter 6 Recommendations for Prescribing Exercise to Patients with Diabetes.

References

1. U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion; 1996.
2. Borjesson M, Urhausen A, Kouidi E, Dugmore D, Sharma S, Halle M, Heidbüchel H, Björnstad HH, Gielen S, Mezzani A, Corrado D, Pelliccia A, Vanhees L. Cardiovascular evaluation of middle-aged/senior individuals engaged in leisure-time sport activities: position stand from the sections of exercise physiology and sports cardiology of the European Association of Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil*. 2010;Jun 19.
3. Balady GJ, Chaitman B, Driscoll D, Foster C, Froelicher E, Gordon N, Pate R, Rippe J, Bazzarre T. Recommendations for cardiovascular screening, staffing, and emergency policies at health/fitness facilities. *Circulation* 1998;Jun 9;97(22):2283-93.
4. Fletcher GF, Balady GJ, Amsterdam EA, Chaitman B, Eckel R, Fleg J, Froelicher VF, Leon AS, Piña IL, Rodney R, Simons-Morton DA, Williams MA, Bazzarre T. Exercise standards for testing and training: a statement for healthcare professionals from the American Heart Association. *Circulation* 2001;Oct 2;104(14):1694-740.
5. American Association of Cardiovascular and Pulmonary Rehabilitation. *Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs*. 4th ed. Champaign, (IL): Human Kinetics Publishers; 2004.
6. Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010.
7. Wilson PWF, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. *Circulation* 1998;97:1837-47.
8. Conroy RM, Pyo¨ ra¨ la¨ K, Fitzgerald AP, Sans S, Menotti A, deBacker G, et al. Estimation of ten-year risk of fatal cardiovascular disease in Europe: the SCORE project. *Eur Heart J* 2003; 24:987–1003.

4

General Principles of Exercise Prescription



4 General Principles of Exercise Prescription

The principles of exercise prescription presented in this chapter are intended to assist primary care practitioners in the development of an individually tailored exercise prescription.

Glossary

Physical Activity 「體能活動」

Any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level. In this handbook, physical activity generally refers to the subset of physical activity that enhances health (1).

Exercise 「運動」

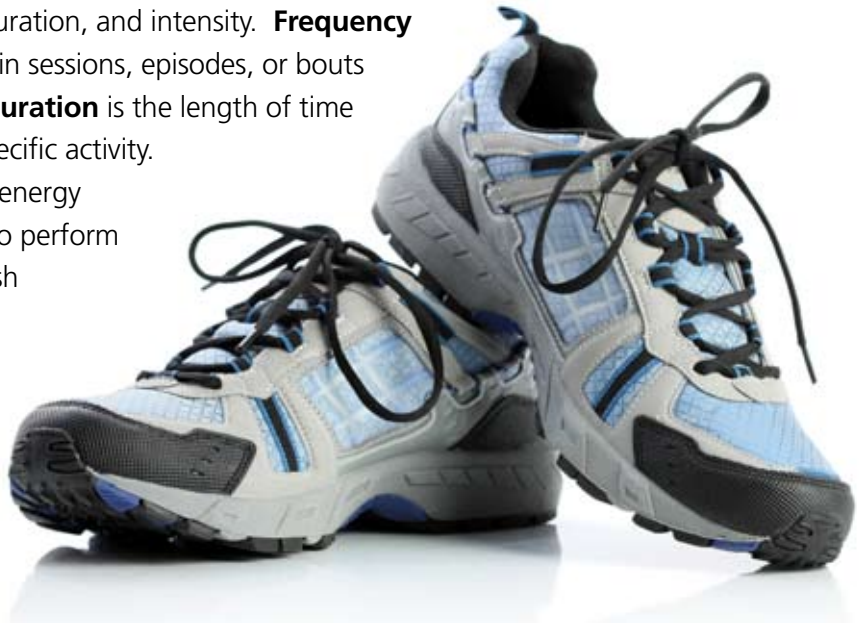
A subcategory of physical activity that is planned, structured, repetitive, and purposive in the sense that the improvement or maintenance of one or more components of physical fitness is the objective. "Exercise" and "exercise training" frequently are used interchangeably and generally refer to physical activity performed during leisure time with the primary purpose of improving or maintaining physical fitness, physical performance, or health (1).

Sport 「體育運動」

Sport covers a range of physical activities performed within a set of rules and undertaken as part of leisure or competition. Sporting activities usually involve physical activity carried out by teams or individuals and are supported by an institutional framework, such as a sporting agency (2).

Dose / Dosage

In the field of physical activity, dose refers to the amount of physical activity performed by the subject or participant. The total dose or amount is determined by the three components of activity: frequency, duration, and intensity. **Frequency** is commonly expressed in sessions, episodes, or bouts per day or per week. **Duration** is the length of time for each bout of any specific activity. **Intensity** is the rate of energy expenditure necessary to perform the activity to accomplish the desired function (aerobic activity) or the magnitude of the force exerted during resistance exercise (1).



Types of Physical Activity

A variety of physical activities to improve the components of physical fitness is recommended for all adults. Different types of physical activities work on different health-related components of physical fitness, as summarised in Table 4.1 (1).

Table **4.1** Types of Physical Activities and Their Effects on Physical Fitness

Type of Physical Activities	Effect on Physical Fitness
Aerobic Activity	• Improves body composition and cardiorespiratory fitness
Muscle-strengthening Activity	• Improves muscular fitness such as muscular strength and endurance
Stretching Activity	• Improves flexibility such as range of motion
Neuromuscular Activity	• Improves neuromuscular fitness such as balance, agility and proprioception

Some physical activity is better than none, and adults who participate in any amount of physical activity gain some health benefits (1). Therefore, it is advisable that all adults should avoid physical inactivity (1). For substantially improving or maintaining a patient's physical fitness, primary care practitioners are best placed to provide customised advice, motivation and encouragement to their patients. An overview of different types of physical activity for consideration of exercise prescription is discussed in the following paragraphs.

◢ Aerobic Exercise

Types of Aerobic Exercise

Any activity that uses large muscle groups, can be maintained continuously, and is rhythmical in nature can be regarded as an aerobic exercise. In general, aerobic exercises requiring little skill to perform are more commonly recommended for all adults to improve fitness. Aerobic exercises that require minimal skills and can be easily modified to accommodate individual physical fitness levels include brisk walking, leisure cycling, swimming, aqua-aerobics and slow dancing. Aerobic exercises that are typically performed at a higher intensity and, therefore, are recommended for persons who exercise regularly include jogging, running, aerobics, stepping exercise, fast dancing and elliptical exercise.

Dosage of Aerobic Exercise

The dosage of aerobic exercise is a function of the frequency (F), intensity (I) and duration (time, T) of the exercise performed. In combination with the type (T) of exercise performed, these factors constitute the basic components of the core principle of exercise prescription (the FITT principle). Primary care practitioners should be able to specify each of the above components when prescribing aerobic exercises to their patients. Further descriptions and elaborations of some related concepts about the FITT principle are summarised in Tables 4.2 - 4.5 (3). It should be noted that even small increases in caloric expenditure with physical activity may improve physical fitness outcomes, with sedentary persons accruing the most benefits.

Table **4.2** The FITT Principle of Prescribing Aerobic Exercise

Key Components	Compositions to be Specified in an Exercise Prescription
Frequency (F)	• The number of days per week dedicated to an exercise session
Intensity (I)	• How hard a person works to do the activity. It can be defined on either an absolute or a relative scale. Absolute intensity refers to the amount of energy expended per min of activity, while relative intensity takes a person's level of exercise capacity or cardiorespiratory fitness into account to assess the level of effort. Either scale can be used to monitor the intensity of aerobic exercises • As a rule of thumb, a person doing moderate-intensity aerobic exercise can talk, but not sing, during the activity. A person doing vigorous-intensity exercise cannot say more than a few words without pausing for a breath. (See Table 4.3 for more information on assessing aerobic intensity (1).)
Time (T)	• The length of time in which an activity or exercise is performed. Duration is generally expressed in mins.
Type (T)	• The mode of exercise performed.

Table **4.3** Methods for Assessing Aerobic Intensity

Methods	Descriptions
METs	Metabolic equivalents (METs) express aerobic intensity as mL per kg per min of oxygen being consumed. Listed in Table 4.4 are the MET values for a variety of physical activities that are of light, moderate or vigorous intensity (4). • 1 MET is the rate of energy expenditure while sitting at rest. It is taken by convention to be an oxygen uptake of 3.5 mL per kg of body weight per min. • Light-intensity aerobic activity is an activity done at 1.1 to 2.9 METs, moderate-intensity activity is an activity done at 3 to 5.9 METs while vigorous activity is an activity done at ≥ 6 METs (1). Sometimes, intensity of aerobic activities may simply be measured as the speed of the activity (for example, walking at 5 km/h, jogging at 10 km/h).
VO_{2max} / VO_2R	The aerobic intensity can be expressed as a percentage of a person's maximal oxygen uptake/aerobic capacity (VO_{2max}) or oxygen uptake reserve (VO_2R), which could be estimated by exercise tests (3)
%HR_{max} / %HRR	The aerobic intensity can be expressed as a percentage of a person's maximum heart rate (HR_{max})* or heart rate reserve (HRR)+, which could be measured by maximal exercise tests or predicted by the person's age (3)
RPE	Ratings of perceived exertion (RPE) – an index of how hard the person feels he or she is exercising (e.g., a 0 to 10 scale). (See Table 4.5 for more information on the classification of relative intensity of aerobic exercise (1).)

* HR_{max} is estimated by "220–age" (applied to adults ≥ 19 year-old only) or some other prediction equation.

\+ HRR method: Target heart rate (HR) = [(HR_{max} – resting HR) × % intensity desired] + resting HR

Table **4.4** MET Equivalents of Common Aerobic Activities*

Types of Activity	Light <3 METs	Moderate 3 to <6 METs	Vigorous ≥ 6 METs
Walking	• Walking slowly around home, store or office = 2.0	• Walking ~5 km/h = 3.3 • Brisk walking at ~6 km/h = 5.0	• Walking at very brisk pace (~7 km/h) = 6.3 • Jogging at 8 km/h = 8.0 • Jogging at 10 km/h = 10.0 • Running at 11 km/h = 11.5
Household Chore and Occupation	• Sitting — using computer work at desk using light hand tools = 1.5 • Standing performing light work such as making bed, washing dishes or preparing food = 2.0–2.5	• Cleaning — heavy: washing windows or car = 3.0 • Sweeping floors or carpet, vacuuming, mopping = 3.0–3.5	• Shovelling, digging ditches = 8.5 • Carrying heavy loads such as bricks = 7.5
Leisure and Sports	• Arts & crafts, playing cards = 1.5 • Playing most musical instruments = 2.0–2.5	• Badminton — recreational = 4.5 • Cycling — on flat: light effort (16–19 km/h) = 6.0 • Golf — walking pulling clubs = 4.3 • Table tennis = 4.0 • Tennis doubles = 5.0 • Volleyball — non-competitive = 3.0–4.0 • Swimming leisurely = 6.0	• Basketball game = 8.0 • Cycling — on flat: moderate effort (20–22 mph) = 8.0; fast (23–26 mph) = 10 • Football — casual = 7.0; competitive = 10.0 • Swimming — moderate/hard = 8–11 • Tennis singles = 8.0

* MET values can vary substantially from person to person due to different strokes and skill levels.

Table **4.5** Classification of Relative Intensity of Aerobic Activities*

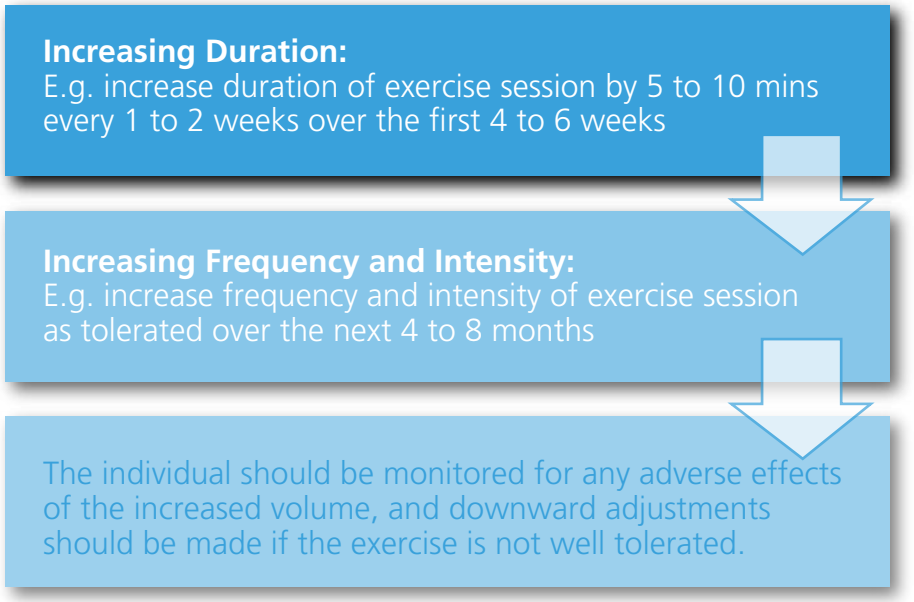
Intensity	Methods to Quantify Relative Intensity		
	$VO_2R(\%)/HRR(\%)$	$HR_{max}(\%)$	RPE
Light	20-39	50-63	<5 out of 10
Moderate	40-59	64-76	5–6 out of 10
Vigorous	60-84	77-93	≥7 out of 10

* Modified from the Physical Activity Guidelines Advisory Committee Report published by the U.S. Department of Health and Human Services (2008); the Physical Activity and Health: A Report of the Surgeon General published by the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion (1996) and Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010. (1,3,5).

Rate of Progression of Aerobic Exercises

Progression of exercise refers to the process of increasing the intensity, duration, frequency, or amount of activity or exercise as the body adapts to a given activity pattern. The recommended sequence of progression is diagrammed at Figure 4.1 (3).

Figure **4.1** The Recommended Sequence of Progression of Aerobic Exercises



◢ Muscle-strengthening Exercise

Types of Muscle-strengthening Exercise

Muscle-strengthening exercises enable muscles to do more work than they are accustomed (i.e., to overload the muscles). Muscle-strengthening exercises count if they involve a moderate to high level of intensity and work the major muscle groups of the body: the

legs, hips, back, chest, abdomen, shoulders, and arms. Resistance exercise, including weight training, is a well-known example of muscle-strengthening exercise which could be prescribed using the FITT framework.

Dosage of Resistance Exercise

The dosage of resistance exercise is a function of the frequency, intensity and volume of the exercise performed. Primary care practitioners should be able to specify the dosage and the type when prescribing resistance exercises to their patients. Further descriptions about the FITT principle of resistance exercises are summarised in Table 4.6 (1,3). It should be noted that each resistance exercise should be performed with proper techniques. Individuals who are new to resistance exercises should receive instructions from trained personnel before engaging in these exercises.

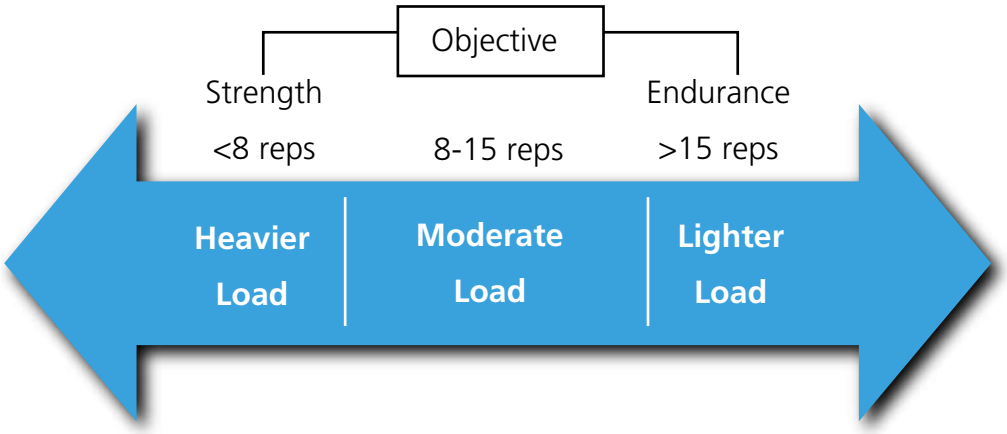
Table **4.6** The FITT Principle of Prescribing Resistance Exercise

Key Components	Compositions to be Specified in an Exercise Prescription
Frequency	• The number of days per week dedicated to an exercise of each muscle group. • Depending on the individual's daily schedule, all muscle groups to be trained may be done so in the same session (i.e. whole body) or each session may "split" the body into selected muscle groups so that only a few of them are trained in any one session. E.g. lower body muscles trained on Monday and Thursday while upper body muscles trained on Tuesday and Friday (In this case, each muscle group is trained on 2 days in the week).
Intensity (Load)	• "Load" is the standard way to refer to the intensity of resistance exercises prescribed. "Load" refers to the amount of weight or resistance assigned to an exercise set. To approximate the appropriate limb-specific weight loads for resistance exercise, one can determine the one-repetition maximum (i.e. 1-RM – the greatest resistance/weight that can be moved through the full range of motion for a single repetition in a controlled manner with good posture e.g. the maximum amount of weight one can lift in a single repetition for a given exercise) and then lift a defined percentage of that amount during each set of the exercise (i.e. % 1-RM). • A useful guide is to exercise to the point at which further repetitions will require further external assistance.

Time (Volume)	No specific amount of time is recommended for resistance exercise while repetitions (reps) and sets are standard ways to refer to the work needed in the exercise prescription. • A "repetition" is one performance of a single exercise e.g. lifting a weight once. • A "set" comprises a group of reps performed without stopping. A reasonable rest interval between sets is 2 to 3 mins though a shorter interval may be allowed for low intensity training (mainly to improve muscular endurance rather than strength and mass). E.g. 1 set = lifting a weight continuously for 12 times • The number of rep performed with each set and the load of resistance exercise are inversely related i.e. the greater the load, the fewer the number of repetitions that will be needed to be completed. (See Figure 4.2 for more information on volume of resistance exercises.) From a practical standpoint of programme adherence, the doctor should recommend each individual to carefully assess his/her own schedule, time demands and level of commitment to determine how many sets per muscle should be performed during each session. Of paramount importance is the adoption of a resistance exercise programme that will be realistically maintained over the long term.
Type	• It is the mode of exercise performed. • The exercise regimens should include multi-joint or compound exercises. Examples of multi-joint exercises include the chest press, shoulder press, pull-down, dips, low-back extension, abdominal crunch/curl-up, and leg press while single-joint exercises include bicep curls, triceps extensions, quadriceps extensions, leg curls and calf raises. These usually take the form of free weights or weight machines. • Other examples of activities with muscle-strengthening effects include working with resistance bands, doing calisthenics that use body weight for resistance (such as push-ups, pull-ups, and crunches), carrying heavy loads, and heavy gardening (such as digging or hoeing).

Figure 4.2 Volume of Resistance Exercises+

A lower repetition range with a heavier load may better optimise muscular strength and power, whereas a higher repetition range with a lighter load may better enhance muscular endurance. Using weight loads that permit 8 to 15 reps will generally facilitate improvements in both muscular strength and endurance.



+ Modified from Williams MA, Haskell WL, Ades PA, Amsterdam EA, Bittner V, Franklin BA, Gulanick M, Laing ST, Stewart KJ; American Heart Association Council on Clinical Cardiology; American Heart Association Council on Nutrition, Physical Activity, and Metabolism. Resistance exercise in individuals with and without cardiovascular disease: 2007 update: a scientific statement from the American Heart Association Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism. *Circulation*. 2007 Jul 31;116(5):572-84. Epub 2007 Jul 16 (6).

Rate of Progression of Resistance Exercises

As the individual progresses with the exercise plan, the exercise dosage can be increased (overload) to facilitate improvements in muscular strength and endurance. Overload can be achieved by modulating several prescriptive variables: increasing the load (or intensity), increasing the rep per set, increasing the number of sets per exercise, decreasing the rest period between sets or exercises and increasing the exercise frequency. An initial increase in the number of rep is recommended before an increase in load. When the participant can comfortably achieve the "upper limit" of the prescribed repetition range, for example, 12 to 15 reps, training loads may be increased (e.g. by~5%) so that no more than 12 reps are completed without volitional fatigue.

◢ Stretching Exercise

Stretching exercises are effective in increasing flexibility, thereby allowing people to more easily do activities that require greater flexibility. For this reason, flexibility activities are a reasonable part of an exercise programme, even though they have no known health benefits and it is unclear whether they reduce risk of injury (3,7). Basic types of stretching techniques are listed in the Table 4.7 (8-9).

Table **4.7** Types of Stretching Techniques

Types	Brief Description
Static Stretching	• Involves a voluntary passive relaxation of muscle while it is elongated
Dynamic Stretching	• Involves a swinging, bouncing or bobbing movement during the stretch as the final position in the movement is not held
Active Stretching	• Involves active contraction of the agonist muscles to move a limb through a full range of motion while the functional antagonist is being stretched
Slow Movements	• Slow movements of a muscle, such as lateral neck flexions, arm rotations and trunk rotations
Proprioceptive Neuromuscular Facilitation	• Isometric contraction of the muscle after static stretching, followed by a greater stretch passively

Components of a Single Exercise Session

Components of a single exercise session is summarised in Table 4.8.

Table **4.8** Components of a Single Exercise Session

Phases	Constituent
Warm-up	• At least 5 to 10 mins of low to moderate intensity aerobic exercise or resistance exercise with lighter weights.
Conditioning	• 0 to 60 mins of aerobic, resistance, neuromuscular, and/or sport activities
Cool-down	• At least 5 to 10 mins of low to moderate intensity aerobic exercise or resistance exercise with lighter weights
Stretching	• At least 10 mins of stretching exercises performed after the warm-up or cool-down phase

Improving Exercise Adoption and Maintenance

Individually adapted behaviour change is critical to facilitate a physically active lifestyle, but the process involves a multitude of complex variables, including personal, programmatic, social, environmental and related factors (10). To achieve long term changes in health-related behaviours, these and medical factors must be addressed collectively (11).

Effective physical activity interventions include (a) increasing social support and self-efficacy, (b) reducing barriers to exercise, (c) using information prompts, and (d) making social and physical environmental changes (12-14). Getting started with exercise prescription will be made easier if you follow the behavioural model and counselling techniques described below.

◢ Applying the Stages of Change Model

In brief, the Transtheorectical Model postulates that individuals move through a series of stages (i.e. stages of change) as they become physically active. Knowing a person's stage of change suggests different strategies for working with that particular person. It is possible to target an intervention to an individual's stage of change. It has been shown that individuals who are in the earlier stages of change – precontemplation and contemplation – are more likely to use the cognitive processes of change, such as increasing knowledge and comprehending the benefits. As people move into the later stages (namely preparation and action), they start to use more behavioural processes of change, such as enlisting social support and substituting alternatives. Primary care practitioners may refer to Box 4.1 for more details about each stage of change of a specific individual.

Box 4.1 The Physical Activity Stage of Change.*

Stages	Description
Precontemplation	• The individual is not physically active now and does not intend to become more physically active in the next 6 months
Contemplation	• The individual is not physically active now but intends to become more physically active in the next 6 months
Preparation	• The individual is physically active now but not to the recommended level (i.e. Engaging in regular physical activity – activities add up to a total of 30 or more mins per day and be done at least 5 days per week).
Action	• The individual has been engaging in regular physical activity to the recommended level for less than 6 months.
Maintenance	• The individual has been engaging in regular physical activity to the recommended level for the past 6 months.

* Modified from Marcus BH, Forsyth LH. *Motivating People to be Physically Active*. Champaign (IL): Human Kinetics; 2003.

◢ Using Client-Centred Techniques during Counselling

Through the use of a few patient-centred counselling techniques, one can increase satisfaction and compliance among patients. Box 4.2 summarises some patient-centred techniques and Box 4.3 lists out a few clues from patients for checking whether these techniques are properly performed (15).

Box 4.2 Summary of Patient-Centred Counselling Techniques.

- Ask simple, open-ended questions.
- Listen and encourage with verbal and non-verbal prompts.
- Clarify and summarise. Check your understanding of what the patient said and check to see that the patient understand what you said.
- Use reflective listening.

Box 4.3 How You Know When You are Using Patient-Centred Approach.

- You are speaking slowly.
- The patient is talking more than you are.
- The patient is talking about behavioural change.
- You are listening intently and directing the conversation when appropriate.
- The patient appears to be making realisations and connections that he or she has not previously considered.
- The patient is asking you for information or advice.

The Five-A's Model (Assess, Advise, Agree, Assist, Arrange) for physical activity counselling is shown in Box 4.4. It provides a simple and effective framework for tailoring counselling for health-behavioural change according to the client's stage of change. Some practical recommendations to enhance exercise programme adherence are also shown in Box 4.5.

Box 4.4 The Five-A's Model to Facilitate Behavioural Changes of Patients in the Context of Promoting Physical Activity.*

Assess	• Current physical activity (type, frequency, intensity, and duration) • Contraindications to physical activity • The patient's readiness for change • Patient-oriented benefits • Social support • Self-efficacy (the patient's self-confidence that he or she can change behaviour)
Advise	• Provide a structured, individually tailored counselling message based on the patient's stage of change, e.g.: – Precontemplation: "As your physician, it's my responsibility to recommend that you get at least 30 mins of moderate-intensity physical activity, such as walking fast on at least 5 days of the week" – Contemplation: Emphasise benefits that the patient cares about – Preparation: Suggest that the patient help someone he or she cares about get physically active for health – Action/maintenance: "Congratulations, you are doing one of the most important things you can for your health" • Personalise risk • Personalise immediate and long term benefits of change

Agree	• Agree on the next step and initiate shared decision making based on the patient's stage of change – Precontemplation: ask the patient if you can talk about physical activity in the future – Contemplation: discuss the next steps – Preparation stage: help the patient make a plan and set a start date – Action/maintenance stage: Ask if the patient is ready to start another healthy behaviour
Assist	• Provide the patient with a written prescription • Correct misunderstanding • Provide information and resources: printed support materials; self-monitoring tools (e.g., pedometer, calendar); or internet-based resources • Provide social support • Identify barriers to change and offer problem solving • Teach skills/recommend coping strategies • Describe options available and identify community resources (See the webpage: http://www.lcsd.gov.hk/en/ls_fac.php for more information about the leisure and sports facilities provided by the Leisure and Cultural Services Department.) • Refer when appropriate
Arrange	• Schedule a follow-up visit • Provide telephone or e-mail reminders (e.g., have a staff member call or e-mail the patient on the start date of the behaviour change) and internet-based counselling • Refer the patient for additional assistance (e.g., dietitian or qualified physical trainer)

* Modified from Meriwether RA, Lee JA, Lafleur AS, Wiseman P. Physical activity counselling. *Am Fam Physician*. 2008 Apr 15;77(8):1129-36. (16)

Box **4.5** Practical Recommendations to Enhance Exercise Adherence.*

- Clarify individual needs to establish the motive for exercise
- Identify individualised attainable goals and objectives for exercise
- Identify safe, convenient and well-maintained facilities for exercise
- Identify social support for exercise
- Identify environmental supports and reminders for exercise
- Identify motivational exercise outcomes for self-monitoring of exercise progress and achievements, such as step counters
- Emphasise and monitor the acute or immediate effects of exercise
- Emphasise variety and enjoyment in the exercise programme
- Establish a regular schedule of exercise
- Provide qualified, personable and enthusiastic exercise professionals
- Minimise muscle soreness and injury by participation in exercise of moderate intensity, particularly in the early phase of exercise adoption

* Adopted from Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010. (3)

References

1. Physical Activity Guidelines Advisory Committee. *Physical Activity Guidelines Advisory Committee Report*, 2008. Washington (DC); US Department of Health and Human Services; 2008.
2. World Health Organization. *Pacific physical activity guidelines for adults: framework for accelerating the communication of physical activity guidelines*. World Health Organization, Western Pacific Region;2008.
3. Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010.
4. Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ, O'Brien WL, Bassett DR Jr, Schmitz KH, Emplaincourt PO, Jacobs DR Jr, Leon AS. Compendium of physical activities: an update of activity codes and MET intensities. *Med. Sci. Sports Exerc* 2000;32(suppl.):S498–504.
5. U.S. Department of Health and Human Services (1996). *Physical Activity and Health: A Report of the Surgeon General*. Atlanta GA. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.
6. Williams MA, Haskell WL, Ades PA, Amsterdam EA, Bittner V, Franklin BA, Gulanick M, Laing ST, Stewart KJ; American Heart Association Council on Clinical Cardiology; American Heart Association Council on Nutrition, Physical Activity, and Metabolism. Resistance exercise in individuals with and without cardiovascular disease: 2007 update: a scientific statement from the American Heart Association Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism. *Circulation* 2007;Jul 31;116(5):572-84.
7. McHugh MP, Cosgrave CH. To stretch or not to stretch: the role of stretching in injury prevention and performance. *Scand J Med Sci Sports* 2010 Apr;20(2):169-81.
8. American College of Sports Medicine. *ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*. 6th edition. American College of Sports Medicine. 2010.

9. National Academy of Sports Medicine. *NASM Essentials of Personal Fitness Training* 3rd edition. National Academy of Sports Medicine. 2007.
10. Kahn, E. B., L. T. Ramsey, R. C. Brownson RC, et al. The effectiveness of interventions to increase physical activity: a systematic review. Am J Prev Med 2002; 22(4 Suppl):73–107.
11. Sallis, J. F., K. Kraft, and L. S. Linton. How the environment shapes physical activity: a transdisciplinary research agenda. *Am J Prev Med* 2002;. 22:208–15.
12. Hillsdon M, Foster C, Thorogood M. Interventions for promoting physical activity. *Cochrane Database Syst Rev* 2005 Jan 25;(1):CD003180.
13. Marcus BH, Forsyth LH. *Motivating People to be Physically Active*. Champaign (IL): Human Kinetics; 2003.
14. Marcus BH, Williams DM, Dubbert PM, Sallis JF, King AC, Yancey AK, Franklin BA, Buchner D, Daniels SR, Claytor RP; American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity); American Heart Association Council on Cardiovascular Disease in the Young; Interdisciplinary Working Group on Quality of Care and Outcomes Research. Physical activity intervention studies: what we know and what we need to know: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity); Council on Cardiovascular Disease in the Young; and the Interdisciplinary Working Group on Quality of Care and Outcomes Research. *Circulation* 2006;Dec 12;114(24):2739-52.
15. Rollnick S, Mason P, Butler C. *Health Behavior Change: A Guide for Practitioners*. New York: Churchill Livingstone; 1999.
16. Meriwether RA, Lee JA, Lafleur AS, Wiseman P. Physical activity counseling. *Am Fam Physician* 2008; Apr 15;77(8):1129-36.

5

Recommendations for Prescribing Exercise to Healthy Adults and Elderly

5 Recommendations for Prescribing Exercise to Healthy Adults and Elderly

Healthy Adults

◢ Recommendations for Exercise Prescription

To promote and maintain health, the following FITT framework is recommended for all healthy adults aged 18 to 64 years (1-3). A combination of aerobic physical activities, resistance exercises and stretching exercises is recommended for substantial health improvement.

	Recommendations for Aerobic Activities*	Recommendations for Resistance Exercises*
Frequency	• Perform moderate-intensity aerobic physical activity on at least 5 days per week or vigorous-intensity activity on at least 3 days per week, or a weekly combination of 3 to 5 days per week of moderate- and vigorous- intensity exercise.	• Perform resistance exercise of each muscle group on 2 to 3 days per week with at least 48 hours separating the exercise training sessions for the same muscle group.
Intensity	• A combination of moderate- and vigorous-intensity aerobic exercise is recommended.	• A load of 60 to 80% of 1 repetition maximum (1-RM) is recommended for resistance exercises.

Time	• Perform moderate-intensity aerobic exercise for at least 30 mins per day to a total of at least 150 mins per week, or vigorous-intensity exercise for at least 20 mins per day to a total of at least 75 mins per week. Performance of intermittent exercise of at least 10 mins in duration to accumulate the minimum duration recommendations above is an effective alternative to continuous exercise. • For additional and more extensive health benefits, adults should increase their aerobic physical activity to 300 mins (5 hours) a week of moderate-intensity, or 150 mins a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity activity. Additional health benefits are gained by engaging in physical activity beyond this amount.	• 8 to 10 resistance exercises are recommended. Each muscle group should be trained for a total of 2 to 4 sets with 8 to 12 repetitions per set and a rest interval of 2 to 3 mins in between.
Type	• Aerobic exercise should be rhythmic in nature that involves large muscle groups and best requires little skill to perform. Exercise and sports requiring skill to perform or higher level of fitness are recommended only for individuals possessing respective skill and fitness. Please see Box 5.1 for certain types of aerobic exercise that could be recommended to healthy adults.	• Concerning resistance exercises, multi-joint exercises involving more than one muscle group and targeting agonist and antagonist muscle groups are recommended, while single-joint exercises targeting major muscle groups may also be included[#]. Please see Box. 5.2 for certain types of resistance exercise that could be recommended to healthy adults.

* As many patients may present with comorbidities, it may be necessary to tailor the exercise prescription accordingly.

\# All individuals should receive professional instruction in proper resistance exercise techniques. In addition to proper body positioning and breathing (i.e. exhalation during exertion/muscle contraction; inhalation during relaxation), instruction should emphasise that all exercises use a full range of motion conducted in a deliberate, controlled manner with each repetition including concentric and eccentric muscle actions.

Recommendations for Stretching Exercise

- A stretching exercise of at least 10 mins involving the major muscle tendon groups of body (i.e., neck, shoulder, upper and lower back, pelvis, hips and legs) with 4 or more repetition (with 10 to 30 seconds for a static stretch) per muscle group performed on a minimum of 2 days per week is recommended. Preferably, stretching activities are performed on all days that aerobic or muscle-strengthening activity is performed.

Box **5.1** Examples of Aerobic Exercises that could be Recommended to Healthy Adults

Exercise Requiring Little Skill to Perform

- Walking
- Hiking uphill
- Window washing
- Stairs climbing
- Jogging*
- Running*
- Rowing*
- Brisk walking
- Dancing
- Sweeping, vacuuming, mopping
- Rope-jumping
- Stepping exercise*
- Aerobic dance*
- Elliptical exercise*

Exercise Requiring Skill to Perform

- Swimming
- Cycling
- Table tennis
- Roller skating
- Golf
- Gateball
- Netball
- Football*
- Rugby*
- Handball*
- Basketball
- Tennis
- Badminton
- Volleyball
- Martial arts
- Baseball
- Tai chi
- Roller hockey*
- Squash*

* These exercise are typically performed at a vigorous intensity and, therefore, are recommended for persons who exercise regularly or who are at least of average physical fitness.

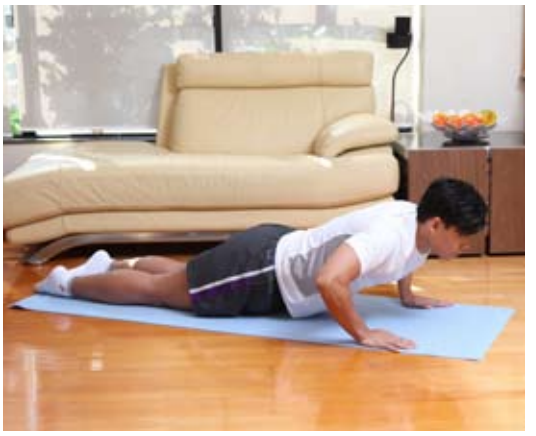
Box **5.2** Examples of Resistance Exercises that could be Recommended to Healthy Adults*

Find the exercises that best suit your patient and advise him/her to work each muscle group in turn.

Chest

◢ Multi-joint Exercises Mainly for Training Chest Muscles


Push Up – also trains shoulders and triceps

Bent-knee Push Up – also trains shoulders and triceps
(For lower intensity training, may also change to wall push up)


Lying Bench Dumbbell Chest Press – also trains shoulders and triceps

* You may refer to the patient leaflet "鍛鍊肌肉保健康" for the Chinese names of some of these exercises

Chest

Seated Machine Chest Press – also trains shoulders and triceps

◢ Single-joint Exercises Mainly for Training Chest Muscles

Lying Bench Dumbbell Chest Fly

Shoulders

◢ Multi-joint Exercises Mainly for Training Shoulder Muscles

Seated Elastic Band Shoulder Press – also trains triceps

Seated Machine Shoulder Press – also trains triceps

Shoulders

◢ Single-joint Exercises Mainly for Training Shoulder Muscles

Elastic Band Shoulder Front Raise

Elastic Band Shoulder Lateral Raise

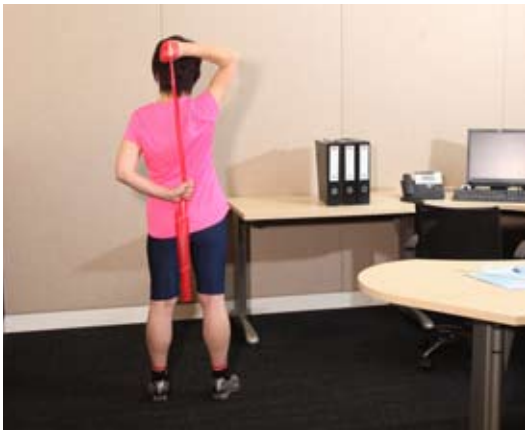
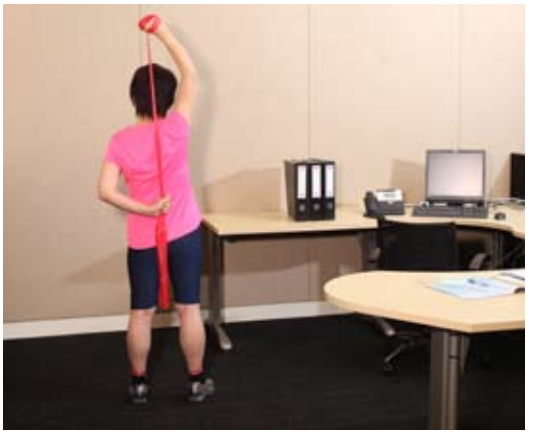
Arms

◢ Multi-joint Exercises Mainly for Training Arm Muscles

Bench Triceps Dip – also trains chest and shoulders

Arms

◢ Single-joint Exercises Mainly for Training Arm Muscles

Elastic Band Triceps Overhead Extension – mainly triceps


Bent-over Dumbbell Triceps Kickback – mainly triceps


Lying Bench Dumbbell Triceps Extension – mainly triceps

Arms

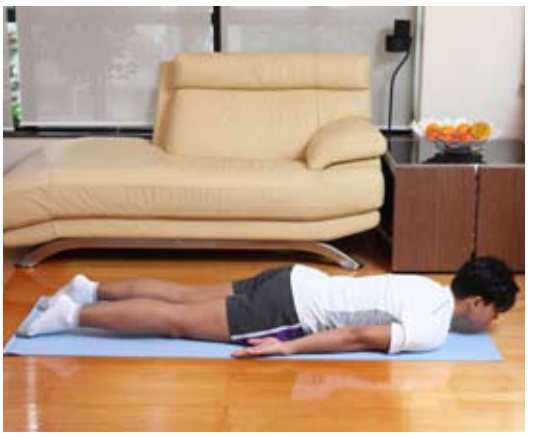
Cable Triceps Push-down – mainly triceps

Elastic Band Biceps Curl – mainly biceps

Elastic Band Hammer Curl – mainly biceps and forearms

Back


Contralateral Limb Raise – also trains gluteus, hamstrings and shoulders




Lying Cobra – mainly middle back
(Perform this exercise in a slow and controlled manner and hold momentarily at the end position for 1-2 sec)


Elastic Band Reverse Fly – mainly middle back, also trains deltoids

Back

Dumbbell Upright Row – mainly trapezius, also trains biceps and shoulders

Bent-over Dumbbell Row – mainly latissimus dorsi, also trains biceps and shoulders

Back


Lying Bench Dumbbell Pullover – mainly latissimus dorsi, also trains chest


Roman Chair Back Extension – mainly middle back and lower back


Seated Cable Row (narrow grip) – mainly latissimus dorsi, also trains biceps and shoulders

Back

Seated Cable Pull-down – mainly latissimus dorsi, also trains middle back, shoulders and biceps

Abdomen

Crunch – mainly abdominals

Leg Pull-in – also trains hip flexors

Abdomen


Bird-dog – also trains back, gluteus and shoulders


Front Plank – also trains back
(Perform in an isometric manner: hold torso up and stabilise for 15 sec to 1 min and repeat for 2-3 times depending on personal fitness)


Dumbbell Trunk Side Bend – mainly abdominals

Abdomen


Seated Machine Crunch – mainly abdominals

Hips and Thighs

◢ Multi-joint Exercises for Training Hip/thigh Muscles


Wall Squat – mainly quadriceps, also trains gluteus and hamstrings


Butt Lift (Bridge) – mainly gluteus, also trains abdominals and hamstrings

Hips and Thighs

Freehand Jump Squat – mainly quadriceps, also trains calves, gluteus and hamstrings

Lunge – mainly quadriceps, also gluteus and hamstrings

Hips and Thighs

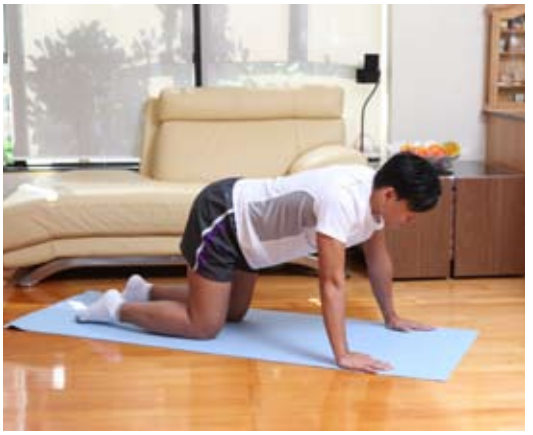

Elastic Band Squat – mainly quadriceps, also trains gluteus and hamstrings


Seated Elastic Band Single Leg Press – mainly quadriceps, also trains gluteus and hamstrings


Seated Machine Leg Press – mainly quadriceps, also trains gluteus and hamstrings

Hips and Thighs

◢ Single-joint Exercises for Training Hip or Thigh Muscles




Quadruped Bent-knee Hip Extension – mainly gluteus and hamstrings

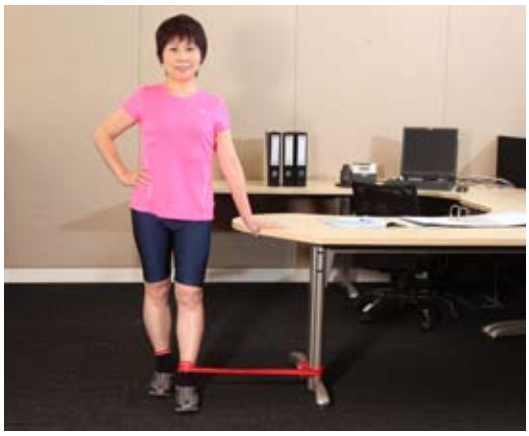

Side Lying Hip Abduction – mainly gluteus


Elastic Band Hip Flexion – mainly hip flexors, also trains quadriceps

Hips and Thighs


Elastic Band Hip Extension – mainly gluteus and hamstrings


Elastic Band Hip Abduction – mainly gluteus




Elastic Band Hip Adduction – mainly inner thighs, also trains quadriceps

Hips and Thighs


Elastic Band Leg Curl – mainly hamstrings


Seated Machine Hip Abduction – mainly gluteus


Seated Machine Hip Adduction – mainly inner thighs, also trains quadriceps

Hips and Thighs

Seated Machine Leg Extension – mainly quadriceps

Seated Machine Leg Curl – mainly hamstrings

Calves

◢ Single-joint Exercise Mainly for Training Calf Muscles

Elastic Band Calf Raise – mainly calves

◢ Special Considerations

- Increase physical activity gradually over time whenever more activity is necessary to meet guidelines or health goals. Inactive people should "start low and go slow" by gradually increasing the frequency and duration of exercising.

- Terminate exercise immediately and seek prompt medical care if warning signs or symptoms develop during or after exercise. These may include dizziness, palpitation, unusual shortness of breath, angina or chest discomfort.

Healthy Older Adults

◢ Recommendations for Exercise Prescription

The term "Older Adult" is defined here as people ≥65 years and people 50 to 64 years with clinically significant conditions or physical limitations that affect movement, physical fitness, or physical activity.

Despite the fact that most older adults recognise the benefits of doing regular exercise, they are usually one of the least physically active amongst all age groups (3). However, age should not be a barrier to physical activity promotion because positive improvements are attainable at any age. Even when older adults cannot perform the recommended amount of physical activity because of chronic conditions, they should be as physically active as their abilities and conditions allow so as to avoid being sedentary. Most healthy older adults in fact do not require an exercise test prior to initiating moderate-intensity physical activity, unless additional cardiovascular risk factor(s) is/are present.

To promote and maintain health, the following FITT framework is recommended to all healthy older adults (2-5).

	Recommendations for Aerobic Activities*	Recommendations for Resistance Exercises*
Frequency	• Perform moderate-intensity aerobic physical activity on at least 5 days per week or vigorous-intensity activity on at least 3 days per week, or a combination of 3 to 5 days per week of moderate- and vigorous- intensity exercise	• Perform resistance exercise at least 2 nonconsecutive days per week.
Intensity	• Intensity of aerobic or resistance exercise is best defined relative to an individual's fitness within the context of perceived physical exertion using a 10-point scale.	
	• A combination of moderate- and vigorous-intensity aerobic exercise is recommended. On a scale of 0 to 10 for level of physical exertion, 5 to 6 is for moderate intensity whilst 7 to 8 is for vigorous intensity.	• For resistance exercise, an intensity between moderate (5 to 6) and vigorous (7 to 8) on a 10-point scale is recommended.
Time	• Perform moderate-intensity aerobic exercise for 30 to 60 mins per day to a total of 150 to 300 mins per week, or vigorous-intensity exercise for 20 to 30 mins per day to a total of 75 to 100 mins per week. Performance of intermittent exercise of at least 10 mins in duration to accumulate the minimum duration recommendations above is an effective alternative to continuous exercise.	• 8 to 10 resistance exercises are recommended and each muscle group should be trained for a total of 1 or more sets with 10 to 15 repetitions per set. Subsequent to a period of adaptation to resistance training and improved musculo-tendinous conditioning, older adults may choose to follow guidelines for younger adults.

Type	• Any modality of aerobic exercise that does not impose excessive orthopaedic stress is recommended. Walking is the most common type of activity. Aquatic exercise and stationary cycle exercise may be advantageous for those with limited tolerance for weight bearing activity.	• Recommended resistance exercises include progressive weight training programme, weight bearing calisthenics, stair climbing and other muscle strengthening activities that use major muscle groups.

Recommendations for Stretching Exercise

- Stretching exercise of at least 10 mins involving the major muscle tendon groups of body with 4 or more repetition (with 10 to 30 seconds for a static stretch) per muscle group performed on a minimum of 2 days per week is recommended.
- Preferably, stretching activities are performed on all days that aerobic or muscle-strengthening activity is performed.
- Neuromuscular exercise (to improve balance, agility and proprioceptive training) is recommended particularly for those who are frequent fallers or with mobility impairments although there are currently no specific recommendations regarding frequency, intensity or type of neuromuscular exercises for older adults.
- A reasonable recommendation would appear to be at least 2 to 3 days per week. General recommendations include using (a) progressively difficult postures that gradually reduce the base of support; (b) dynamic movements that perturb the centre of gravity; (c) stressing posture muscle groups; and (d) reducing sensory input.
- Examples include tai chi and yoga. The emphasis should be placed on progressing to higher degrees of difficulty than high volumes of training. Tai chi and similar forms of exercise have been successfully prescribed for 45 mins to 1 hour, 2 to 3 days per week.

* As many patients may present with comorbidities, it may be necessary to tailor the exercise prescription accordingly.

◢ Special Precautions

- Intensity and duration of physical activity should be low at the beginning in particular for older adults who are highly deconditioned, functionally limited, or have chronic conditions that affect their ability to perform physical tasks.
- Progression of activities should be individualised and tailored to tolerance and preference.
- For resistance training involving use of weight-lifting machines, initial training sessions should be supervised and monitored by personnel who are sensitive to special needs of older adults.
- In the early stages of exercise programme, muscle strengthening activities may need to precede aerobic exercise among very frail individuals.

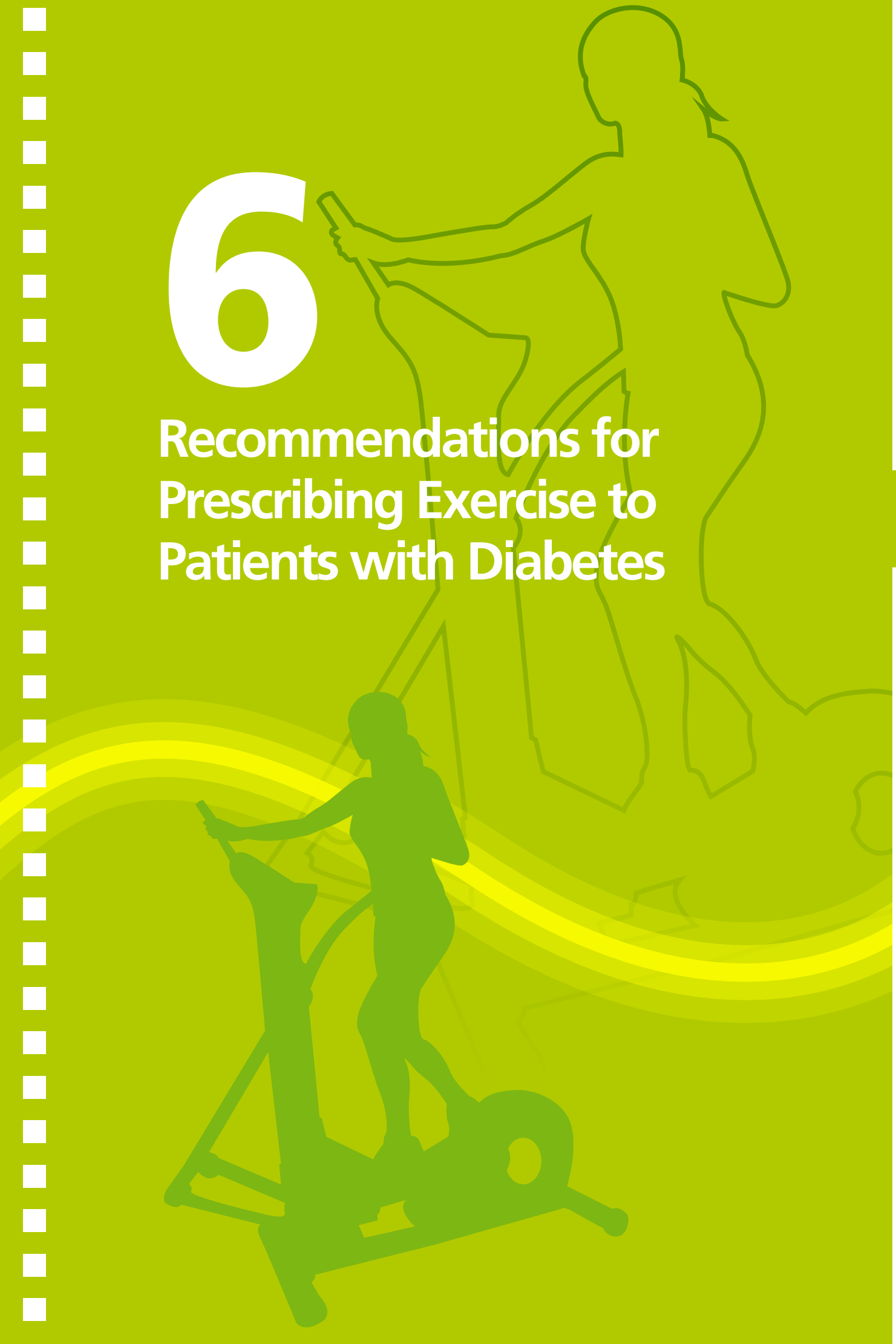
References

1. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW, Thompson PD, Bauman A; American College of Sports Medicine; American Heart Association. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 2007;Aug;116(9):1081-93.
2. Physical Activity Guidelines Advisory Committee. *Physical Activity Guidelines Advisory Committee Report*, 2008. Washington (DC); US Department of Health and Human Services; 2008.
3. World Health Organization. *Global recommendations on physical activity for health*. Geneva: World Health Organization 2010.
4. Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, Macera CA, Castaneda-Sceppa C; American College of Sports Medicine; American Heart Association. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation*. 2007 Aug 28;116(9):1094-105.
5. American College of Sports Medicine. *ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*. 6th edition. American College of Sports Medicine. 2010.

Reading Note

6

Recommendations for Prescribing Exercise to Patients with Diabetes



6 Recommendations for Prescribing Exercise to Patients with Diabetes

Effects of Exercise

Regular exercise has been shown to improve blood glucose control, reduce cardiovascular risk, contribute to weight loss, and improve well being. Furthermore, regular exercise may prevent Type 2 Diabetes Mellitus (T2DM) in high-risk individuals. Moderate-intensity (e.g. brisk walking) to vigorous-intensity exercises of ≥150 mins per week have been proven to confer significant benefits in the prevention of T2DM onset (a risk reduction of 46% in the Da Qing Study in mainland China, and by 58% in the Diabetes Prevention Program in the United States) (1-3). Recent follow-up studies suggest that this risk reduction can be sustained over a prolonged period (4). Structured exercise interventions of at least 8 weeks' duration have been shown to lower A1C by an average of 0.66% in people with T2DM, even with no significant change in body mass index (5). While higher levels of exercise intensity are associated with greater improvements in A1C and fitness, milder forms of physical activities, like yoga and tai chi, may also benefit control of blood glucose (6-9).

Progressive resistance exercise improves insulin sensitivity in older men with T2DM to the same or even greater extent as aerobic exercise (10). Clinical trials have provided strong evidence for the A1C-lowering value of resistance exercise in older adults with T2DM and for an additive benefit of combined aerobic and resistance exercise in adults with T2DM (11-13). Resistance exercise also enhances skeletal muscle mass and endurance, and hence may reduce the risk of fall in these elderly (14).

Recommendations for Exercise Prescription

The *Global Recommendations on Physical Activity for Health* published by the World Health Organisation in 2010 specify that adults over 18 years of age should perform at least 150 mins per week of moderate-intensity or 75 mins per week of vigorous-intensity aerobic physical activity or an equivalent combination of the two. The recommendations further suggest adults to perform muscle-strengthening activities involving all major muscle groups 2 or more days per week. Adults over 65 years of age are advised to follow the adult recommendations if possible or (if this is not possible) be as physically active as they are able. Studies included in the meta-analysis of effects of exercise interventions on glycaemic control had a mean number of sessions per week of 3.4, with a mean of 49 mins per session (5). The Diabetes Prevention Program lifestyle intervention, which involved 150 mins per week of moderate-intensity exercise, had a beneficial effect on glycaemic control in those with pre-diabetes (1). Therefore, it seems reasonable to recommend people with T2DM to follow the same physical activity recommendations for the general population.

The following table summarises the exercise prescription that is recommended for patients with T2DM.

	Recommendations*
Frequency	• Perform aerobic exercise spread out at least 3 days during the week, with no more than two consecutive days between bouts of activity (14). • Undertake resistance exercise at least twice weekly on nonconsecutive days, but more ideally 3 times a week, along with regular aerobic exercise (14).
Intensity	• Aerobic exercise should be at least at moderate intensity (e.g. brisk walking), corresponding approximately to 40%–60% of maximal aerobic capacity (VO_{2max}) (14). Relatively, moderate-intensity activity could be expressed as a level of effort of 5 or 6 on a scale of 0 to 10 (where 0 is the level of effort of sitting, and 10 is maximal effort) or 50–70% of maximum heart rate (15-17). • Additional benefits may be gained from vigorous-intensity aerobic exercise (i.e. >60% of VO_{2max}) (14). Relatively, vigorous-intensity activity could be expressed as a level of effort of 7 or 8 on a scale of 0 to 10 or 70–90% of maximum heart rate (15-16). • Resistance exercise should be moderate (>50% of 1-repetition maximum, i.e.1-RM – maximum amount of weight one can lift in a single repetition for a given exercise) or vigorous (75–80% of 1-RM) at intensity (14).

Time	• 20 to 60 mins per day of aerobic exercise should be performed continuously or intermittently in bouts of at least 10 mins accumulated to total 150 mins per week (14, 18). • 3 sets of 8–10 repetitions on 8–10 exercises involving the major muscle groups may be an optimal goal for resistance exercise (14).
Type	• A variety of modes of aerobic exercise is recommended but any form (including brisk walking) that uses large muscle groups and causes sustained increases in heart rate (HR) is likely to be beneficial (14). Exercises like walking, swimming or cycling that do not impose undue stress on the feet are some appropriate choices. • Each session of resistance exercise should involve the major muscle groups (legs, hips, chest, back, abdomen, shoulders, and arms). According to the literature, resistance exercise programme involving a combination of bench press, leg extension, upright row, lateral pull-down, standing leg curl (ankle weights), dumbbell seated shoulder press, dumbbell seated biceps curl, dumbbell triceps kickback, and abdominal curls has been shown to improve glycaemic control in older adults with T2DM (11).

* Given that many patients may present with comorbidities, it may be necessary to tailor the exercise prescription accordingly.

Initial instruction and periodic supervision by a qualified exercise trainer is recommended for most persons with T2DM, particularly if they undertake resistance exercise, to ensure optimal benefits to blood glucose control, blood pressure, lipids, and cardiovascular risk and to minimise injury risk (19).

Rate of Progression

Gradual progression of intensity of aerobic exercise is advisable to minimise the risk of injury, particularly if health complications are present, and to enhance compliance (14). Points to be taken into consideration in exercise prescription include age, ability, disease state, and individual preference of type of exercise. In general, the elderly and obese patients with T2DM take longer time for adaptation and may require slower progression, though it is advisable for the aged to be as physically active as possible.

Similarly, to avoid injury, progression of frequency and intensity of resistance exercise should occur slowly. Increases in weight or resistance are undertaken first and only once when the target number of repetitions per set can consistently be exceeded, followed by a greater number of sets and lastly by increased frequency (14). Early in training, each session of resistance exercise should minimally include 5–10 exercises and involve completion of 10–15 repetitions to near fatigue per set, progressing over time to heavier weights (or resistance) that can be lifted only 8–10 times. A minimum of one set of repetitions to near fatigue for each exercise, but as many as 3 to 4 sets, is recommended for optimal strength gains (14).

Evaluation of the Diabetic Patient Before Recommending an Exercise Programme

Medical practitioners should use clinical judgment in this area. Certainly, high-risk patients should be encouraged to start with short periods of low-intensity exercise and to increase the intensity and duration slowly. Medical practitioners should assess patients for conditions that might contraindicate certain types of exercise or predispose to injury, such as uncontrolled hypertension, severe autonomic neuropathy, severe peripheral neuropathy or history of foot lesions, and unstable proliferative retinopathy as well as take into consideration patients' age and previous physical activity levels (17).

Exercise stress testing is not routinely recommended to detect ischaemia in asymptomatic individuals at low coronary heart disease (CHD) risk (<10 % in 10 yrs.). It is advised primarily for sedentary adults with diabetes who are at higher risk for CHD and who would like to undertake activities more intense than brisk walking, e.g. age > 40, concomitant risk factors such as hypertension, microalbuminuria, etc., or presence of advanced cardiovascular or microvascular complications (e.g. retinopathy, nephropathy) (14).

Exercise in the Presence of Non-optimal Glycaemic Control

◢ Hyperglycaemia

When people with type 1 diabetes are deprived of insulin and are ketotic, exercise can worsen hyperglycaemia and ketosis; therefore, vigorous activity should be avoided in the presence of ketosis (20). On the other hand, T2DM subjects usually are not profoundly insulin-deficient. They do not have to postpone exercise simply because of high blood glucose (e.g. > 16.7 mmol/L), as long as they feel well, and are adequately hydrated without ketosis (14).

◢ Hypoglycaemia

In individuals with T2DM performing moderate exercise, blood glucose utilisation by muscles usually rises more than hepatic glucose production, and blood glucose levels tend to decline. Plasma insulin levels normally fall, however, making the risk of exercise-induced hypoglycaemia in anyone not taking insulin or insulin secretagogues very minimal, even with prolonged physical activities (14). In individuals taking insulin and/or insulin secretagogues (e.g. sulfonylureas like glyburide, glipizide, and glimepiride, as well as nateglinide and repaglinide), physical activity can cause hypoglycaemia if medication dose or carbohydrate consumption is not altered. For individuals on these therapies, added carbohydrate should be ingested if pre-exercise glucose levels are <5.6 mmol/l (21-22). Hypoglycaemia is rare in diabetic individuals who are not treated with insulin or insulin secretagogues, and no preventive measures for hypoglycaemia are usually advised in these cases.

Exercise in the Presence of Specific Long-term Complications of Diabetes

◢ Retinopathy

In the presence of proliferative diabetic retinopathy or severe non-proliferative diabetic retinopathy, vigorous aerobic or resistance exercise may be contraindicated because of the risk of triggering vitreous haemorrhage or retinal detachment (23).

◢ Peripheral neuropathy

Decreased pain sensation in the extremities results in increased risk of skin breakdown and infection and of Charcot joint destruction and this is why some prior recommendations have advised non-weight-bearing exercise for patients with severe peripheral neuropathy. Studies have shown that moderate-intensity walking may not lead to increased risk of foot ulcers or re-ulceration in those with peripheral neuropathy (24). Individuals with peripheral neuropathy and without acute ulceration may participate in moderate weight-bearing exercise (14). Comprehensive foot care including daily inspection of feet and use of proper footwear is recommended for prevention and early detection of sores or ulcers (14). Anyone with a foot injury or open sore should confine themselves to non-weight-bearing activities.

◢ Autonomic neuropathy

Autonomic neuropathy can increase the risk of exercise-induced injury or adverse events through decreased cardiac responsiveness to exercise, postural hypotension, impaired thermoregulation, impaired night vision due to impaired papillary reaction, and unpredictable carbohydrate delivery from gastroparesis predisposing to hypoglycaemia (25). Autonomic neuropathy is also strongly associated with cardiovascular disease in people with diabetes (26-27). People with diabetic autonomic neuropathy should be screened and receive physician approval and possibly an exercise stress test before embarking on physical activity levels more intense than usual. Exercise intensity is best prescribed using the HR reserve method with direct measurement of maximal HR (14).

◢ Albuminuria and nephropathy

Physical activity can acutely increase urinary protein excretion. However, there is no evidence that vigorous exercise increases the rate of progression of diabetic kidney disease and likely no need for any specific exercise restrictions for people with diabetic kidney disease (28). Exercise increases physical function and quality of life in individuals with kidney disease and may even be undertaken during dialysis sessions.

Special Precautions

- Encourage patients with T2DM to monitor their blood glucose level before and after exercise session, especially when beginning an exercise programme. This allows the patient to understand their glucose response to the particular physical activity.
- Encourage patients to keep log with the exercise intensity, duration and type. It helps them know their glucose response to the exercise sessions.
- Encourage patients to exercise with partners, especially when beginning an exercise programme until the patient know very well their glucose response to the exercise sessions.

References

1. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM, Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002;346:393–403.
2. Tuomilehto J, Lindstro¨m J, Eriksson JG, Valle TT, Ha¨ma¨la¨inen H, Ilanne-Parikka P, Keina¨nen-Kiukaanniemi S, Laakso M, Louheranta A, Rastas M, Salminen V, Uusitupa M, Finnish Diabetes Prevention Study Group. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* 2001;344: 1343–50.
3. Pan X-R, Li G-W, Hu Y-H, et-al. Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance: the Da Qing IGT and diabetes study. *Diabetes Care*. 20:537,1997.
4. Li G, Zhang P, Wang J, Gregg EW, Yang W, Gong Q, Li H, Li H, Jiang Y, An Y, Shuai Y, Zhang B, Zhang J, Thompson TJ, Gerzoff RB, Roglic G, Hu Y, Bennett PH. The long-term effect of lifestyle interventions to prevent diabetes in the China Da Qing Diabetes Prevention Study: a 20-year follow-up study. *Lancet*. 2008 May 24;371(9626):1783-9.
5. Boule´ NG, Haddad E, Kenny GP, Wells GA, Sigal RJ. Effects of exercise on glycaemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. *JAMA* 2001;286: 1218–27.
6. Boule´ NG, Kenny GP, Haddad E, Wells GA, Sigal RJ. Meta-analysis of the effect of structured exercise training on cardiorespiratory fitness in Type 2 diabetes mellitus. *Diabetologia* 2003;46:1071–81.
7. Innes KE, Vincent HK. The influence of yoga-based programs on risk profiles in adults with type 2 diabetes mellitus: a systematic review. *Evid Based Complement Alternat Med*. 2007; 4(4):469–86.
8. Wang JH. Effects of tai chi exercise on patients with type 2 diabetes. Med Sport Sci 2008;52:230–8.
9. Yeh SH, Chuang H, Lin LW, Hsiao CY, Wang PW, Yang KD. Tai chi chuan exercise decreases A1c levels along with increase of regulatory T-cells and decrease of cytotoxic T-cell population in type 2 diabetic patients. *Diabetes Care*. 2007;30(3):716–8.
10. Cauza E, Hanusch-Enserer U, Strasser B, Ludvik B, Metz-Schimmerl S, Pacini G, Wagner O, Georg P, Prager R, Kostner K, Dunky A, Haber P. The relative benefits of endurance and strength training on the metabolic factors and muscle function of people with type 2 diabetes mellitus. *Arch Phys Med Rehabil* 2005;86: 1527–33.
11. Dunstan DW, Daly RM, Owen N, Jolley D, De Courten M, Shaw J, Zimmet P. High-intensity resistance training improves glycaemic control in older patients with type 2 diabetes. *Diabetes Care* 2002;25:1729–36.
12. Castaneda C, Layne JE, Munoz-Orians L, Gordon PL, Walsmith J, Foldvari M, Roubenoff R, Tucker KL, Nelson ME. A randomized controlled trial of resistance exercise training to improve glycaemic control in older adults with type 2 diabetes. *Diabetes Care* 2002;25:2335–41.
13. Sigal RJ, Kenny GP, Boule´ NG, Wells GA, Prud'homme D, Fortier M, Reid RD, Tulloch H, Coyle D, Phillips P, Jennings A, Jaffey J. Effects of aerobic training, resistance training, or both on glycaemic control in type 2

diabetes: a randomized trial. *Ann Intern Med* 2007;147: 357–69.
14. Sheri R. Colberg, Ronald J. Sigal, Bo Fernhall, Judith G. Regensteiner, Bryan J. Blissmer, Richard R. Rubin, Lisa Chasan-Taber, Ann L. Albright, Barry Braun. Exercise and Type 2 Diabetes: The American College of Sports Medicine and the American Diabetes Association: joint position statement. Diabetes Care November 29, 2010; 33(12): e147-67.
15. Physical Activity Guidelines Advisory Committee. *Physical Activity Guidelines Advisory Committee Report*, 2008. Washington (DC); US Department of Health and Human Services; 2008.
16. U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion; 1996.
17. American Diabetes Association. Standards of Medical Care in Diabetes—2011. *Diabetes Care* January 2011;34:S1161.
18. Exercise Prescription for Other Clinical Populations. In Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010.
19. Balducci S; Zanuso S; Nicolucci A; De Feo P; Cavallo S; Cardelli P; Fallucca S; Alessi E; Fallucca F; Pugliese G. Effect of an intensive exercise intervention strategy on modifiable cardiovascular risk factors in subjects with type 2 diabetic subjects. A randomized controlled trial: The Italian Diabetes and Exercise Study (IDES). Arch Intern Med 2010; Nov 8; 170 (20), 1794-803..
20. Berger M, Berchtold P, Cu¨ ppers HJ, Drost H, Kley HK, Mu¨ ller WA, Wiegelmann W, Zimmerman-Telschow H, Gries FA, Kru¨ skemper HL, Zimmermann H. Metabolic and hormonal effects of muscular exercise in juvenile type diabetics. *Diabetologia* 1977;13: 355–65.
21. American Diabetes Association: Physical activity/exercise and diabetes (Position Statement). *Diabetes Care* 2004; 27(Suppl. 1):S58–62.
22. Berger M: Adjustment of insulin and oral agent therapy. In *Handbook of Exercise in Diabetes*. 2nd ed. Ruderman N, Devlin JTSSH, Krisska A, Eds. Alexandria, VA, American Diabetes Association, 2002, p.365–76.
23. Aiello LP, Wong J, Cavallerano J, Bursell SE, Aiello LM: Retinopathy. In *Handbook of Exercise in Diabetes*. 2nd ed. Ruderman N, Devlin JT, Kriska A, Eds. Alexandria, VA, American Diabetes Association, 2002, p. 401–13.
24. Lemaster JW, Reiber GE, Smith DG, Heagerty PJ, Wallace C. Daily weight-bearing activity does not increase the risk of diabetic foot ulcers. *Med Sci Sports Exerc* 2003;35:1093–9.
25. Vinik A, Erbas T: Neuropathy. In *Handbook of Exercise in Diabetes*. 2nd ed. Ruderman N, Devlin JT, Kriska A, Eds. Alexandria, VA, American Diabetes Association, 2002, p. 463–96.
26. Wackers FJ, Young LH, Inzucchi SE, Chyun DA, Davey JA, Barrett EJ, Taillefer R, Wittlin SD, Heller GV, Filipchuk N, Engel S, Ratner RE, Iskandrian AE, Detection of Ischaemia in Asymptomatic Diabetics Investigators. Detection of silent myocardial ischaemia in asymptomatic diabetic subjects: the DIAD study. Diabetes Care 2004;27: 1954–61.
27. Valensi P, Sachs RN, Harfouche B, Lormeau B, Paries J, Cosson E, Paycha F, Leutenegger M, Attali JR. P Predictive value of cardiac autonomic neuropathy in diabetic patients with or without silent myocardial ischaemia. *Diabetes Care* 2001;24:339–43.
28. Mogensen CE: Nephropathy. In *Handbook of Exercise in Diabetes*. 2nd ed. Ruderman N, Devlin JT, Kriska A, Eds. Alexandria, VA, American Diabetes Association, 2002, p. 433–49.

Reading Note

7

Recommendations for Prescribing Exercise to Patients with Hypertension

7 Recommendations for Prescribing Exercise to Patients with Hypertension

Effects of Exercise

Epidemiological studies suggest that regular physical activity may be beneficial for both prevention and treatment of hypertension, to enable weight loss, for functional health status, and to diminish all-cause mortality and risk of cardiovascular disease. Cross-sectional studies of select populations from China and other Eastern populations have confirmed the presence of a strong association between physical inactivity and an adverse heart disease risk factor profile (1). In Japanese men, duration of walk-to-work and leisure-time physical activity was significantly associated with a reduction in the risk for incident hypertension (2). A meta-analysis of randomised controlled trials concluded that dynamic aerobic endurance training reduces resting systolic and diastolic blood pressures by 3.0/2.4 mmHg, and daytime ambulatory blood pressure by 3.3/3.5 mmHg. The reduction in resting blood pressure was more pronounced in the hypertensive group (-6.9/-4.9 mmHg) than in the normotensive group (-1.9/-1.6 mmHg) (3). Even moderate levels of exercise lowered blood pressure, and this type of exercise also reduced body weight, body fat and waist circumference (4). Dynamic resistance exercise can also decrease resting blood pressure by 3.5/3.2 mmHg (5).

Recommendations for Exercise Prescription

The following table summarises the exercise prescription that is recommended for patients with hypertension in general.

Regular physical activity of even lower intensity and duration, however, has been shown to be associated with about a 20% decrease in mortality in cohort studies (11). Individuals engaging in resistance exercise should seek guidance by a trained professional, for appropriate machine adjustment, selection of specific exercises, appropriate initial exercise prescription, and subsequent exercise progression (10). Resistive isotonic activities, when done as the only form of exercise training, are not recommended for lowering blood pressure in hypertensive patients (12). An exercise prescription for achieving and maintaining flexibility, such as proper stretching for all the major joints, may be advised after a thorough warm-up and during the cool-down period (6).

	Recommendations*
Frequency	• Perform aerobic exercise preferably all days of the week (6). • Supplemented by resistance exercise twice to thrice weekly on nonconsecutive days (6).
Intensity	• Aerobic exercise should be at least at moderate intensity (e.g. brisk walking), corresponding approximately to 40 to 60% of maximal aerobic capacity (VO_{2max}) (6). Relatively, moderate-intensity activity could be expressed as a level of effort of 5 or 6 on a scale of 0 to 10 (where 0 is the level of effort of sitting, and 10 is maximal effort) or 50 to 70% of maximum heart rate (7-8). • Resistance exercise should be at moderate intensity (6), which could be expressed as 50 to 70% of 1-repetition maximum (1-RM – maximum amount of weight one can lift in a single repetition for a given exercise) (8).
Time	• Perform 30 to 60 mins per day of aerobic exercise continuously or intermittently in bouts of at least 10 mins accumulated to total of at least 30 mins per day (6). • Each session of resistance exercise should minimally include 8–10 exercises and should consist of at least 1 set of 8–12 repetitions per exercise (6).

Type	• Emphasis on aerobic exercises such as walking, jogging, cycling and swimming (6). Rope skipping is also a very good option that can be performed every day, requires little equipment and learning, and involves a lot of muscle group. However, any activity that uses large muscle groups, can be maintained continuously, and is rhythmical and aerobic in nature is recommended as the primary modality for those with hypertension (9). • Resistance exercise should involve the major muscle groups (legs, hips, chest, back, abdomen, shoulders, and arms) (6). Either machine weights or free weights might be used while the former is likely the safest approach (10). Resistance exercise performed should be alternating between upper- body and lower-body works to allow for adequate rest between exercises. Some examples of resistance exercise include chest press, shoulder press, triceps extension, biceps curl, pull-down (upper back), lower-back extension, abdominal crunch/curl-up, quadriceps extension or leg press, leg curls (hamstrings), and calf raise (10).

* Given that many patients may present with comorbidities, it may be necessary to tailor the exercise prescription accordingly.

Rate of Progression

In November 2010, the American College of Sports Medicine and the American Diabetes Association published a joint position statement on exercise recommendations for patients with Type 2 diabetes mellitus which covers rate of progression (13). Their general principles, as outlined below, can also be applied to patients with hypertension:

- To avoid injury, progression of frequency and intensity of resistance exercise should occur slowly.
- Gradual progression of intensity of aerobic exercise is also advisable to enhance compliance.

Evaluation of Patient with Hypertension Before Recommending an Exercise Programme

The need for and scope of pre-exercise evaluation of the cardiovascular status will depend on the extent of the envisaged exercise and on the patient's symptoms and signs, total cardiovascular risk and associated clinical conditions (14). The risk of cardiovascular disease in patients with hypertension is determined not only by the level of blood pressure, but also by the presence or absence of target organ damage and other risk factors such as smoking, dyslipidaemia and diabetes, as shown in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (15). These factors independently modify the risk for subsequent cardiovascular disease, and their presence or absence is determined during the routine evaluation of patients with

hypertension (i.e., history, physical examination, and/or laboratory tests). High-intensity resistance training should not be initiated for persons without prior exposure to more moderate resistance exercise independently of age, health status, or fitness level (10). Therefore, patients with hypertension should consult a primary care practitioner prior to any substantive increase in physical activity, particularly vigorous-intensity activity (16).

Special Precautions

- Intensive isometric exercise such as heavy weight lifting can have a marked pressor effect and should be avoided (14).
- If hypertension is poorly controlled, heavy physical exercise as well as maximal exercise testing should be discouraged or postponed until appropriate drug treatment has been instituted and blood pressure lowered (16). When exercising, it appears prudent to maintain systolic blood pressures at ≤220 mmHg and/or diastolic blood pressures ≤105 mmHg (6).
- β-blockers and diuretics may adversely affect thermoregulatory function and cause hypoglycaemia in some individuals. In these situations, educate patients about the sign and symptoms of heat intolerance and hypoglycaemia, and the precautions that should be taken to avoid these situations (6).
- Antihypertensive medications such as calcium channel blockers, β-blockers and vasodilators may lead to sudden reductions in post-exercise blood pressure. Extend and monitor the cool-down period carefully in these situations (6).
- β-blockers, particularly the non-selective types, may reduce sub-maximal and maximal exercise capacity primarily in patients without myocardial ischaemia. Consider using perceived exertion to monitor exercise intensity in these individuals (6).
- Patients should be informed about the nature of cardiac prodromal symptoms e.g. shortness of breath, dizziness, chest discomfort or palpitation and seek prompt medical care if such symptoms develop.

References

1. Hong Y, Bots ML, Pan X, et al. Physical activity and cardiovascular risk factors in rural Shanghai, China. *Int J Epidemiol*. 1994;23:1154–8.
2. Hayashi, T., K. Tsumura, C. Suematsu, K. Okada, S. Fujii, and G. Endo. Walking to work and the risk for hypertension in men: the Osaka Health Survey. *Ann. Intern. Med* 1999, 130: 21-26.
3. Cornelissen VA, Fagard RH. Effects of endurance training on blood pressure, blood pressure-regulating mechanisms, and cardiovascular risk factors. *Hypertension* 2005;46:667–75.
4. Fagard RH. Exercise characteristics and the blood pressure response to dynamic physical training. *Med Sci Sports Exerc* 2001;33:S484–92.
5. Cornelissen VA, Fagard RH. Effect of resistance training on resting blood pressure: a meta-analysis of randomized controlled trials. *J Hypertens* 2005;23:251–9.
6. Exercise Prescription for Other Clinical Populations. In Walter R Thompson; Neil F Gordon; Linda S Pescatello. *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine; 2010.
7. Physical Activity Guidelines Advisory Committee. *Physical Activity Guidelines Advisory Committee Report*, 2008. Washington (DC); US Department of Health and Human Services; 2008.
8. U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.
9. Pescatello L, Franklin B, Fagard R, Farquhar W, Kelley G, Ray C. Exercise and Hypertension. *Medicine & Science in Sports & Exercise*. 2004, March 36(3):533-53.
10. Mark A. Williams, William L. Haskell, Philip A. Ades, et al. Resistance Exercise in Individuals With and Without Cardiovascular Disease: 2007 Update. A Scientific Statement from the American Heart Association Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism. *Circulation* 2007;116:572-84.
11. Leitzmann MF, Park Y, Blair A, Ballard-Barbash R, Mouw T, Hollenbeck AR, Schatzkin A. Physical activity recommendations and decreased risk of mortality. *Arch Intern Med* 2007; Dec 10;167(22):2453-60
12. Institute for Clinical Systems Improvement (ICSI). *Hypertension diagnosis and treatment*. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); Nov 2010.
13. Sheri R. Colberg, Ronald J. Sigal, Bo Fernhall, et al. Exercise and Type 2 Diabetes: The American College of Sports Medicine and the American Diabetes Association: joint position statement. *Diabetes Care* November 29, 2010; 33(12), e147-67.
14. 2007 Guidelines for the management of arterial hypertension. The Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *European Heart Journal*.2007, 28, 1462–36.
15. Chobanian AV, Bakris GL, Black HR, et al. National Heart, Lung, and Blood Institute Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; National High Blood Pressure Education Program Coordinating Committee. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA* 2003 May 21;289(19):2560-72.
16. Thompson PD, Buchner D, Pina IL, et al. American Heart Association Council on Clinical Cardiology Subcommittee on Exercise, Rehabilitation, and Prevention; American Heart Association Council on Nutrition, Physical Activity, and Metabolism Subcommittee on Physical Activity. Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: a statement from the Council on Clinical Cardiology (Subcommittee on Exercise Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity and Metabolism (Subcommittee on Physical Activity). *Circulation* 2003, 107:3109–16.
17. Fagard RH, Bjornstad HH, Borjesson M, Carre F, Deligiannis A, Vanhees L. European Society of Cardiology. ESC Study Group of Sports Cardiology recommendations for participation in leisure-time physical activities and competitive sports for patients with hypertension. *Eur J Cardiovasc Prev Rehabil* 2005;12:326–31.

Reading Note

8

Recommendations for Prescribing Exercise to Patients with Heart Disease

8 Recommendations for Prescribing Exercise to Patients with Heart Disease

Introduction

Participation in regular exercise by patients with known heart disease poses a number of clinical and ethical questions, including the most appropriate physical activities and sport in which patients may safely be engaged. In fact, identification of a heart disease, or incidence of a cardiac event, is usually associated with prudent advice for patients to reduce (or leave) intensive exercise training and competitive sport, justified by clinical concern for the increased cardiac risk associated with exercise and sport. Therefore, primary care practitioners are often faced with the dilemma of whether to prescribe exercise to their patients or not, knowing that for some medical conditions, exercise is not advisable.

This chapter aims to provide useful references for primary care practitioners who wish to prescribe exercise to adult patients who suffer from certain types of heart disease, including ischaemic heart disease (IHD), chronic heart failure (CHF), arrhythmia and valvular heart disease (VHD). Rarer conditions such as congenital heart disease and cardiomyopathies are not within the scope of this chapter.

It should be emphasised at this point that in any case, patients with heart disease should be referred to a cardiologist or similar specialist for consultation and/or assessment before the exercise programme starts, especially where doubt exists. Exercise prescription for heart disease patients should be individualised according to risk.

Risk of Exercise in Patients with Heart Disease

Physical activity and exercise training may pose risks to individuals with certain heart conditions. While the commonest risk of physical activity among adults is musculoskeletal injury, IHD accounts for most exercise-related sudden deaths among those aged 35 years or above (1). The incidence of major cardiovascular complications during outpatient cardiac exercise programmes, among a mixed group of patients after percutaneous coronary intervention (PCI) or cardiac surgery, or those with other coronary and non-coronary conditions, has been estimated to be one in 50,000 participant-hours (2). In fact, sudden cardiac death (SCD) is often the initial coronary event in patients with either silent or symptomatic IHD (3). Pathology findings suggested that a considerable number of fatal myocardial infarctions (MIs) were not due to significant stenosis of the coronary arteries but rupture of unstable coronary atherosclerotic plaque possibly during exercise (3). Another cause of SCD in patients with heart disease is exercise-induced ventricular arrhythmias which are commonly detected during exercise testing (4).

Benefits of Exercise

Increasing physical activity is universally recognised as a desirable lifestyle modification for improving cardiovascular health, as exercise has been shown to be an important adjunct to reduce atherosclerotic risk factors such as hypertension, hyperlipidaemia, hyperglycaemia, obesity and tobacco use (5-9). In addition, regular physical activity has potential benefits on the autonomic nervous system, ischaemia threshold, endothelial function and blood coagulation. One randomised controlled trial also demonstrated slower disease progression and significantly fewer ischaemic events in patients with stable IHD who regularly exercised (10).

Cardiac rehabilitation (CR) is an important element of a comprehensive plan for secondary prevention of acute cardiac events in patients with IHD. CR was initially defined by the U.S. Public Health Service as a comprehensive long-term programme involving medical evaluation, prescribed exercise, cardiac risk factor modification, education, and counselling (11). Several meta-analyses have concluded that cardiac rehabilitation reduced mortality rates in patients after MI (12-14). Of these, one (a meta-analysis of 51 randomised controlled trials of CR in patients who have had MI, coronary artery bypass graft (CABG) or percutaneous transluminal coronary angioplasty, or who have angina pectoris or coronary artery disease defined by angiography) also concluded that exercise-only CR, when compared to a comprehensive CR, could also reduce total cardiac mortality and all-cause mortality by 31% and 27% respectively (14). These results suggest that exercise is a crucial component of the rehabilitation process (15).

Benefits of physical activity for CHF patients have also been well documented. These include improved physical capacity (an increase of 10 to 30% of the maximum physical capacity) (16-17), quality of life (18), endothelial function (19), serum catecholamine levels

(20), morbidity and hospital re-admission rates (21). Other potential benefits of exercise, with limited scientific evidence to support at this point, include the reduction of all-cause mortality (22) and improving resting cardiac function (23).

Pre-participation Evaluation

In any case, all patients with heart disease should have their clinical status carefully reviewed by relevant specialists before heading for an exercise programme. In addition to history taking and physical examination to identify cardiac and non-cardiac problems that might limit exercise participation and other factors possibly contributing to exercise intolerance, a blood test for basic biochemistries and electrolytes may be indicated (24). A physical exercise testing is also necessary to identify any potentially dangerous electrocardiographic abnormalities and to stratify risks in patients with heart disease (25). Any recommendation for exercise training should be based on the pathology of the patient's condition, the individual's response to exercise (including heart rate, blood pressure, symptoms, and perceived exertion) as well as measurements obtained during exercise testing (24).

The following evaluation methods may be considered in assessing cardiac patients' risk of exercise participation (26).

- Resting 12-lead electrocardiogram (ECG) for detection of ischaemia, arrhythmias and cardiac hypertrophy.*
- Physical exercise test (using treadmill or bicycle) for evaluation of symptoms, ST segment changes, arrhythmias, ischaemia and anginal thresholds, exercise capacity and blood pressure/heart-rate responses.
- Echocardiography for evaluation of left ventricular function, structural abnormalities or regional wall motion abnormalities.
- Physical or pharmacological stress test with single photon emission computed tomography, for detection of regional perfusion defects of the myocardium.
- Maximal physical or pharmacological stress with echocardiography or magnetic resonance imaging, for detection of reversible regional wall motion abnormalities, as a sign of reversible ischaemia.
- Coronary angiography for evaluation of luminal coronary stenosis or occlusion in one or more of the main branches or left main stem, coronary flow disturbances or abnormal coronary anatomy.
- Twenty-four-hour or longer (Holter) electrocardiographic monitoring for detection of electrical instability or ST–T changes.

* It should also be noted that some kinds of cardiac arrhythmias can occur in structurally normal hearts or reflect the physiological adaptation to exercise participation itself. Atrial premature beats, first-degree atrioventricular block or second degree Wenckebach-type atrioventricular block (Mobitz type I), for instance, are prevalent in the general population especially among athletes as they may be part of the physiological adaptations to exercise. In those cases with absence of structural heart disease, there is no need to proceed with further investigation or therapy and participation in all types of exercise are allowed (27).

Recommendations for Exercise Prescription

It is recommended that exercise prescribed should be tailored to each individual in accordance with their physical condition, aerobic/anaerobic fitness and local muscular condition. It is also important that exercise should be suited to each individual in terms of its intensity, duration and volume, in relation to his or her intended level of physical activity and their training goals. The activity should be linked to other lifestyle modifications to minimize the cardiac risk. Adequate pre- and post-exercise medical evaluations (follow-up) are also essential (26). Box. 8.1 lists some good practices when heart disease patients undertake physical activity.

Box **8.1** Good Practices for Cardiac Patients Undertaking Physical Activity

- Include three periods in each physical activity session: warm-up, training and cool-down (28). Proper warm-up and cool-down phases (5 mins of light activity at a reduced intensity) may have an anti-anginal and possibly cardioprotective effect (28).
- Advise low-impact aerobic activity to minimise the risk of musculoskeletal injury. Recommend gradual increases in the volume of physical activity over time (28).
- Explore daily schedules to suggest how to incorporate increased activity into usual routine (e.g., parking farther away from entrances, walking 2 flights of stairs, and walking during lunch break) (28).
- Terminate exercise immediately if warning signs or symptoms occur. These include dizziness, dysrhythmias, unusual shortness of breath, angina or chest discomfort.
- No exercise in case of unusual asthenia, fever or viral syndrome (29).
- The level of supervision and monitoring during exercise training depends on the result of risk stratification from patient assessments and clinical evaluations. Medical supervision and monitoring are particularly recommended for patients with multiple risk factors, and with moderate-to-high risk of cardiac events (i.e., recent revascularization, heart failure). The supervision should include physical examination, monitoring of heart rate, blood pressure and rhythm before, during and after exercise training (28). The supervised period should be prolonged in patients with new symptoms, signs, blood pressure abnormalities and increased supraventricular or ventricular ectopy during exercise (30).
- Provide progressive updates to the exercise prescription and modify further if clinical status changes.
- Ensure adequate hydration before, during and after physical activity. Adapt the intensity of physical activity to the environmental conditions, temperature, humidity and altitude (31).
- Avoid smoking at all times (32).
- Hot shower, which may result in an increased heart rate and arrhythmias, should be avoided during the 15 mins after physical activity (33).

Special Precautions

Patients with IHD

- Patients with unstable angina are not eligible for competitive sports or any other regular physical activity. Patients with stable angina, silent ischaemia or post-PCI/CABG and with a high probability for exercise-induced coronary events are also not eligible for competitive sports. Recreational sports are also restricted for post-MI patients with a high risk of cardiovascular events while leisure-time physical activity should always be encouraged (26).

Patients with CHF

- Specific contraindications to exercise in patients with CHF include new onset atrial fibrillation, obstructive valvular disease, especially aortic stenosis or active myocarditis (either viral or autoimmune) (24).

- CHF patients with diastolic and systolic dysfunction should refrain from swimming (24).

Individuals with pacemakers

- Patients with heart disease and a pacemaker can participate only in exercises consistent with the limitations of the underlying heart disease.

- Individuals with a pacemaker should also be restricted from exercises with a risk of bodily impact (e.g. rugby, martial arts), because of the possible damage to the electrodes/pacing unit and risk of skin perforation (which may occur late after trauma). Extreme ipsilateral arm movements should be avoided at least until complete fixation of the leads, namely 6 weeks. Sports with pronounced arm movements (such as volleyball, basketball, tennis and climbing) may also increase the risk of late lead damage as a result of subclavian crush (with insulation or conductor failure) (27).

Patients with valvular heart disease

- Physical check-ups among individuals with valvular heart disease are of significant relevance and exercise testing should be obtained after evaluation of the heart valves by echocardiography.

- Exercise is contraindicated in patients with unexplained syncope, family history of SCD, complex supraventricular or ventricular arrhythmias, long QT interval or severe mitral regurgitation (34).

References

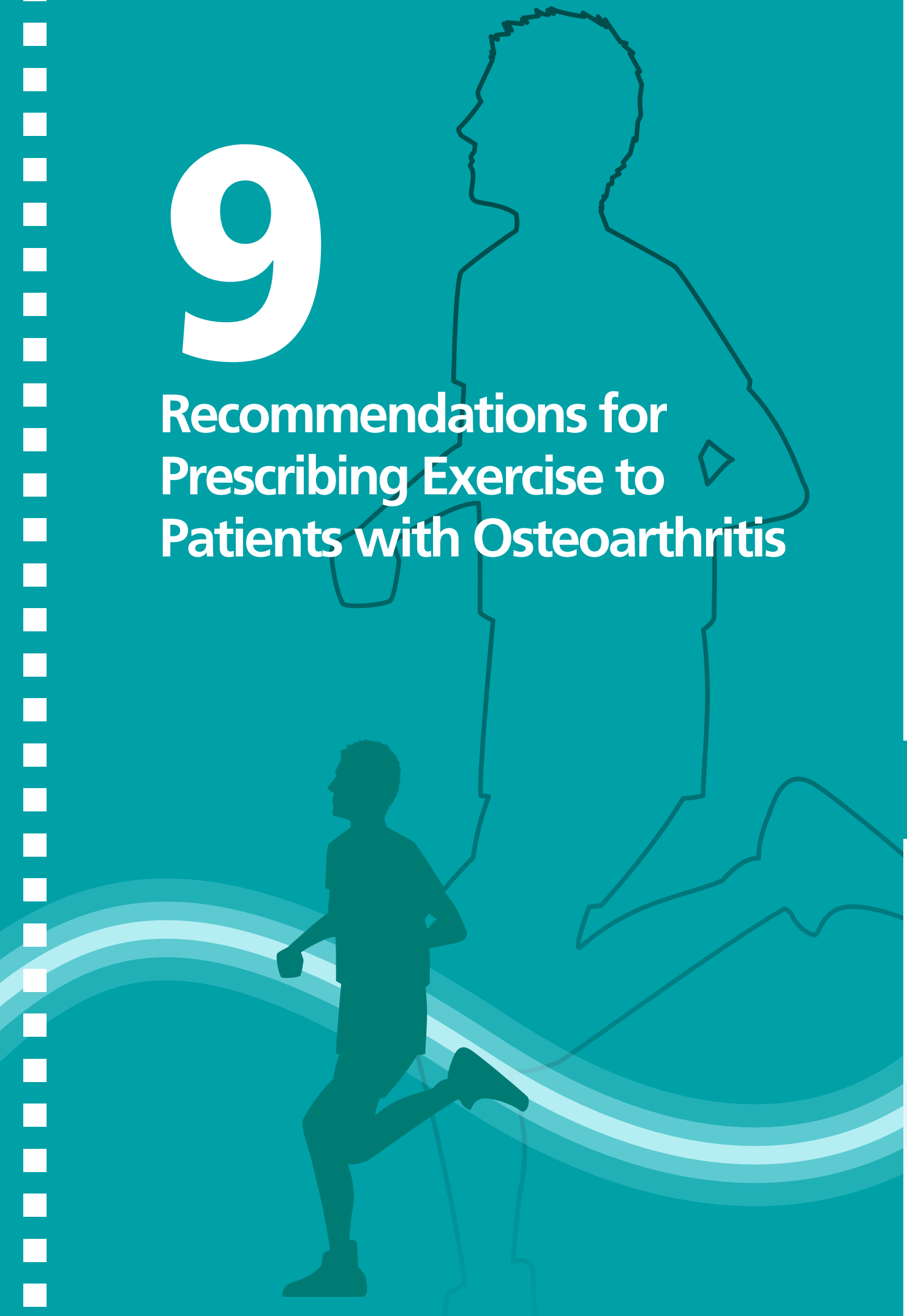
1. Weaver WD, Cobb LA, Hallstrom AP. Characteristics of survivors of exertion–non exertion related cardiac arrest: value of subsequent exercise testing. *Am J Cardiol* 1982; 50:671–6.
2. Pavy B, Iliou MC, Meurin P, Tabet JY, Corone S; Functional Evaluation and Cardiac Rehabilitation Working Group of the French Society of Cardiology. Safety of exercise training for cardiac patients: results of the French registry of complications during cardiac rehabilitation. *Arch Intern Med* 2006;Nov 27;166(21):2329-34.
3. Kannel WB, Doyle JT, McNamara PM, Quickenton P, Gordon T. Precursors of sudden coronary death. Factors related to the incidence of sudden death. *Circulation* 1975; 51:606–3.
4. Beckerman J, Mathur A, Stahr S, Chun S, Froelicher V. Exercise-induced ventricular arrhythmias and cardiovascular death. *Ann Noninvasive Electrocardiol* 2005; 10:47–52.
5. Cornelissen VA, Fagard RH. Effects of endurance training on blood pressure, blood pressure-regulating mechanisms, and cardiovascular risk factors. *Hypertension* 2005;46:667–75.
6. Leon AS, Sanchez O. Meta-analysis of the effects of aerobic exercise training on blood lipids. *Circulation* 2001; 104 (suppl II): II-414–5.
7. Knowler WC, Barrett-Connor E, Fowler SE, et al. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002;346:393–403.
8. Di Pietro, L., J. Dziura, and S. N. Blair. Estimated change in physical activity level (PAL) and prediction of 5-year weight change in men: the Aerobics Center Longitudinal Study. *Int J Obes Relat Metab Disord* 2004;28:1541–7.
9. Marcus BH, Albrecht AE, King TK, et al. The efficacy of exercise as an aid for smoking cessation in women: a randomized controlled trial. *Arch Intern Med* 1999; 159: 1229–34.
10. Hambrecht R, Walther C, Möbius-Winkler S, et al. Percutaneous coronary angioplasty compared with exercise training in patients with stable coronary artery disease: a randomized trial. Circulation 2004;Mar 23;109(11):1371-8.
11. Wenger NK. *Cardiac rehabilitation. Clinical practice guideline No. 17*. Rockville, Md.: U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research; 1995.
12. O'Connor GT, Buring JE, Yusuf S, Goldhaber SZ, Olmstead EM, Paffenbarger RS Jr, Hennekens CH.. An overview of randomized trials of rehabilitation with exercise after myocardial infarction. Circulation 1989; 80: 234–44.
13. Oldridge NB, Guyatt GH, Fischer ME, Rimm AA. Cardiac rehabilitation after myocardial infarction: combined experience of randomized clinical trials. *JAMA* 1988; 260: 945–50.
14. Jolliffe JA, Rees K, Taylor RS, Thompson DR, Oldridge N, Ebrahim S.. Exercise-based rehabilitation for coronary heart disease. *Cochrane Database Syst Rev* 2001; (1): CD001800.
15. Thompson PD, Buchner D, Pina IL, et al. American Heart Association Council on Clinical Cardiology Subcommittee on Exercise, Rehabilitation, and Prevention; American Heart Association Council on Nutrition, Physical Activity, and Metabolism Subcommittee on Physical Activity. Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: a statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity). *Circulation* 2003 Jun 24;107(24):3109-16.
16. Keteyian SJ, Levine AB, Brawner CA et al. Exercise training in patients with heart failure. A randomized, controlled trial. *Ann Intern Med* 1996; 124: 1051–7.
17. Papathanasiou G, Tsamis N, Georgiadou P, Adamopoulos S. Beneficial effects of physical training and methodology of exercise prescription in patients with heart failure. *Hellenic J Cardiol*, 2008; 49: 267–77.
18. Belardinelli R, Georgiou D, Cianci G, Purcaro A. Randomized, controlled trial of long-term moderate exercise training in chronic heart failure: effects on functional capacity, quality of life, and clinical outcome. *Circulation* 1999; 99: 1173–82.
19. Hornig B, Maier V, Drexler H. Physical training improves endothelial function in patients with chronic heart failure. *Circulation* 1996; 93: 210–4.

20. Hambrecht R, Gielen S, Linke A, Fiehn E, Yu J, et al. Effects of exercise training on left ventricular function and peripheral resistance in patients with chronic heart failure: A randomized trial. *JAMA* 2000; 283: 3095–101.
21. Piepoli MF, Davos C, Francis DP, Coats AJ; ExTraMATCH Collaborative. Exercise training meta-analysis of trials in patients with chronic heart failure (ExTraMATCH). *BMJ* 2004; 328: 189.
22. O'Connor CM, Whellan DJ, Lee KL, et al. HF-ACTION Investigators. Efficacy and safety of exercise training in patients with chronic heart failure: HF-ACTION randomized controlled trial. *JAMA* 2009; Apr 8;301(14):1439-50.
23. Tai MK, Meininger JC, Frazier LQ. A systematic review of exercise interventions in patients with heart failure. *Biol Res Nurs* 2008; 10:156–2.
24. Working Group on Cardiac Rehabilitation and Exercise Physiology and Working Group on Heart Failure of the European Society of Cardiology. Recommendations for exercise testing in chronic heart failure patients. *Eur Heart J* 2001;22:37–45.
25. Myers J. Principles of exercise prescription for patients with chronic heart failure. *Heart Fail Rev*, 2008;13:61–8.
26. Börjesson, Mats; Assanelli, Deodato; Carré, François; et al. ESC Study Group of Sports Cardiology: recommendations for participation in leisure-time physical activity and competitive sports for patients with ischaemic heart disease. *Eur J Cardiovasc Prev Rehabil* 2006;13(2):137-49.
27. Heidbüchel H, Panhuyzen-Goedkoop N, Corrado D, et al. Study Group on Sports Cardiology of the European Association for Cardiovascular Prevention and Rehabilitation. Recommendations for participation in leisure-time physical activity and competitive sports in patients with arrhythmias and potentially arrhythmogenic conditions Part I: Supraventricular arrhythmias and pacemakers. *Eur J Cardiovasc Prev Rehabil* 2006;Aug;13(4):475-84.
28. Gary J. Balady, Mark A. Williams, Philip A. Ades, et al. Core Components of Cardiac Rehabilitation/Secondary Prevention Programs: 2007 Update: A Scientific Statement From the American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee, the Council on Clinical Cardiology; the Councils on Cardiovascular Nursing, Epidemiology and Prevention, and Nutrition, Physical Activity, and Metabolism; and the American Association of Cardiovascular and Pulmonary Rehabilitation. *Circulation* 2007;115;2675-82/
29. Weber TS. Environmental and infectious conditions in sports. *Clin Sport Med* 2003; 22:181–96.
30. Massimo Francesco Piepoli, Ugo Corra` , Werner Benzer, et al. Secondary prevention through cardiac rehabilitation: from knowledge to implementation. A position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil* 2010;17:1–17.
31. Murray R. Nutrition for the marathon and other endurance sports: environmental stress and dehydration. *Med Sci Sports Exerc* 1992; 9(suppl):S319–323.
32. Yasue H, Kugiyama K. Coronary spasm: clinical features and pathogenesis. *Intern Med* 1997; 36:760–65.
33. Imai Y, Nobuoka S, Nagashima J, Awaya T, Aono J, Miyake F, Murayma M. Acute myocardial infarction induced by alternating exposure to heat in sauna and rapid cooling in cold water. *Cardiology* 1998; 90:299–301.
34. H. Heidbuchel, D. Corrado, A. Biffi, et al. and on behalf of the Study Group on Sports Cardiology. Recommendations for participation in leisure-time physical activity and competitive sports of patients with arrhythmias and potentially arrhythmogenic conditions Part II: Ventricular arrhythmias, channelopathies and implantable defibrillators. *Eur J Cardiovasc Prev Rehabil* 2006;October 1;13(5):676-86.

Reading Note

9

Recommendations for Prescribing Exercise to Patients with Osteoarthritis



9 Recommendations for Prescribing Exercise to Patients with Osteoarthritis

Effects of Exercise

Although pain and functional limitations can result in challenges to physical activity among patients with osteoarthritis, regular exercise is essential for managing this condition.

Studies conducted in recent years provided evidence that supports the assumption that muscle weakness and muscle atrophy contribute to the disease process (1-4). Thus, rehabilitation and physiotherapy are often prescribed with the intention to alleviate pain and increase mobility. However, to counteract muscle atrophy, exercise has to be performed on a regular basis as health benefits do not persist if exercise programmes are discontinued (5). Therefore, people with degenerative joint disease should be put on continuous exercise programmes (5).

Evidence from a large systematic review and a large randomised controlled trial for knee osteoarthritis demonstrated the beneficial effects of exercise compared with no exercise (6-7). Exercise in this context included aerobic walking, home quadriceps exercise, strengthening and home exercise, aerobic exercise with weight training, and diet with aerobic and resistance exercise. These studies showed that exercise was associated with reduced pain and disability, medication intake, as well as improved physical functioning, stair climbing, walking distance, muscle strength, balance, self-efficacy and mental health and physical functioning (6-7). Majority of these beneficial outcomes were observed during follow up at 18 months post-randomisation (6-7). Risk of adverse events is considered low if exercise recommended for the individual has been appropriately assessed by a trained health professional (8). While some individuals may experience an exacerbation of symptoms, the vast majority (including those severely affected) will neither develop adverse reaction to controlled exercise nor experience an increase in the severity of arthritis (9-10). For example, patients with significant osteoarthritis can ride a bicycle, go swimming or exercise in a gym with often no or minimal discomfort.

Recommendations for Exercise Prescription

Although management guidelines for osteoarthritis recommend exercise therapy, specifics – such as the frequency, intensity, duration and mode – have not been addressed.

In general, the recommendations for exercise participation for apparently healthy adults mentioned in previous chapters could also be followed. The following table summarises the salient points of the FITT framework for patients with osteoarthritis:

	Recommendations*
Frequency	• At least 3 days per week of aerobic exercise is recommended (11), or follow the recommendations for healthy adults as tolerated. • Resistance exercise should be performed 2 to 3 nonconsecutive days per week (11). • Stretching exercise should be emphasised and performed at least daily (11).
Intensity	• General recommendations for exercise intensity apply for aerobic exercises. Initial aerobic exercise should begin at lower levels of moderate intensity (e.g. about 40% heart rate reserve) for individuals who have been sedentary or limited by pain (11-12). • For resistance exercise, start with a relatively low amount of load (e.g. 10% 1-repetition maximum (1-RM) for individuals with severe arthritis) and progress at a maximal rate of 10% increase per week as tolerated to the point of pain tolerance and/or low to moderate intensity (i.e. 40–60% 1-RM) (11).
Time	• Start engaging in aerobic exercise in short bouts of 5 to 10 mins to accumulate 20 to 30 mins per day as tolerated, with a goal of progressing to a total of 150 mins per week of moderate-intensity activity (11). • Perform at least 1 set of resistance exercise involving 10 to 15 repetitions per exercise (11).
Type	• Aerobic exercise: activities having low joint stress, such as walking, cycling or swimming are recommended (11). Studies have shown that jogging would neither increase the risk of developing osteoarthritis nor result in increased severity of the disease (13). • Resistance exercise: Individuals with significant joint pain or muscle weakness may benefit from beginning with maximum voluntary isometric contractions around the affected joint (e.g. partial squat) and progressing to dynamic training (11). Training all major muscle groups as recommended in healthy adults is the ultimate goal. • Stretching exercises for stretching all major muscle groups are recommended (11).

	• Incorporate functional exercises such as sit-to-stand and step-ups as tolerated to improve neuromuscular control and maintenance of activity of daily living (11). • There is some encouraging evidence suggesting that tai chi may reduce pain and improve physical function, self-efficacy, depression, and health-related quality of life for people with knee osteoarthritis (14-15).

* As many patients may present with comorbidities, it may be necessary to tailor the exercise prescription accordingly.

Special Considerations

- Avoid strenuous exercises during acute flare-ups and periods of inflammation (11).
- Progression in duration of activity should be emphasised over increased intensity (11).
- Adequate warm-up and cool-down periods of 5 to 10 mins are critical for minimising pain (11).
- Inform individuals with osteoarthritis that some discomfort during or immediately after exercise may be expected. However, if joint pain persists for 2 hours after exercise and exceeds the level of pain before exercise, the duration and/or intensity of exercise should be reduced in future sessions (11).
- Many patients suffering from osteoarthritis refuse to start exercising due to joint pain. In such cases, the use of painkillers during the first weeks of an exercise programme might not only facilitate joint movement but can also drastically improve patient compliance (5). Encourage patients to exercise during the time of day when pain is typically least severe and/or in conjunction with peak activity of pain medications (11).
- In case of severe joint pain or in obese patients, an initial period of water-based exercise may be helpful (5). As swimming or aqua-jogging provides a muscle workout without joint loading, further pain and weight-related joint destruction can be avoided.
- Appropriate shoes that provide shock absorption and stability are particularly important for people with knee osteoarthritis (11).
- Because it is common for patients with osteoarthritis of lower extremities to be overweight and obese, healthy weight loss and maintenance should be encouraged (11).

References

1. Ikeda S, Tsumura H, Torisu T. Age-related quadriceps-dominant muscle atrophy and incident radiographic knee osteoarthritis. *J of Orthop Sci* 2005;10(2):121–6.
2. Amaro A, Amado F, Duarte JA, Appell HJ. Gluteus medius muscle atrophy is related to contralateral and ipsilateral hip joint osteoarthritis. *Int J Sports Med* 2007;28(12):1035–9.
3. Grimaldi A, Richardson C, Durbridge G, Donnelly W, Darnell R, Hides J. The association between degenerative hip joint pathology and size of the gluteus maximus and tensor fascia lata muscles. *Manual Therapy* 2009;14(6):611–7.
4. Grimaldi A, Richardson C, Stanton W, Durbridge G, Donnelly W, Hides J. The association between degenerative hip joint pathology and size of the gluteus medius, gluteus minimus and piriformis muscles. *Manual Therapy*. 2009;14(6):605–0.
5. Valderrabano V, Steiger C. Treatment and prevention of osteoarthritis through exercise and sports. *J Aging Res* 2010; Dec 6;2011:374653.
6. Roddy E, Zhang W, Doherty M. Aerobic walking or strengthening exercise for osteoarthritis of the knee? A systematic review. *Annals of the Rheumatic Diseases* 2005; 64(4):544–8.
7. Miller GD, Nicklas BJ, Davis C, Loeser RF, Lenchik L, Messier SP. Intensive weight loss program improves physical function in older obese adults with knee osteoarthritis. *Obesity* 2006;14 (7): 1219–30.
8. National Collaborating Centre for Chronic Conditions. *Osteoarthritis. The care and management of osteoarthritis in adults*. London (UK): National Institute for Health and Clinical Excellence (NICE); 2008;Feb.
9. Hurley MV, Walsh NE, Mitchell HL, Pimm TJ, Patel A, Williamson E, Jones RH, Dieppe PA, Reeves BC. Clinical effectiveness of a rehabilitation program integrating exercise, self-management, and active coping strategies for chronic knee pain: a cluster randomized trial. *Arthritis Rheum* 2007; 57 (7): 1211–9.
10. Ettinger WH Jr, Afable RF. Physical disability from knee osteoarthritis: the role of exercise as an intervention. *Med Sci Sports Exerc* 1994 Dec;26(12):1435-40.
11. Exercise Prescription for Other Clinical Populations. In Walter R Thompson; Neil F Gordon; Linda S Pescatello; *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine, 2010, P. 226
12. American College of Sports Medicine. *ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*, 6th edition. American College of Sports Medicine. 2010.
13. Bruce B, Fries JF, Lubeck DP. Aerobic exercise and its impact on musculoskeletal pain in older adults: a 14 year prospective, longitudinal study. *Arthritis Res Ther* 2005;7(6):R1263-70.
14. Lee MS, Pittler MH, Ernst E. Tai chi for osteoarthritis: a systematic review. *Clin Rheumatol* 2008; Feb;27(2):211-8.
15. Wang C, Schmid CH, Hibberd PL, Kalish R, Roubenoff R, Rones R, McAlindon T. Tai Chi is effective in treating knee osteoarthritis: a randomized controlled trial. *Arthritis Rheum* 2009; Nov 15;61(11):1545-53.

10

Recommendations for Prescribing Exercise to Overweight and Obese Patients

Recommendations for Prescribing Exercise to Overweight and Obese Patients

Effects of Exercise

The increasing prevalence of obesity reflects a lack of energy balance in a large number of people who are consistently expending fewer calories than they consume. It is reasonable to assume that persons with relatively high daily energy expenditures would be less likely to gain weight over time, compared with those who have low energy expenditures.

Research has shown that adults are more likely to maintain a healthy weight if they have an active lifestyle and reduce their physical inactivity (1-3). A systematic review of randomised control trials (RCTs) in early postmenopausal women suggested that walking at least 30 mins per day plus twice weekly resistance exercise sessions was likely to be effective in preserving normal body weight (4). International consensus guidelines, based largely around data from epidemiological prospective studies also recommended that adults should engage in 45 to 60 mins of moderate-intensity physical activity per day to prevent transition to overweight or obesity (5). Currently, the specific types and amounts of activity required to prevent weight gain have not been well established using prospective study designs, and it is best to assume that the specific amount of physical activity that will help prevent unhealthy weight gain is a function that differs between individuals, but that in general more activity increases the probability of success (6).

Despite the intuitive appeal of the idea that physical activity helps in losing weight, physical activity appears to produce only modest increments of weight loss beyond those achieved by dietary measures and its effects no doubt vary among people (7). A meta-analysis of RCTs on the effectiveness of physical activity for weight loss in obese individuals revealed physical activity (minimum of 45 mins 3 times a week) combined with diet (600 kcal/deficit or low fat) results in an approximate weight change of –1.95 kg (95% CI -3.22 to -0.68) (range –1.00 kg to –3.60 kg) compared to diet alone at 12 months (1). Whilst the addition of physical activity on top of a dietary intervention enhanced weight loss, physical activity appeared to be less effective than diet as a sole weight loss intervention (8).

Several observational studies have been conducted on the role of physical activity in preventing weight regain after an initial sizable weight loss (9-13). Although these studies had different study design and methodology, all of them focused on people who had lost 30–50 lb (13.6–22.7 kg) and had not regained after several years. Studies using self-reported physical activity and energy expenditure generally support the notion that 60–90 mins of moderate-intensity physical activity per day might be necessary for weight maintenance after such large weight losses (11-12).

Recommendations for Exercise Prescription

Adults who are overweight or obese should be encouraged to increase their physical activity levels even if they do not lose weight as a result, because physical activity can bring other health benefits such as reduced risk of type 2 diabetes and cardiovascular disease. Overweight or obese adults should be encouraged to perform at least 30 mins of at least moderate-intensity physical activity on 5 or more days a week. The activity can be undertaken in one session or several lasting 10 mins or more. For those who have already achieved this level of activity, an increase in the amount of their physical activity is a reasonable component of any strategy to lose weight. It is generally estimated that 1 pound (0.45kg) of body fat loss requires about 3,500 kcal of energy consumption. As studies on the effect of prescription of muscle strengthening exercise on weight loss are limited, it seems reasonable to recommend overweight/obese people to follow the same muscle strengthening exercise recommendations for the general population for having a balanced exercise programme.

The following is the recommended FITT framework for prescribing aerobic exercises to people who are overweight and obese:

	Recommendations*
Frequency	• ≥5 days per week of aerobic exercises to maximise caloric expenditure (14).
Intensity	• Moderate- to vigorous-intensity aerobic exercises should be encouraged. • Some individuals may prefer doing vigorous exercise as it is less time consuming, but vigorous exercise is probably not appropriate for the very obese (BMI > approximately 35 kg/m^2) (8). • Individuals choosing to incorporate vigorous intensity activity into their programme should do this gradually and after an initial 4–12 week period of moderate-intensity activity (8).

Time	• To prevent obesity, people may need 45 to 60 mins of moderate-intensity aerobic activity each day unless they also reduce their energy intake (1). • Patients who are overweight or obese should be prescribed a volume of 45 to 60 mins of moderate-intensity activity a day (corresponding to approximately 225 to 300 mins/week of moderate-intensity physical activity or lesser amounts of vigorous physical activity) (5,8). • People who have been obese and have lost weight should be advised they may need to do 60 to 90 mins of activity a day to avoid regaining of weight (1,5,8). • Sedentary individuals should build up to their physical activity targets over several weeks, starting with 10 to 20 mins of physical activity every other day during the first week or two, to minimise potential muscle soreness and fatigue (8).
Type	• Walking is an excellent form of physical activity for overweight and obese people (for obese, sedentary individuals, brisk walking often constitutes moderate-intensity physical activity.) (8). • Weight-bearing physical activity may be difficult for some individuals with BMI over approximately 35 kg/m^2, particularly for those with joint problems. For these individuals, gradually increasing non-weight-bearing moderate-intensity physical activities (e.g. cycling, swimming, water aerobics, etc.) should be encouraged (8).

* As many patients may present with comorbidities, it may be necessary to tailor the exercise prescription accordingly.

Evaluation of Overweight or Obese Patients Before Recommending an Exercise Programme

It is important to ensure that individuals have no contraindications to exercise before commencing a physical activity programme. The presence of other comorbidities (e.g. dyslipidaemia, hypertension, hyperinsulinaemia, hyperglycaemia, etc.) may increase the risk stratification for overweight and obese individuals, resulting in the need for additional medical screening before exercise testing. The presence of musculoskeletal and/or orthopaedic conditions and limitations of exercise capacity may require modifications to the exercise testing procedure.

Special Considerations

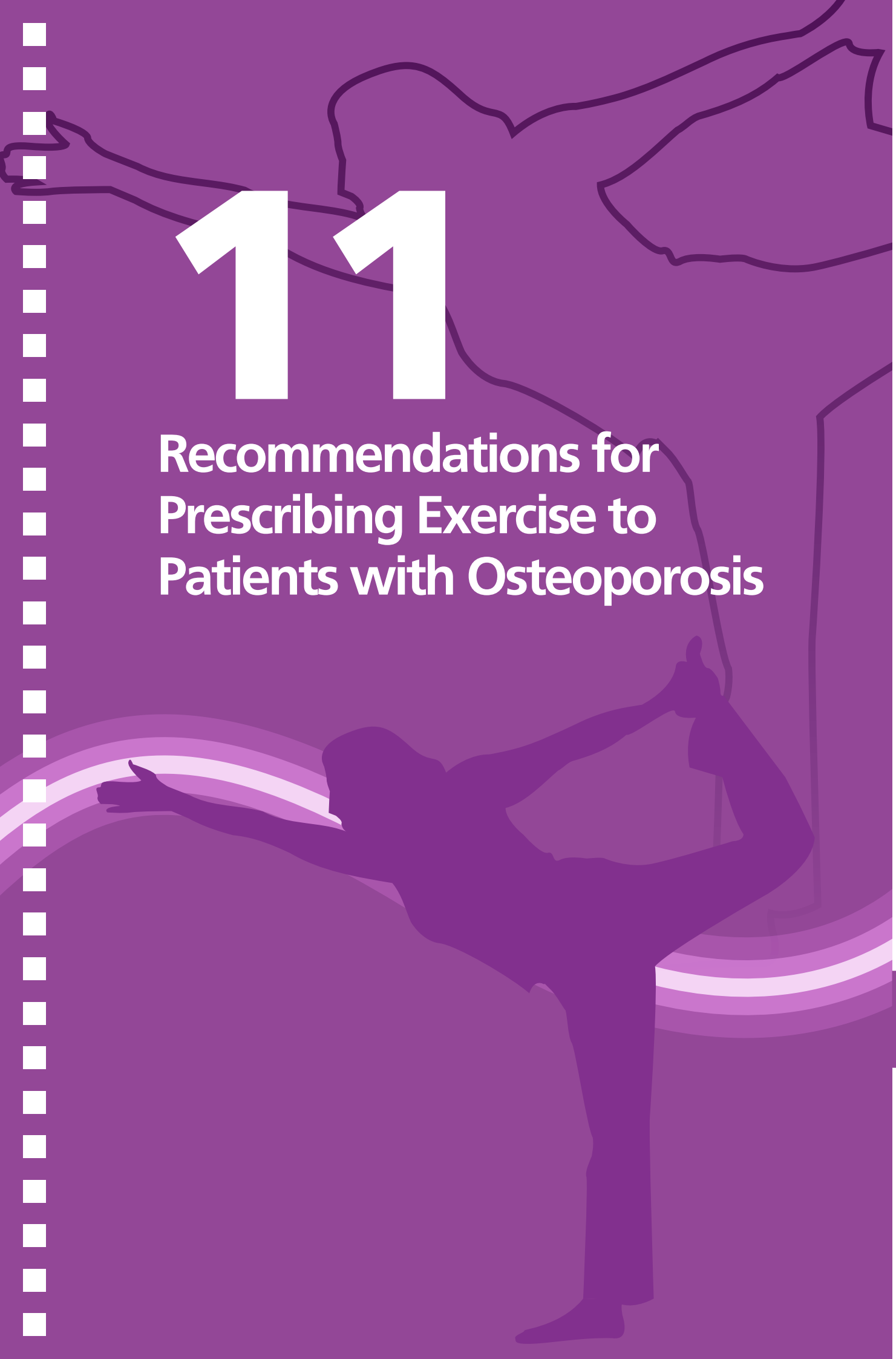
Prescription of higher physical activity targets (i.e. >300 mins per week of moderate-intensity physical activity) only resulted in significantly greater weight loss when participants received additional support, such as inclusion of family members in programme, small group meetings with exercise coaches or small monetary incentives, to help them to achieve their activity goals (15). When additional support is not provided, prescription of higher physical activity targets may not result in significantly greater weight loss than prescription of standard physical activity (8).

References

1. National Institute for Health and Clinical Excellence (NICE). *Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children*. London: NICE; 2006.
2. Kay SJ, Fiatarone Singh MA. The influence of physical activity on abdominal fat: a systematic review of the literature. *Obes Rev* 2006;7(2):183-200.
3. Fogelholm M, Lahti-Koski M. Community health-promotion interventions with physical activity: does this approach prevent obesity? *Scand J Nutr* 2002;46(4):173-77.
4. Asikainen TM, Kukkonen-Harjula K, Miilunpalo S. Exercise for health for early postmenopausal women: A systematic review of randomised controlled trials. *Sports Med* 2004;34(11):753-78.
5. Saris WH, Blair SN, van Baak MA, Eaton SB, Davies PS, Di Pietro L, et al. How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. *Obes Rev* 2003;4(2):101-14.
6. Slentz, C. V., B. D. Duscha, J. L. Johnson, et al. Effects of the amount of exercise on body weight, body composition, and measures of central obesity: STRRIDE-A randomized controlled study. *Arch. Intern. Med* 2004;164:31–9.
7. Stephanick, M. L. Exercise and weight control. *Exerc. Sport Sci. Rev* 1993; 21:363–96.
8. *Management of obesity. A national clinical guideline*. Edinburgh (Scotland): Scottish Intercollegiate Guidelines Network (SIGN); 2010 Feb.
9. Klem, M. L., R. R. Wing, W. Lang, M. T. Mcguire, and J. O. Hill. Does weight loss maintenance become easier over time? *Obes. Res* 2000; 8:438–44.
10. Mcguire, M. T., R. R. Wing, M. L. Klem, H. M. Seagle, and J. O. Hill. Long-term maintenance of weight loss: do people who lose weight through various weight loss methods use different behaviors to maintain their weight? *Int J Obes Relat Metab Disord* 1998; 22:572–7.
11. Schoeller, D. A., K. Shay, and R. F. Kusher. How much physical activity is needed to minimize weight gain in previously obese women? *Am J Clin Nutr* 1997; 66:551–6.
12. Weinsier, R. L., G. R. Hunter, R. A. Desmond, N. M. Byrne, P. A. Zuckerman, and B. E. Darnell. Free-living activity energy expenditure in women successful and unsuccessful at maintaining a normal body weight. *Am J Clin Nutr* 2002; 75:499–504.
13. Wing, R. R., and J. O. Hill. Successful weight loss maintenance. *Annu Rev Nutr* 2001; 21:323–41.
14. Exercise Prescription for Other Clinical Populations. In Walter R Thompson; Neil F Gordon; Linda S Pescatello; *ACSM's guidelines for exercise testing and prescription*. 8th ed. American College of Sports Medicine, 2010, P. 254
15. Jeffery RW, Wing RR, Sherwood NE, Tate DF. Physical activity and weight loss: does prescribing higher physical activity goals improve outcome? *Am J Clin Nutr* 2003;78(4):684-9.

11

Recommendations for Prescribing Exercise to Patients with Osteoporosis



11 Recommendations for Prescribing Exercise to Patients with Osteoporosis

Effects of Exercise

Weight-bearing aerobic exercises and muscle-strengthening exercises have been shown to be an integral part of osteoporosis prevention, as well as a part of the treatment process (1).

There is strong evidence that physical activity early in life contributes to higher peak bone mass. Physical activity during early age was more strongly associated with higher bone mineral density (BMD) at all sites than was physical activity in the past two years (2). Lifetime weight-bearing is more strongly associated with higher BMD of the total and peripheral skeleton than is non-weight-bearing exercise (2). Exercise during the later years in the presence of adequate calcium and vitamin D probably has a modest effect on slowing the decline in BMD (3). Physical activity, particularly weight-bearing exercise, is thought to provide the mechanical stimuli or "loading" important for the maintenance and improvement of bone health (1). A number of systematic reviews and meta-analyses have suggested that an exercise programme combining low impact weight bearing exercise and high-intensity resistance training maintains bone density in men and postmenopausal women (4-6). Resistance training may have more profound site-specific effect than aerobic exercise (7). High-intensity resistance training may have added benefits for decreasing osteoporosis risks by improving strength and balance, and increasing muscle mass (7).

Although patients with osteoporosis may think exercise increases the risk of injury from broken bones, the truth is quite the opposite. A regular and properly designed exercise programme may help to prevent falls and fall-related osteoporotic fractures, which in turn reduces the risk of disability and premature death among patients with osteoporosis. Randomised clinical trials have shown exercise to decrease the risk of falls by approximately 25% (8-10). Stronger back extensor muscles have been shown to decrease the risk of vertebral fractures independent of pharmacotherapy (8-10).

Recommendations for Exercise Prescription

All three components of an exercise program are needed for strong bone health: weight-bearing aerobic exercise such as jogging, brisk walking, stair climbing; muscle strengthening exercise with weights; and balance training such as Tai Chi. Patients should be encouraged and offered assistance in developing a lifetime programme of exercise that they will continue to do and enjoy.

The following table summarises the salient points of the FITT framework for patients with osteoporosis:

	Recommendations*
Frequency	• To perform at least 3 days per week of aerobic exercise (11). • To perform resistance exercise 2 to 3 nonconsecutive days per week (11).
Intensity	• To perform moderate intensity for weight-bearing aerobic exercise (11). • To perform moderate intensity for resistance exercises in terms of bone-loading forces, although some individuals may be able to tolerate more intense training (11). Individuals at risk of osteoporosis are recommended to perform high-intensity training (80-90% 1-repetition maximum for 5 to 6 repetitions) to help preserve bone health (11).
Time	• Initial goal of 20-30 mins per session of moderate-intensity aerobic activity is reasonable, with a goal of progressing to a total of 150 mins per week. In case of extreme reconditioning, a shorter duration at the beginning should be employed (12). • Perform at least 1 set of resistance exercise involving 8 to 10 repetitions per exercise at moderate intensity (11).
Type	• Weight-bearing aerobic exercise includes stair-climbing/ descending, walking with intermittent jogging and table-tennis. • Resistance training of a high intensity produces gains in strength and BMD. Any form of resistance training should be site specific i.e. targeting areas such as the muscle groups around the hip, the quadriceps, dorsi/plantar flexors, rhomboids, wrist extensors and back extensors (13). Certain types of movements should be avoided (refer to the section "Special Considerations" below) • For older women and men at increased risk for falls, the exercise prescription should also include activities that improve balance.

* As many patients may present with comorbidities, it may be necessary to tailor the exercise prescription accordingly.

To be effective, all exercise programmes need to be progressive in terms of impact and intensity as fitness and strength levels improve. Programmes should begin at a low level that is comfortable for the patient. It would be the best if an initial assessment by a suitably trained individual such as a physiotherapist could be done for giving the patient a reference point from which to start the exercise programme.

Special Considerations

- Because the majority of individuals with osteoporosis are older in age and sedentary, they are usually considered as moderate to high risk for atherosclerotic disease. Based on this, it would be prudent to assess the patient before participating in exercise of level higher than usual (12). For resistance training involving use of weight-lifting machines, initial training sessions should be supervised and monitored by personnel who are sensitive to special needs of older adults.

- There are currently no established guidelines regarding contraindications for exercise for people with osteoporosis. The general recommendation is to prescribe moderate intensity exercise that does not cause or exacerbate pain.

- Exercises that involve explosive movements or high-impact loading should be avoided. Low impact weight-bearing activity is characterised by always having one foot on the floor. Ballistic movements or jumping (both feet off floor) is termed high impact training. (11-13)

- Exercises that cause twisting (e.g. golf swing), bending or compression of the spine (e.g. rowing or other dynamic abdominal exercises including sit-ups) should also be avoided. (11-12)

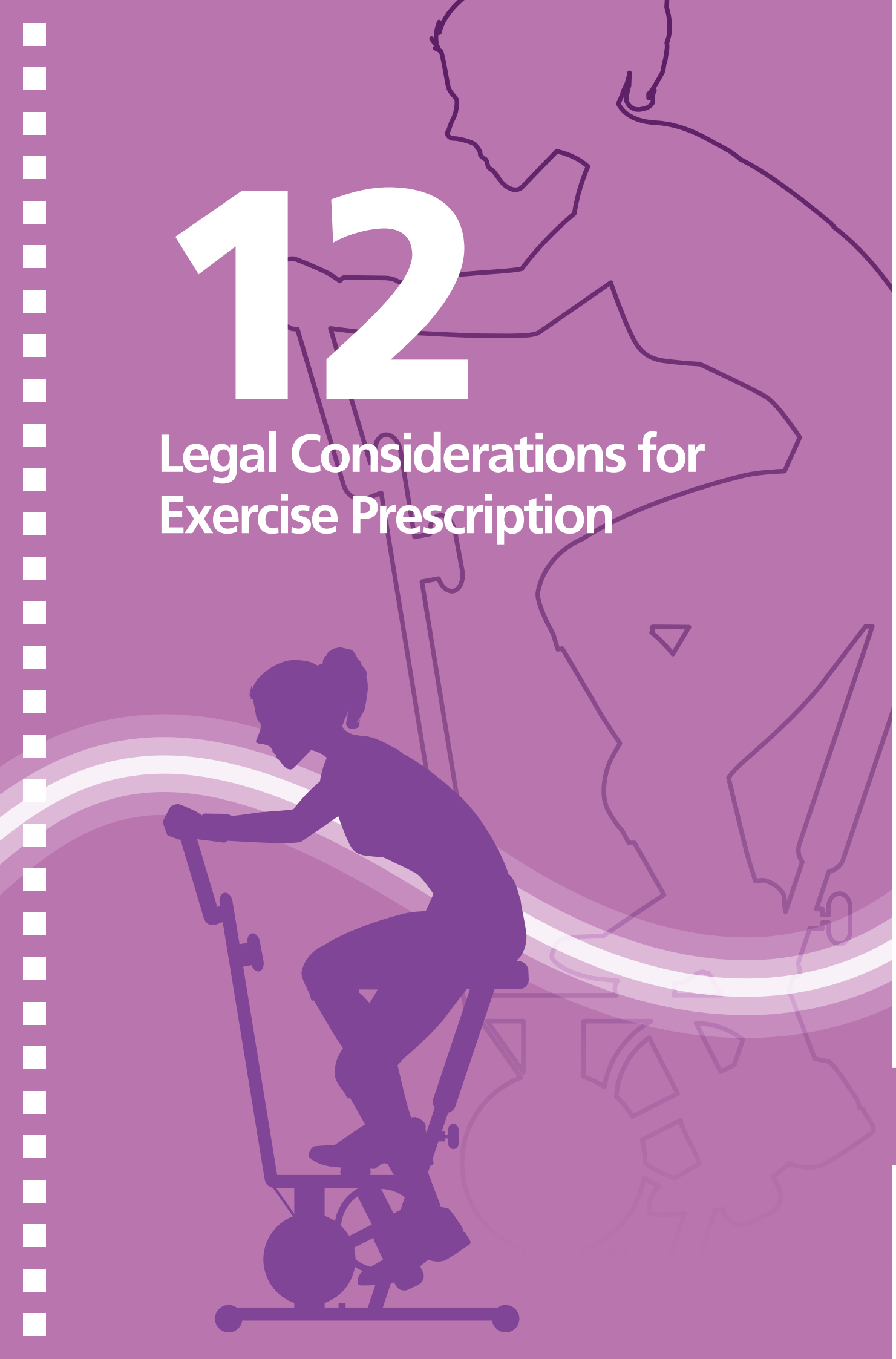
References

1. Ulrich CM, Georgiou CC, Gillis DE, Snow CM. Lifetime physical activity is associated with bone mineral density in postmenopausal women. *J Women Health* 8:365-75, 1999.
2. Etherington J, Harris PA, Nandra D, et al. The effect of weight-bearing exercise on bone mineral density: a study of female ex-elite athletes and the general population. *J Bone Miner Res* 1996;11:1333–8.
3. Institute for Clinical Systems Improvement (ICSI). *Diagnosis and treatment of osteoporosis*. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2008 Sep.
4. Ernst E. Exercise for female osteoporosis. A systematic review of randomised clinical trials. *Sports Med* 1998;25:359-68.
5. Kelley G. Aerobic exercise and lumbar spine bone mineral density in postmenopausal women: a meta-analysis. *J Am Geriatr Soc* 1998;46:143-52.
6. Kelley GA, Kelley KS, Tran ZV. Resistance training and bone mineral density in women: a meta-analysis of controlled trials. *Am J Phys Med Rehabil* 2001;80:65-77.
7. Layne JE, Nelson ME. The effects of progressive resistance training on bone density: a review. *Med Sci Sports Exerc* 31:25-30, 1999.
8. Sinaki M, Brey RH, Hughes CA, et al. Significant reduction in risk of falls and back pain in osteoporotic kyphotic women through a spinal proprioceptive extension exercise dynamic (SPEED) program. *Mayo Clin Proc* 2005;80:849-55
9. NIH Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy. Osteoporosis prevention, diagnosis, and therapy. *JAMA* 2001;285:785-95.
10. Sinaki M, Itoi E, Wahner HW, et al. Stronger back muscles reduce the incidence of vertebral fractures: a prospective 10-year follow-up of postmenopausal women. *Bone* 2002;30:836-41.
11. Exercise Prescription for Other Clinical Populations. In Walter R Thompson; Neil F Gordon; Linda S Pescatello; ACSM's guidelines for exercise testing and prescription. 8th ed. American College of Sports Medicine, 2010, P. 256

12. American College of Sports Medicine. ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription, 6th edition. American College of Sports Medicine. 2010.
13. *Management of osteoporosis. A national clinical guideline*. Edinburgh (Scotland): Scottish Intercollegiate Guidelines Network (SIGN); 2003 Jun. (reaffirmed 2007)

12

Legal Considerations for Exercise Prescription



12 Legal Considerations for Exercise Prescription

As in other areas of health care delivery, a doctor who prescribes exercise to his patients owes a duty of care to them to exercise reasonable care and skills. Box 12.1 provides some tips for primary care practitioners regarding legal matters related to exercise prescription in daily practice (1).

Box 12.1 Tips for Primary Care Practitioners Regarding Legal Matters Related to Exercise Prescription

- Ensure you have the requisite training to enable you to discharge your professional responsibility toward your patients before involving in exercise prescription practice.
- Know and apply in practice the most rigorous and current peer-developed guidelines applicable to your services, patients, and organisation or environment.
- Seek advice from another clinician with the requisite expertise in exercising prescription, or refer the patient to that clinician, if you are uncertain about the appropriateness of a proposed exercise regime, or whether the regime is contraindicated in view of a patient's medical history.
- Explain the potential health risks of exercise participation and give specific instructions on what symptoms to look out for and also what to do if the patient experiences those symptoms. Use appropriate informed consent in which such consent is relevant.
- Instruct patients in techniques of participation and limitations relevant to their health and physical capabilities, observe their related participation, correct problems, and follow up to verify that they manage their own participation safely and effectively.
- Document fulfilment of your service, including the outcome of patient assessment, patient's agreement and the given explanation, in the patient's clinical note in a manner consistent with standard of care and/or your written clinical pathways and procedures.
- Suitably engage family members or significant others when the subject does not fully comprehend the nature of the advice given during exercise prescription.

These guidelines are only considered as the commonly accepted practice in the primary care settings but not intended to be construed as a standard practice of individual patient care. Standards of care are determined on the basis of all the facts and circumstances involved in a particular case and are subject to change as scientific knowledge and technology advance and patterns of care evolve. The management must be made by the appropriate primary care practitioners responsible for clinical decisions regarding a particular treatment procedure or care plan. The management should only be arrived at following discussion of the options with the patient, covering the diagnostic and treatment choices available.

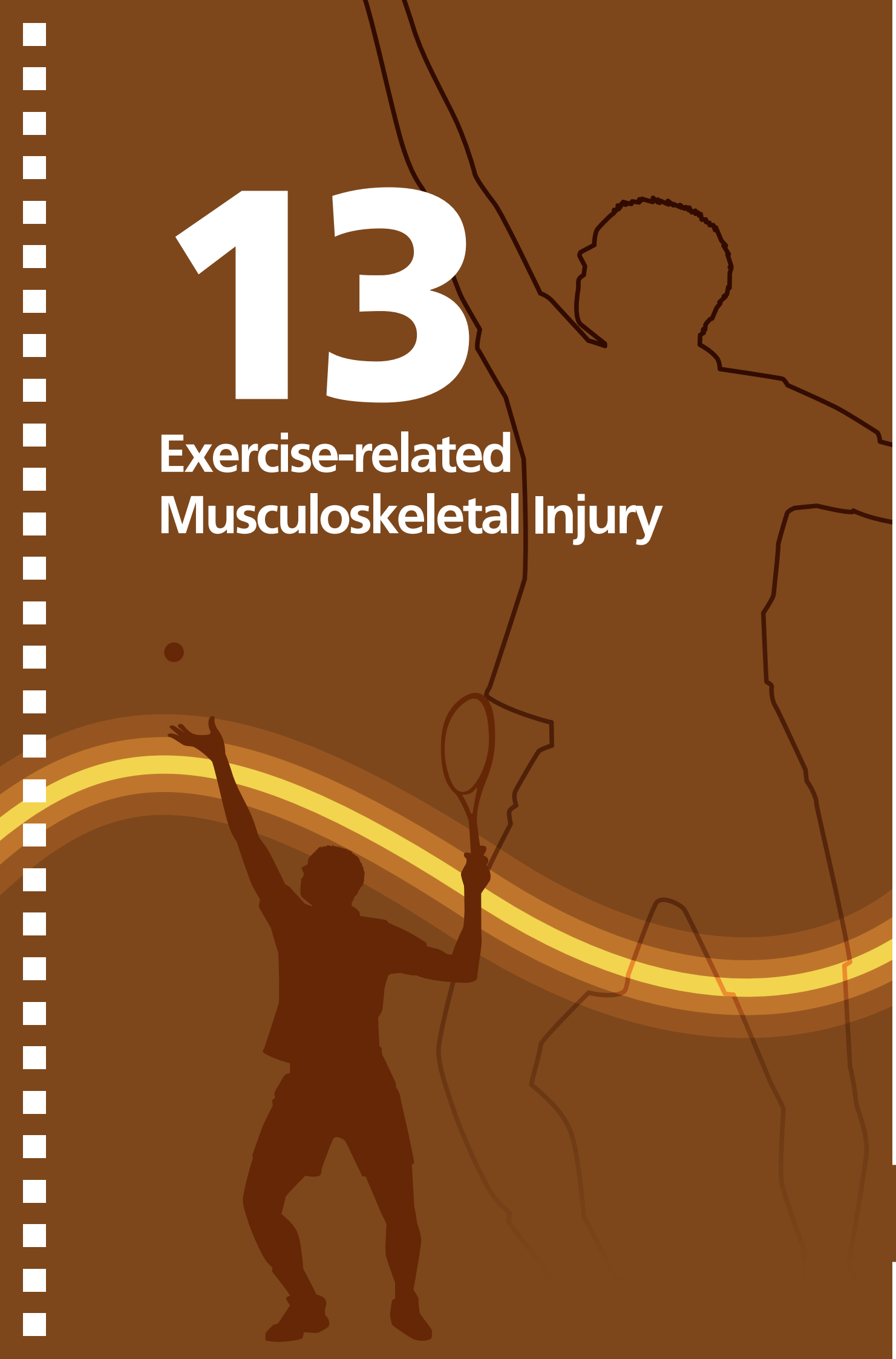
In the event that a patient suffers an injury or harm as a result of exercising, a doctor may defend his position if he can demonstrate that, in prescribing the exercise, he has exercised reasonable care and skill (i.e. he has discharged his professional responsibilities), and that he has acted with professional competence and in good faith.

Reference

1. American College of Sports Medicine. ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription, 6th edition. American College of Sports Medicine. 2010.

13

Exercise-related Musculoskeletal Injury



13 Exercise-related Musculoskeletal Injury

Most people are unlikely to sustain injury when performing exercise in accordance with a customised exercise plan. However, injuries and other adverse events do sometimes occur, with musculoskeletal injuries being the commonest. Even so, studies have shown that such injury occurs about once in every 1,000 hours of walking, and fewer than 4 for every 1,000 hours of running (1). Overall, the benefits of being physically active outweigh the potential harms (2).

Both physical fitness and total amount of exercise affect risk of musculoskeletal injuries (1) – people who are physically fit have a lower risk of injury than those who are not, and people who do large amounts of activity generally have a higher risk of injury than people who do less. More active men and women have a higher injury rate during sport and leisure-time activity while inactive adults report more injuries during non-sport and non-leisure time (3-4). Overall, it appears that healthy adults who meet the present recommendations by performing moderate-intensity activities have an overall musculoskeletal injury rate that is not significantly different from inactive adults (3). It is interesting to note that while physical activity above the minimal recommended level results in additional health benefits, the associated musculoskeletal health risks may increase possibly negating some of the added benefit (4). This dose-injury relation for specific activities is unknown and likely differs by activity and individual anatomic and behavioural characteristics (5). Hence, it is important for people to be engaged in physical activity safely. Box 13.1 provides some general points on how this can be done (1).

Box 13.1 Reminders for Safe Physical Activity

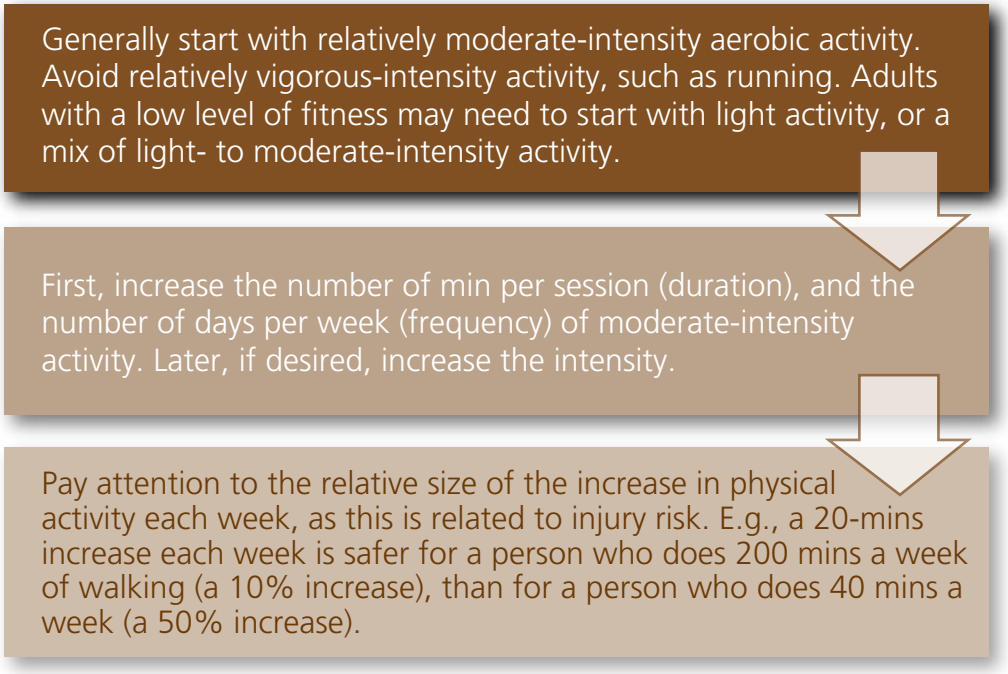
To perform physical activity safely, reduce risk of injuries and prevent adverse events, people should:

- Understand the risks and yet be confident that physical activity is safe for almost everyone.
- Choose to do types of physical activity that are appropriate for their current fitness level and health goals, because some activities are safer than others. Please refer to Table 13.1 for details about risks of different activities (1).
- Increase physical activity gradually over time whenever more activity is necessary to meet guidelines or health goals. Inactive people should "start low and go slow" by gradually increasing the frequency and duration of exercising. See Figure 13.1 for a general guidance on how to increase physical activity (1).
- Protect themselves by putting on protective gear, such as appropriate sports equipment, looking for safe environments, following rules and instructions, and making sensible choices about when, where, and how to be active. E.g. considering weather conditions and air quality.
- Be under the care of a health care provider if they have chronic medical conditions or symptoms. People with chronic conditions and symptoms should consult their family doctor about the types and amounts of activity suited to their needs.
- Seek professional advice from physical instructors or experts in sports medicine when embarking on new forms of resistance activity that require specific skills or are associated with a higher risk of injury.

Table 13.1 The Continuum of Injury Risk Associated with the Nature of Physical Activities (1)

Injury Risk Level	Nature of Physical Activity	Example
Lowest Risk	• Commuting	• Walking, cycling
Lower Risk	• Lifestyle	• Home repair, gardening/ yard work
Medium Risk	• Recreation/sports No contact	• Walking for exercise, golf, dancing, swimming, running, tennis
Higher Risk	• Recreation/sports Limited contact	• Cycling, aerobics, volleyball, baseball
Highest Risk	• Recreation/sports Collision/contact	• Football, basketball

Figure **13.1** General Guidance for Inactive People and Those with Low Levels of Physical Activity on How to Increase Physical Activity (1).



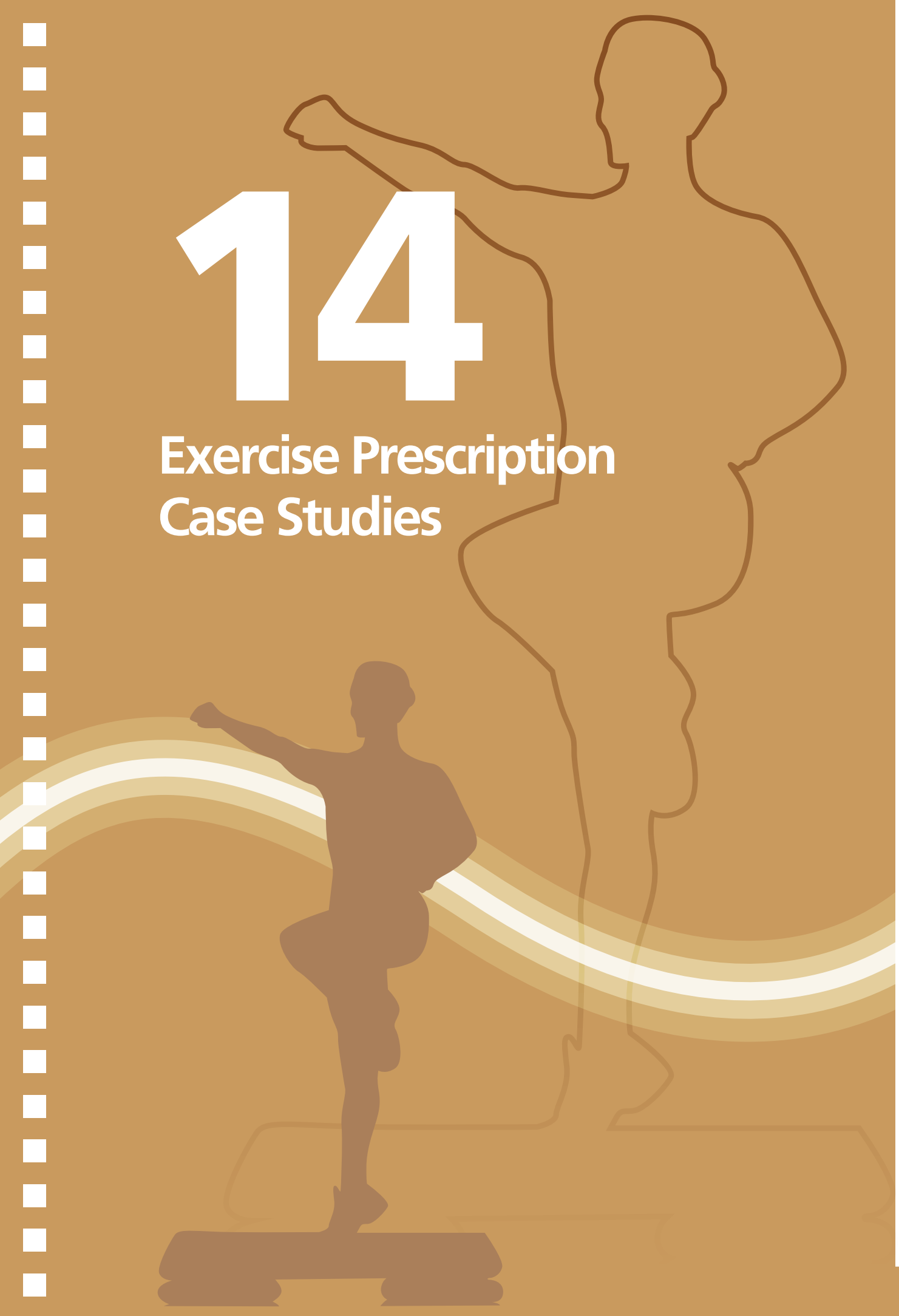
References

1. Physical Activity Guidelines Advisory Committee. *Physical Activity Guidelines Advisory Committee Report*, 2008. Washington (DC); US Department of Health and Human Services; 2008.
2. World Health Organization. *Global recommendations on physical activity for health*. Geneva: World Health Organization; 2010.
3. Carlson SA, Hootman JM, Powell KE, Macera CA, Heath GW, Gilchrist J, Kimsey CD Jr, Kohl HW 3rd. . Self-reported injury and physical activity levels: United States 2000–2002. *Ann Epidemiol* 2006; 16:712–9.
4. Haskell WL, Lee IM, Pate RR, Powell KE, et al. American College of Sports Medicine; American Heart Association. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 2007; Aug 28;116(9):1081-93.
5. Hootman, J. M., C. A. Macera, B. E. Ainsworth, C. L. Addy, M. Martin, and S. N. Blair. Epidemiology of musculoskeletal injuries among sedentary and physically active adults. *Med Sci Sports Exer* 2002; 34:838–44.

Reading Note

14

Exercise Prescription Case Studies



14 Exercise Prescription Case Studies

Case 1 – Risk Stratification

CY CHAN is a 43-year-old man with known history of hypertension on medication under good control. He works as a construction site labourer. He smokes one and a half pack of cigarettes per day, and has done so for over 25 years. His father died from a heart attack at age 60. CY has no signs and symptoms of cardiorespiratory disease. He has just completed a body check-up and the report showed body height of 173cm and body weight of 80kg, whereas blood test showed total cholesterol was found to be 8 mmol/L and fasting glucose of 5.4 mmol/L.

You are going to suggest CY to perform regular aerobic and muscle-strengthening exercises as some primary preventive measures for future cardiovascular events. Before that, you would like to stratify his risk to see if he should need further medical workup or exercise testing before increasing his physical activity level.

What risk stratification category is Mr. CHAN in?

Mr. CHAN has FOUR risk factors: cigarette smoking, hypertension (because he is on medication, even though his current blood pressure is under controlled), hypercholesterolaemia (based only on knowing his total cholesterol), and obesity (his BMI is 26.7kg/m^2 , which is regarded as obese according to the WHO's standard Asian classification of weight status).

He would not be classified as sedentary because of his physically active job nature. He does not have a family history of heart disease for screening purposes, because his father's heart attack occurred after the age of 55. His fasting glucose is normal. Although Mr. CHAN is considered to be young (less than 45), he is in the moderate-risk category, because he does not have any signs or symptoms of cardiorespiratory disease or know cardiovascular, pulmonary or metabolic disease.

At this stage, for performing low- to moderate-intensity physical activity, further medical workup and exercise testing are not necessary, although a sub-maximal exercise test of his cardiovascular fitness can offer a comprehensive appraisal of his condition. However, for embarking on a vigorous exercise programme, he would need further medical clearance from specialists or equivalent professionals according to the recommendations from the American College of Sports Medicine.

Case 2 – Prescribing Exercise Intensity

KC CHAN is a 56-year-old, moderate-risk male client. His old friend suffered a heart attack a week ago and he is worried about his own health. He wants to control his body weight so as to reduce his risk of heart disease. You are going to advise him to embark on moderate-intensity aerobic exercises on regular basis. His resting heart rate is 86 bpm.

What would be an appropriate target heart rate (HR) range for Mr. CHAN?

You could estimate Mr. CHAN's maximal heart rate (HR_{max}) as 220 – 56 = 164bpm. You may prescribe his target HR range by the following methods:

(1) %HR_{max} Method

The target HR range for performing moderate-intensity aerobic physical activity is 64 – 76% of HR_{max}.

Lower target HR = 164(0.64) = 105bpm
Upper target HR = 164(0.76) = 125bpm

(2) %HRR (Heart Rate Reserve) Method

The target HR range for performing moderate-intensity aerobic physical activity is 40 – 59% of HRR.

Lower target HR = (0.4)(164-86)+86 = 117bpm
Upper target HR = (0.59)(164-86)+86 = 132bpm

%HR_{max} Method of prescribing exercise intensity is simple to use and therefore very popular. However, it does not account for resting HR, which means clients with a slower resting HR would have a relatively higher exercise intensity compared to those with a faster resting HR. The %HRR Method avoids the problems association with these variations in resting HR.

Case 3 – Prescribing Exercise to Healthy Adult

SH CHAN is 40-year-old housewife seeing you for contact dermatitis. She enjoys good past health and has got no other significant risk factors for cardiovascular disease and is in the low risk category for exercise participation. Upon further exploration, she is interested in embarking on more physical activity for better health.

Design a comprehensive exercise prescription for Ms. CHAN.

You could apply the FITT principle (Frequency, Intensity, Time [duration] and Type [mode]) for devising an appropriate exercise prescription for Ms. CHAN.

◢ Aerobic Physical Activity

(1) Frequency

Perform moderate-intensity aerobic physical activity on at least 5 days per week or vigorous-intensity activity on at least 3 days per week, or a weekly combination of 3 to 5 days per week of moderate- and vigorous-intensity exercise.

(2) Intensity

A combination of moderate- and vigorous-intensity aerobic exercise is recommended. You could calculate a target heart rate range based on 64-93% maximal heart rate or based on 40-84% heart rate reserve.

(3) Time [duration]

Perform moderate-intensity aerobic exercise for at least 30 mins per day to a total of at least 150 mins per week, or vigorous-intensity exercise for at least 20 mins per day to a total of at least 75 mins per week. Performance of intermittent exercise of at least 10 mins in duration to accumulate the minimum duration prescribed above is an effective alternative to continuous exercise.

For additional and more extensive health benefits, you could advise her to increase her aerobic physical activity to 300 mins (5 hours) a week of moderate-intensity, or 150 mins a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate-and vigorous-intensity activity.

(4) Type [mode]

Aerobic exercise should be rhythmic in nature that involves large muscle groups and best require little skill to perform. Depending on Ms. CHAN's present skill and fitness, exercise and sports requiring skill to perform or higher level of fitness could also be recommended.

◢ Muscle-strengthening Physical Activity

(1) Frequency

Perform resistance exercise of each muscle group on 2 to 3 days per week with at least 48 hours separating the exercise training sessions for the same muscle group.

(2) Intensity

A load of 60 to 80% of 1 repetition maximum is recommended for resistance exercises.

(3) Time [duration]

8 to 10 resistance exercises are recommended. Each muscle group should be trained for a total of 2 to 4 sets with 8 to 12 repetitions per set and a rest interval of 2 to 3 mins in between.

(4) Type [mode]

Progressive weight training programme, weight bearing calisthenics, stair climbing and other muscle strengthening activities that use all major muscle groups are recommended. Multi-joint exercises involving more than one muscle group and targeting agonist and antagonist muscle groups are recommended, while single-joint exercises targeting major muscle groups may also be included. You should advise her to receive professional instruction in proper resistance exercise techniques.

◢ Others

A stretching exercise of at least 10 mins involving the major muscle tendon groups of body (i.e., neck, shoulder, upper and lower back, pelvis, hips and legs) with 4 or more repetitions (with 10 to 30 seconds for a static stretch) per muscle group performed on a minimum of 2 days per week is also recommended. Preferably, stretching activities are performed on all days that aerobic or muscle-strengthening activity is performed.

◢ Initiation and Progression of Exercise

Besides setting the recommended level of physical activity, you could also prescribe the rate of progression of exercise. Gradual increase in the volume of physical activity over time to pursue the above prescribed level is recommended.

◢ Follow Up

You must monitor Ms. CHAN's response to the exercise prescription. If she has difficulty completing this level, you need to reduce the intensity/duration. If she finds that at this level is very easy, increase the intensity/duration until it feels somewhat hard.

Case 4 – Prescribing Exercise to Sedentary Old Man

WM CHAN is 68-year-old man, who used to enjoy a sedentary lifestyle. His past medical history is unremarkable and he has got no other significant risk factors for cardiovascular disease and is in the moderate risk category for exercise participation.

Design a comprehensive exercise prescription for Mr. CHAN.

You could apply the FITT principle (Frequency, Intensity, Time [duration] and Type [mode]) for devising an appropriate exercise prescription for Mr. CHAN.

◢ Aerobic Physical Activity

(1) Frequency

Perform moderate-intensity aerobic physical activity on at least 5 days per week.

(2) Intensity

Moderate-intensity aerobic exercise is recommended. On a scale of 0 to 10 for level of physical exertion, 5 to 6 is for moderate intensity. Alternatively, you could calculate a target heart rate range based on 64-76% maximal heart rate or based on 40-59% heart rate reserve. (For embarking on vigorous-intensity aerobic exercise, further medical workup and exercise testing is necessary.)

(3) Time [duration]

Perform moderate-intensity aerobic exercise for 30 to 60 mins per day to a total of 150 to 300 mins per week. Performance of intermittent exercise of at least 10 mins in duration to accumulate the minimum duration recommended above is an effective alternative to continuous exercise.

(4) Type [mode]

Walking is most commonly recommended type of activity. Aquatic exercise and stationary cycle exercise may be advantageous for a sedentary old man with limited tolerance for weight bearing activity.

◢ Muscle-strengthening Physical Activity

(1) Frequency

Perform resistance exercise at least 2 days per week.

(2) Intensity

Moderate-intensity (5 to 6) on a 10-point scale is recommended.

(3) Time [duration]

8 to 10 resistance exercises are recommended and each muscle group should be trained for a total of 1 or more sets with 10 to 15 repetitions per set.

(4) Type [mode]

Progressive weight training programme, weight bearing calisthenics, stair climbing and other muscle strengthening activities that use all major muscle groups are recommended. For resistance training involving use of weight-lifting machines, initial training sessions should be supervised and monitored by personnel who are sensitive to special needs of older adults.

◢ Others

For enhancing Mr. CHAN's physical flexibility, stretching exercise of at least 10 mins involving the major muscle tendon groups of body with 4 or more repetitions (with 10 to 30 seconds for a static stretch) per muscle group performed on a minimum of 2 days per week is recommended.

For improving balance, agility and proprioception, neuromuscular exercises is also recommended at least 2 days per week.

◢ Initiation and Progression of Exercise

Besides setting the recommended level of physical activity, you could also prescribe the rate of progression of exercise. Since Mr. CHAN used to be sedentary, the intensity and duration of physical activity to be performed should be low at the beginning of the exercise programme for enhancing compliance and ensuring safety. Gradual increase in the volume of physical activity over time to pursue the above prescribed level is recommended. Subsequent to a period of adaptation and improved musculo-tendinous conditioning, Mr. CHAN may also choose to follow guidelines for younger adults in the long run.

◢ Follow Up

You must monitor Mr. CHAN's response to the exercise prescription. If he has difficulty completing this level, you need to reduce the intensity/duration. If he finds that at this level is very easy, increase the intensity/duration until it feels somewhat hard.

Case 5 – Prescribing Exercise to Obese Adult

CT CHAN is 35-year-old female with a BMI of 28.5kg/m^2. She asks you for the types of exercise she should do for shaping up her body. Her past medical history is unremarkable and she has got no other significant risk factors for cardiovascular disease and is in the low risk category for exercise participation.

Design a comprehensive exercise prescription for Ms. CHAN.

You could apply the FITT principle (Frequency, Intensity, Time [duration] and Type [mode]) for devising an appropriate exercise prescription for Ms. CHAN.

◢ Aerobic Physical Activity

(1) Frequency

Perform aerobic physical activity on at least 5 days per week.

(2) Intensity

Moderate- to vigorous-intensity aerobic exercises are recommended. Subject to Ms. CHAN's availability and ability, she may prefer doing vigorous exercise as it is less time consuming. You could calculate a target heart rate range based on 64-93% maximal heart rate or based on 40-84% heart rate reserve.

(3) Time [duration]

Perform 45 to 60 mins of moderate-intensity activity a day (corresponding to approximately 225 to 300 mins/week of moderate-intensity physical activity or lesser amounts of vigorous physical activity)

(4) Type [mode]

Walking is most commonly recommended type of activity. Weight-bearing physical activity may be difficult for some obese individuals particularly for those with joint problems. For these individuals, gradually increasing non-weight-bearing moderate-intensity physical activities (e.g. cycling, swimming, water aerobics, etc.) should be encouraged.

◢ Muscle-strengthening Physical Activity

(1) Frequency

Perform resistance exercise of each muscle group on 2 to 3 days per week with at least 48 hours separating the exercise training sessions for the same muscle group.

(2) Intensity

A load of 60 to 80% of 1 repetition maximum is recommended for resistance exercises.

(3) Time [duration]

8 to 10 resistance exercises are recommended. Each muscle group should be trained for a total of 2 to 4 sets with 8 to 12 repetitions per set and a rest interval of 2 to 3 mins in between.

(4) Type [mode]

Progressive weight training programme, weight bearing calisthenics, stair climbing and other muscle strengthening activities that use all major muscle groups are recommended.

◢ Initiation and Progression of Exercise

If Ms. CHAN is sedentary, she should build up to her physical activity targets over several weeks, starting with 10 to 20 mins of physical activity every other day during the first week or two, to minimise potential muscle soreness and fatigue for enhancing compliance.

If she chooses to incorporate vigorous intensity activity into her programme, she should do this gradually and after an initial 4–12 week period of moderate-intensity activity.

With additional social and technical support (e.g. inclusion of family members in programme, small group meetings with exercise coaches or small monetary incentives), prescribing higher physical activity targets (i.e. >300 mins per week of moderate-intensity physical activity) may resulted in significantly greater weight loss.

◢ Follow Up

You must monitor Ms. CHAN's response to the exercise prescription. If she has difficulty completing this level, you need to reduce the intensity/duration. If she finds that at this level is very easy, increase the intensity/duration until it feels somewhat hard.