

4

General Principles of Exercise Prescription



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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).

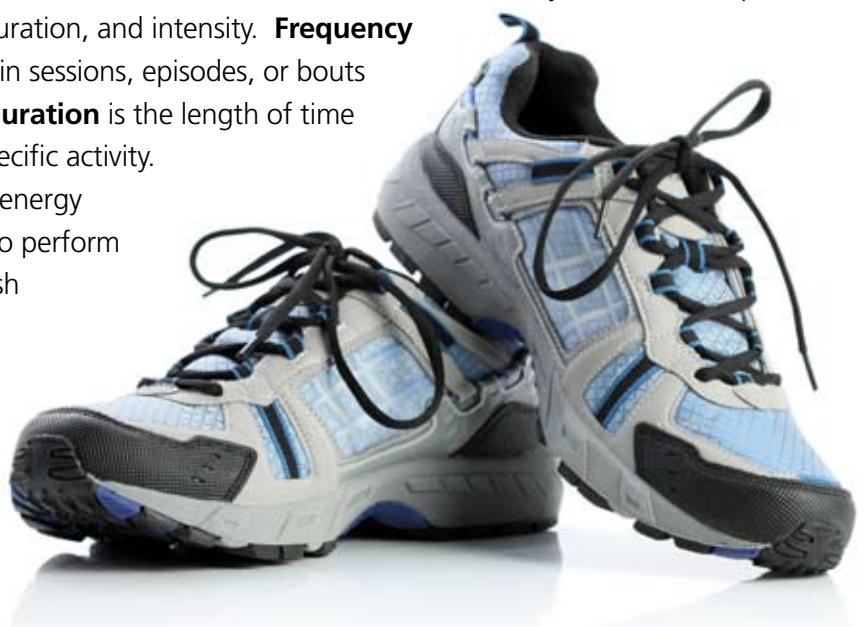
Sport 「體育運動」

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	<ul style="list-style-type: none">Improves body composition and cardiorespiratory fitness
Muscle-strengthening Activity	<ul style="list-style-type: none">Improves muscular fitness such as muscular strength and endurance
Stretching Activity	<ul style="list-style-type: none">Improves flexibility such as range of motion
Neuromuscular Activity	<ul style="list-style-type: none">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)	<ul style="list-style-type: none"> The number of days per week dedicated to an exercise session
Intensity (I)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> The length of time in which an activity or exercise is performed. Duration is generally expressed in mins.
Type (T)	<ul style="list-style-type: none"> The mode of exercise performed.

Table 4.3 Methods for Assessing Aerobic Intensity

Methods	Descriptions
METs	<p>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).</p> <ul style="list-style-type: none"> • 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). <p>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).</p>
VO_{2max} / VO_{2R}	<p>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)</p>
$\%HR_{max} / \%HRR$	<p>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)</p>
RPE	<p>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).)</p>

* 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) = $[(HR_{max} - \text{resting HR}) \times \% \text{ intensity desired}] + \text{resting HR}$

Table 4.4 MET Equivalents of Common Aerobic Activities*

Types of Activity	Light <3 METs	Moderate 3 to <6 METs	Vigorous ≥ 6 METs
Walking	<ul style="list-style-type: none"> Walking slowly around home, store or office = 2.0 	<ul style="list-style-type: none"> Walking ~5 km/h = 3.3 Brisk walking at ~6 km/h = 5.0 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Cleaning — heavy: washing windows or car = 3.0 Sweeping floors or carpet, vacuuming, mopping = 3.0–3.5 	<ul style="list-style-type: none"> Shovelling, digging ditches = 8.5 Carrying heavy loads such as bricks = 7.5
Leisure and Sports	<ul style="list-style-type: none"> Arts & crafts, playing cards = 1.5 Playing most musical instruments = 2.0–2.5 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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*

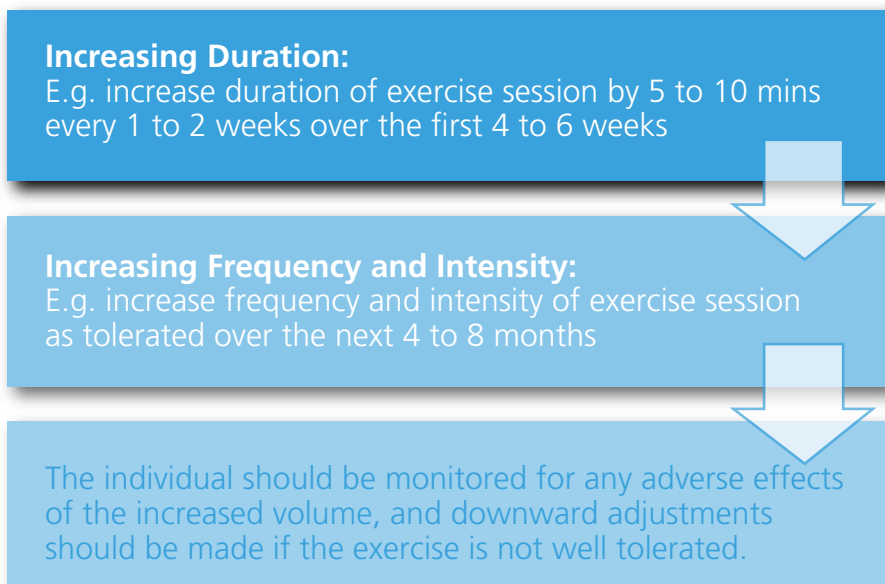
Intensity	Methods to Quantify Relative Intensity		
	VO ₂ R(%)/HRR(%)	HR _{max} (%)	RPE
Light	20-39	50-63	<5 out of 10
Moderate	40-59	64-76	5–6 out of 10
Vigorous	60-84	77-93	≥7 out of 10

* 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

Table 4.7 Types of Stretching Techniques

Types	Brief Description
Static Stretching	<ul style="list-style-type: none"> • Involves a voluntary passive relaxation of muscle while it is elongated
Dynamic Stretching	<ul style="list-style-type: none"> • Involves a swinging, bouncing or bobbing movement during the stretch as the final position in the movement is not held
Active Stretching	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Slow movements of a muscle, such as lateral neck flexions, arm rotations and trunk rotations
Proprioceptive Neuromuscular Facilitation	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • At least 5 to 10 mins of low to moderate intensity aerobic exercise or resistance exercise with lighter weights.
Conditioning	<ul style="list-style-type: none"> • 0 to 60 mins of aerobic, resistance, neuromuscular, and/or sport activities
Cool-down	<ul style="list-style-type: none"> • At least 5 to 10 mins of low to moderate intensity aerobic exercise or resistance exercise with lighter weights
Stretching	<ul style="list-style-type: none"> • 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 Transtheoretical 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	<ul style="list-style-type: none">The individual is not physically active now and does not intend to become more physically active in the next 6 months
Contemplation	<ul style="list-style-type: none">The individual is not physically active now but intends to become more physically active in the next 6 months
Preparation	<ul style="list-style-type: none">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	<ul style="list-style-type: none">The individual has been engaging in regular physical activity to the recommended level for less than 6 months.
Maintenance	<ul style="list-style-type: none">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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Provide a structured, individually tailored counselling message based on the patient's stage of change, e.g.:<ul style="list-style-type: none">– 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	<ul style="list-style-type: none"> • Agree on the next step and initiate shared decision making based on the patient's stage of change <ul style="list-style-type: none"> – 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	<ul style="list-style-type: none"> • 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/lc_fac.php for more information about the leisure and sports facilities provided by the Leisure and Cultural Services Department.) • Refer when appropriate
Arrange	<ul style="list-style-type: none"> • 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, Emplainscourt 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.