Prescribing exercise for women

Carlin Senter · Nicole Appelle · Sarina K. Behera

Published online: 4 April 2013
© Springer Science+Business Media New York 2013

Abstract One- half of women in the United States do not meet the weekly dose of physical activity recommended by the Centers for Disease Control. Many women could benefit tremendously if they were to adopt a more active lifestyle. Health benefits from exercise include lowering the risk for cardiovascular disease, slowing the rate of bone loss in osteoporosis, and improving mood during pregnancy. In this article, we review the health benefits that women may gain from physical activity and the recommendations for physical activity for adults in the United States. We offer evidence supporting use of the exercise prescription, discuss how to write an exercise prescription, and how to tailor the exercise prescription for women with particular medical problems.

Keywords Exercise prescription · Physical activity · Exercise · Women · Primary care · Fitness · Cardiovascular disease · Hypertension · Congestive heart failure · Diabetes · Osteoarthritis · Osteoporosis · Depression · Cognitive decline · Pregnancy · Obesity

C. Senter (✉)
Departments of Medicine and Orthopedics,
University of California, San Francisco, 1500 Owens
Street, San Francisco, CA 94158, USA
e-mail: Carlin.Senter@ucsf.edu

N. Appelle
Division of General Internal Medicine,
University of California, San Francisco, 1545 Divisadero,
2nd Floor, San Francisco, CA 94143, USA
e-mail: Nicole.appelle@ucsf.edu

S. K. Behera
Departments of Cardiology and Pediatrics,
California Pacific Medical Center, 3700 California Street,
Ste 1560, San Francisco, CA 94118, USA
e-mail: Beheras@sutterhealth.org

Introduction

There is a large body of evidence supporting the health benefits of physical activity and exercise. Despite this literature, however, the majority of people in the United States do not achieve the recommended goal of 150 min/wk of moderate intensity aerobic exercise [1]. Furthermore, women often get less exercise than men. According to the Center for Disease Control's Behavioral Risk factor surveillance system in 2007, 26.2 % of women reported getting no leisure-time physical activity compared with 21.7 % of men [2]. In this article, we review the health benefits of exercise, the utility of exercise prescriptions to encourage physical activity, and the principles of writing exercise prescriptions for women.

Definitions

A review of definitions is important in any discussion of exercise prescriptions. Physical activity includes any movement of the body such as shopping, gardening, riding a bike to work, or walking upstairs. Exercise is a type of physical activity that is planned and structured with the intention of improving physical fitness. An exercise prescription is a written or verbal order from a healthcare provider to a patient describing the type, duration, intensity, and frequency of exercise recommended for the patient to achieve a particular health goal.

Benefits of exercise for women's health

Coronary heart disease

Cardiovascular benefits of exercise have been well established through large epidemiological studies. In studies

combining women and men, women have had similar findings to men with reductions of 30 %–50 % risk of cardiovascular events with regular physical activity [3]. In the Women's Health Initiative Observational Study, a prospective multicenter trial of 73,743 postmenopausal women ages 50 to 79 years from diverse racial and ethnic backgrounds, women who walked briskly or exercised vigorously at least 2.5 hours per week had 30 % risk reduction of cardiovascular events including myocardial infarction and congestive heart failure [3]. Physical activity lowers cardiovascular risk in a dose-dependent fashion. Even small amounts of exercise are better for cardiovascular health than no exercise [4]. The longer the exercise duration the lower the cardiovascular risk [5].

Hypertension

Exercise decreases blood pressure and lowers mortality in women with hypertension [6]. During moderate aerobic or resistance activity, systolic blood pressure modestly increases while diastolic blood pressure is unchanged or mildly decreases. After 1 aerobic exercise session, systolic and diastolic blood pressure acutely decrease by 8 and 9 mm Hg, and there is sustained peripheral vasodilation for a few hours [7, 8].

Congestive heart failure

Historically, patients with heart failure were prohibited from exercising until it was recognized that physical deconditioning leads to worsening of heart failure symptoms and exercise intolerance. Short-term aerobic, endurance, and resistance training programs can improve exercise capacity, quality of life, and cardiac function in women and men with heart failure [9–13]. The (Heart Failure) HF-ACTION randomized controlled trial (RCT) demonstrated that exercise training leads to modest reductions in all-cause mortality and hospitalization in heart failure patients [13].

Osteoarthritis of the knee

Aerobic and strength exercises are beneficial for lower extremity osteoarthritis [14, 15]. Walking and home quadriceps strengthening exercises have been shown to decrease pain and improve function. The Arthritis, Diet and Activity Promotion trial, where >70 % of participants were women, demonstrated that moderate exercise and weight loss resulted in significant improvement in self-reported and observed function as well as decreased pain [16]. Aquatic therapy has not been as well-studied as land-based activity in osteoarthritis, but can also lead to small short-term improvements in function and reductions in pain [17].

Osteoporosis

Exercise interventions including weight bearing exercise and strength training have been shown in a variety of studies to decrease loss of bone density, especially in postmenopausal women [18–20]. In the Nurse's health cohort, increased amounts of physical activity were associated with a significant decrease in the risk of hip fracture [21]. In this study, participants who did at least 24 metabolic equivalent hours per week of physical activity were found to have a 55 % reduction in their risk of fracture compared with the sedentary participants.

Pregnancy

Aerobic exercise during pregnancy is associated with many health benefits including decreased maternal hypertension [22] and gestational diabetes [23]. One RCT of nulliparous women found that aerobic exercise during pregnancy helps reduce depressive symptoms during pregnancy [24]. Daley et al. found that exercise significantly reduced symptoms of postpartum depression [25].

Diabetes

The Diabetes Prevention Program established the effectiveness of lifestyle intervention in prevention of type II diabetes in patients at risk [26]. In this landmark trial, intensive lifestyle modification with improved diet and exercise habits resulted in a 58 % reduction in the development of diabetes compared with placebo [26]. In a 10-year observation period after completion of the intervention, the intervention group had a 34 % reduction in the risk of type 2 diabetes compared with the placebo group [27]. The Finnish prevention trial also showed a significant decrease in the incidence of diabetes with an intensive lifestyle intervention, with a 43 % reduction in the relative risk of diabetes in the intervention period and a 36 % reduction in risk in the 3-year observation period following the intervention [28]. Exercise helps improve glycemic control and reduce the risk of cardiovascular disease in diabetics. Diabetic women who participate in more than 4 hours per week of exercise have a 40 % lower risk of cardiovascular events than sedentary diabetic women [29].

Obesity

Exercise clearly leads to health benefits in obese patients. Patients lose more weight when dieting if they add an exercise program [30]. Exercise is important in maintenance of weight loss after a patient has lost weight from dieting [31–33]. Even without loss of weight, physical activity lowers the risk of cardiovascular disease and death in obese patients. In the nurse's health study, obese patients who

exercised 3.5 hours per week significantly decreased their risk of coronary artery disease compared with obese patients who did not exercise [34].

Cancer

Lack of physical activity has been associated with increased risk for developing colon cancer [35], postmenopausal breast cancer [36], and endometrial cancer [37]. The risk reduction for colon cancer appears to be approximately equal for men and women [35]. The Nurse's Health study reported a 23 % reduction in colon cancer risk between the most active and least active patients [35]. Many trials have studied physical activity and breast cancer patients. According to a systematic review of RCTs by McNeely et al., higher levels of physical activity are significantly associated with improvement in quality of life and reduction of fatigue in women with breast cancer [38].

Depression

According to the National Health and Nutrition Evaluation survey, women are more likely to be depressed than men, and patients with depression are less likely to participate in vigorous physical activity than patients without depression [39]. The benefit of physical activity on depressive symptoms is well established [40]. Herring et al. conducted a large meta-analysis of the effect of exercise on depression for patients with chronic illness [41]. Exercise was more effective for improving depressive symptoms if it was of moderate to vigorous intensity. There was a trend toward increased effectiveness of group or leader-led exercise interventions compared with solo exercise.

Cognitive impairment

Exercise has been shown to significantly decrease cognitive decline. One large meta-analysis of RCTs evaluating the effect of exercise in patients with cognitive impairment, demonstrated that aerobic and resistance exercises significantly increased physical fitness and improved cognitive outcomes [42]. Maki et al. conducted a RCT of 150 adults (106 women and 44 men) studying the effect of introducing a walking program and found significant improvements in quality of life, word fluency, and functional capacity [43].

Risks of exercise

Most data on adverse events from physical activity comes from studies of walkers, runners, and military recruits. The prevalence of injuries in recreational walkers and runners varies depending on the study, from <10 % to 40 % [44]. Injury rates increase linearly with minutes per week of

physical activity [45]. The majority of injuries reported are lower extremity injuries [44].

Sudden cardiac death can be triggered by intense exercise, usually in adults >35 years of age who do not exercise regularly [46]. Sudden cardiac death during exercise is a very rare event in women. Regular moderate to vigorous exercise >2 hours per week may actually mitigate the very small risk of exertion-related sudden death by improving overall health status and leading to a decrease in long-term mortality from cardiovascular disease [47].

The exercise prescription

Several high-quality RCTs demonstrate the efficacy of exercise prescriptions. Elley et al. found that exercise prescriptions increased the total number of people exercising and were associated with modest health benefits [48]. Lawton et al. conducted a RCT of physically inactive women and found an increase in physical activity, self-reported physical function, and mental health parameters by combining exercise prescription with telephone counseling [49].

It is possible that not every patient benefits from exercise counseling in the office. The U.S. Preventive Services Task Force (USPSTF) recently issued a grade C recommendation for primary care providers conducting behavioral counseling on exercise with their patients who do not have risk factors for cardiovascular disease. The evidence suggests that the effects of counseling on lowering blood pressure, lipids, and blood sugar in these low-risk patients are small. The interventions yielding benefit involved a significant amount of time (at least 360 minutes of counseling), the majority of which was done by health educators, nurses, dietitians, or exercise instructors (not primary care providers). The USPSTF suggests that primary care providers consider offering counseling on diet and physical activity for a select group of patients, such as patients who are ready to change or who have risk factors for cardiovascular disease. The USPSTF also suggests that clinicians consider community resources in helping patients achieve diet and physical activity goals [50].

Exercise prescription under-utilized in primary care

The exercise prescription can affect change in patients, particularly those who are motivated to change and those with risk factors for or existing cardiovascular disease. However, many practitioners do not incorporate exercise prescriptions into their practice. On self-report, primary care providers found that 40 % of the time they provided less than 1 verbal or written exercise prescription per month [51]. One study observed primary care physicians counseling about exercise and found that physicians did not assess activity type or amount in detail, rarely assessed readiness

for change for patients not meeting exercise goals, and offered minimal assistance if a patient admitted ambivalence toward behavior change [52].

Barriers to using the exercise prescription

Providers cite the following limitations in their ability to provide behavioral health counseling: the need to concentrate on more medically pressing issues, lack of time, lack of compensation, lack of training, and lack of knowledge of available resources [53].

There are many potential barriers that prevent patients from following an exercise prescription. Simons-Morton evaluated a series of nearly 900 primary care patients and found that lack of exercise was associated with being female, being over the age of 65, and with having low self-efficacy around exercise [54]. Barriers preventing indigent internal medicine patients with arthritis from being more active included perceived bad health and pain [55]. Environmental factors, such as living in an unsafe neighborhood or living too far from the local park, are also cited by patients as limiting their ability to exercise [56]. Targeting counseling around patients' concerns may increase the likelihood of effectively adopting an exercise regimen.

Action plan: writing the exercise prescription

Assess the patient

Using exercise as medicine in the primary care setting first requires that the provider determine whether or not the patient is meeting current goals for physical activity. We ask patients to describe the frequency, intensity, duration, and type of activity they are doing. Next we evaluate the patient's stage of change. The Stages of Change model describes patients' behavior regarding addiction and has been validated for use in physical activity counseling [57, 58]. The model describes 6 stages: precontemplation (not intending to exercise), contemplation (planning to exercise in the next 6 months), preparation (exercising less than the recommended amount), action (meeting the exercise goal for less than 6 months), maintenance (exercising more than 6 months), and relapse (slipping to earlier stage). The closer a patient is to the maintenance stage, the more likely he or she is to adopt the given behavior, whether this is quitting smoking or exercising [57].

Next, we determine whether or not the patient is healthy enough to start exercising. We ask our patients whether or not they have chest pain with or without physical activity. We ask about any history of syncope, dizziness, coronary artery disease, hypertension, diabetes, or pulmonary disease. We review all medications. Patients with certain medical problems will benefit from accommodations in their exercise prescription

(see section below). Most asymptomatic adults can undertake an exercise program without additional work-up.

Physical activity dose

The 2008 Physical Activity Guidelines for Americans and the Centers for Disease Control recommend that adults age 18–64 undertake a minimum of 150 minutes of moderate-intensity aerobic activity and 2 days of strength training of all major muscle groups each week [1, 59•]. The American College of Sports Medicine (ACSM) recommends 4 types of exercise: cardiorespiratory, resistance, flexibility, and balance. Each type is modified using the FITT principle. FITT stands for Frequency, Intensity, Time, and Type. See Table 1 for the ACSM recommendations using the FITT principle for each type of exercise [60•]. For our patients who are in the contemplation, action, and maintenance stages we write an exercise prescription in the primary care setting. We write the prescription by selecting 1 to 4 types of exercise for the patient (depending on the patient's comfort level and experience), then describing the frequency, intensity, and amount of time to be spent on that type of activity.

Which exercise prescriptions are most likely to facilitate adherence?

After motivating a patient to adopt a physical activity intervention, the next challenge is adherence. Clinicians should be aware of factors associated with low adherence as patients with these characteristics may benefit from higher intensity counseling. Factors associated with poor adherence to exercise programs include baseline inactivity, lack of time to exercise, and female gender [61, 62]. For patients who are new to exercise, adherence is higher for moderate-intensity exercise prescriptions than vigorous-intensity programs [59•].

Like other forms of behavior change, increasing physical activity requires follow-up to motivate the patient and to address barriers to regular exercise. Exercise programs that support individualized goals, provide social support, and offer ongoing therapeutic contact may increase patient compliance. In a systematic review of RCTs evaluating long-term exercise adherence, authors found that use of written exercise prescriptions had the most evidence as an effective means of increasing long-term exercise adherence [63].

Prescribing exercise for special patient populations

Coronary heart disease

Patients who have experienced a major cardiac event, including myocardial infarction, should be referred to a cardiac rehabilitation program. Although these programs are

Table 1 Summary of the American College of Sports Medicine exercise recommendations for adults in the US [56]

	Frequency	Intensity	Time	Type
Cardiorespiratory	5 d/wk	Moderate	30 min	Vigorous walking, jogging, swimming, hiking, cycling
Strength	2–3 d/wk	60 %–70 % of one-rep max for novice, 40 %–50 % of one-rep max for older person or sedentary person	8–12 repetitions, 2–4 sets with rest of 2–3 min between each set	Involving all major muscle groups. Can be body weight, free weights, bands, weight machines.
Flexibility	2–3 d/wk	Stretch to point of feeling tightness	Hold stretch for 10–30 s, repeat each flexibility exercise 2–4 times.	Involving all major muscle-tendon units. Can be ballistic, static, dynamic, or proprioceptive neuromuscular facilitation.
Balance	2–3 d/wk	Has not been determined	20–30 min	Tai Chi, Yoga, Qigong

typically underutilized and have low attendance, they are beneficial in these at-risk patients. Patients who are not enrolled in a formal cardiac rehabilitation program can be prescribed aerobic exercise for 30 minutes at least 5 days a week at a moderate intensity or 65 %–85 % of peak heart rate [64]. Perceived exertion should be 5–7 on a scale of 0 (rest) to 10 (high-intensity exercise training). Moderate intensity resistance training consisting of 10–15 repetitions, 1–3 sets of 8–10 different exercises for both upper and lower extremities 2–3 times/week can be recommended to supplement aerobic exercise [63].

Hypertension

Patients who have hypertension should be advised to gradually increase their intensity and duration of exercise. Their exercise prescription can otherwise have similar goals as the general population: moderate intensity aerobic exercise for 30 minutes at least 5 days a week [65, 66]. For those patients who are achieving the goals for moderate aerobic exercise, there may be a role for high intensity training. High intensity interval training may lead to higher levels of cardiorespiratory fitness than the standard recommendation of continuous moderate intensity exercise training in hypertensive patients [67]. Similarly, young normotensive women at high familial risk for hypertension have lower recovery heart rate and higher functional capacity with high intensity interval training than with continuous moderate intensity training [68]. Patients who have severe baseline hypertension (BP > 180/110 mm Hg) should be started on medication prior to starting an exercise program.

Congestive heart failure

The American College of Cardiology and the American Heart Association recommend exercise training in stable outpatients with chronic heart failure [69]. Heart failure patients should undergo exercise testing for ischemia in conjunction with a cardiologist evaluation before starting an exercise program [9]. Establishing the maximum heart

rate to guide exercise training can be done during initial testing. Heart failure patients need a longer warm-up period and should increase the length of low-intensity aerobic exercise gradually by 1 to 2 minutes until they can tolerate 15–30 minutes of exercise approximately 3–5 times per week. Ideally, initiation of the exercise program with the goal of achieving 60 %–70 % of heart rate reserve (peak heart rate on exercise testing minus resting heart rate) would be done under medical supervision and then transitioned to a home maintenance program when appropriate [70]. High-intensity interval training (at 85 %–95 % of peak heart rate lasting 1 to 4 minutes interspersed with intervals of rest or active recovery) as tolerated in heart failure patients may lead to further improvements in functional capacity [10]. However, large studies to establish safety of high intensity training in this patient population are required before changing the current paradigm [71].

Patients taking beta blockers

Beta blockers are used to treat patients with heart failure, hypertension, post-myocardial infarction, cardiomyopathy, and/or arrhythmias. Beta blockers can decrease exercise performance. It can be difficult to use the general recommendation of exercise training at 70 %–85 % of peak heart rate in these patients because of their blunted heart rate response. In one small study of predominately men with coronary artery disease on a beta blocker, a heart rate-driven exercise prescription led to undertraining and lower intensity exercise than using workload or patient feelings of perceived exertion [72]. In these patients, using the Borg scale of perceived exertion may be helpful to assess their target response to exercise with a goal of about 13 [73, 74]. The Borg scale ranges from 6 to 20 with 6 being no exertion at all, 11 being light exertion, 15 hard, and 19 extremely hard.

Osteoarthritis of the knee

The American Academy of Orthopaedic Surgeons (AAOS) recommends that patients with osteoarthritis of the knee

participate in low-impact aerobic exercise that focusses on quadriceps strengthening, muscle flexibility, and knee range of motion. Evidence is strong regarding the benefits of low-impact activity for knee osteoarthritis. The AAOS reviewed 13 RCTs evaluating the effect of walking or cycling on patients' pain and disability. They found that low-impact activity significantly lowered disability and pain in these patients. Studies on knee range of motion and muscle flexibility in patients with knee osteoarthritis are lacking; thus the AAOS recommendation is an expert opinion. Data on quadriceps strengthening is heterogeneous; however in their meta-analysis the AAOS found significant effects of pain and disability with increased quadriceps strength in patients with knee osteoarthritis [75].

Osteoporosis

Women with osteoporosis of the femoral neck should participate in progressive resistance training for the lower extremities. Progressive resistance training has been shown to have the greatest effect on increasing femoral neck bone mineral density compared with other forms of exercise. Women with osteoporosis of the spine should participate in mixed type of exercise (both weight-bearing exercise and low to high resistance training) to increase bone mineral density. The exercise intervention should be done 2–3 times per week [76]. Group and home-based exercise programs that focused on gait, balance, strength, walking, and/or 3-dimensional movement (such as Tai Chi) have been shown to reduce rates of falling [77].

Pregnancy

The American Congress of Obstetricians and Gynecologists has published the following absolute contraindications to exercise in pregnancy: hemodynamically significant heart disease, restrictive lung disease, incompetent cervix/cerclage, multiple gestations at risk for premature labor, persistent second or third trimester bleeding, placenta previa after 26 weeks gestation, premature labor during the current pregnancy, ruptured membranes, and preeclampsia or pregnancy-induced hypertension. Barring one of the above conditions, pregnant women benefit from following the recommendations from ACSM and the CDC to undertake moderate-intensity exercise 30 minutes a day most days of the week. Pregnant women should avoid contact sports, sports with a high risk of falling, and scuba diving [78].

Diabetes

With a few exceptions as noted below, diabetics should follow the same physical activity guidelines as the general adult population, obtaining 150 min/wk of moderate-

intensity aerobic activity and 2 days/week of strength work. Exercise is safe in hyperglycemia as long as the patient does not have urine or blood ketones. If pre-exercise glucose is <100 mg/dL in a diabetic patient who uses insulin, a pre-exercise carbohydrate should be ingested in order to avoid further hypoglycemia. Patients with severe nonproliferative diabetic retinopathy or proliferative diabetic retinopathy should avoid high-intensity aerobic and resistance exercise due to increased risk for vitreous hemorrhage and retinal detachment. Patients with severe peripheral neuropathy should consider non weight-bearing activities, as decreased peripheral sensation puts these patients at higher risk for skin breakdown, infection, and joint injury with impact activities. Patients with autonomic neuropathy are at risk for decreased cardiac response to exercise. These patients should be evaluated by a cardiologist prior to initiating an exercise program [79].

Conclusions

Exercise can serve as a low-risk, beneficial treatment for many common medical problems faced by women in the United States, from coronary artery disease to osteoporosis to osteoarthritis. Despite the health benefits that may be reaped from exercising, the majority of people in the United States do not meet the recommended daily dose of 30 minutes of moderate-intensity exercise most days of the week. Many primary care providers do not commonly prescribe exercise. Writing an exercise prescription is one way to encourage a patient to increase his or her physical activity. An exercise prescription can be written first by assessing the patient's stage of change, next assessing the patient's safety for exercise, and lastly writing a prescription using the FITT principle (Frequency, Intensity, Time, and Type). Close follow-up with the patient helps facilitate adherence. Most patients will see health benefits by incorporating 30 min/d of moderate-intensity cardiovascular activity into their daily routine. Some patients, such as those with coronary artery disease, congestive heart failure, knee osteoarthritis, and diabetes will benefit from specific tailoring of their exercise prescription based on their medical history. Involving a cardiologist, orthopedist, and/or physical therapist can help the primary care provider use exercise as medicine for patients with all kinds of medical problems. Often it is these patients who stand to benefit the most from an exercise intervention.

Conflict of interest Carlin Senter declares that she has no conflict of interest. Nicole Appelle declares that she has no conflict of interest. Sarina K. Behera declares that she has no conflict of interest.

References

Papers of particular interest, published recently, have been highlighted as:

- Of importance

1. US Department of Health and Human Services. Physical Activity Guidelines for Americans. 2008. Available at: <http://www.health.gov/paguidelines/guidelines/default.aspx>. Accessed October, 2012.
2. Center for Disease Control and Prevention. US Physical Activity Statistics. 2007. Available at: apps.nccd.cdc.gov. Accessed November, 2012.
3. Manson JE, Greenland P, LaCroix AZ, et al. Walking compared with vigorous exercise for the prevention of cardiovascular events in women. *N Engl J Med*. 2002;347:716–25.
4. Lee IM, Rexrode KM, Cook NR, et al. Physical activity and coronary heart disease in women: is "no pain, no gain" passé? *JAMA*. 2001;285:1447–54.
5. Sattelmair J, Pertman J, Ding EL, et al. Dose response between physical activity and risk of coronary heart disease: a meta-analysis. *Circulation*. 2011;124:789–95.
6. Rossi A, Dikareva A, Bacon SL, Daskalopoulou SS. The impact of physical activity on mortality in patients with high blood pressure: a systematic review. *J Hypertens*. 2012;30:1277–88.
7. Liu S, Goodman J, Nolan R, et al. Blood pressure responses to acute and chronic exercise are related in prehypertension. *Med Sci Sports Exerc*. 2012;44:1644–52.
8. Halliwill J, Buck TM, Lacewell AN, Romero SA. Post-exercise hypotension and sustained post-exercise vasodilation: what happens after we exercise? *Exp Physiol*. 2013;98(1):7–18.
9. Haykowsky M, Brubaker P, Kitzman D. Role of physical training in heart failure with preserved ejection fraction. *Curr Heart Fail Rep*. 2012;9:101–6.
10. Smart N. Exercise training for heart failure patients with and without systolic dysfunction: an evidence-based analysis of how patients benefit. *Cardiol Res Pract*. 2010;30:2011.
11. Carvalho VO, Guimarães GV. An overall view of physical exercise prescription and training monitoring for heart failure patients. *Cardiol J*. 2010;17:644–9.
12. Downing J, Balady GJ. The role of exercise training in heart failure. *J Am Coll Cardiol*. 2011;58:561–9.
13. Flynn KE, Piña IL, Whellan DJ, et al. Effects of exercise training on health status in patients with chronic heart failure: HF-ACTION randomized controlled trial. *JAMA*. 2009;301:1451–9.
14. Roddy E, Zhang W, Doherty M, et al. Evidence-based recommendations for the role of exercise in the management of osteoarthritis of the hip or knee—the MOVE consensus. *Rheumatology*. 2005;44:67–73.
15. Roddy E, Zhang W, Doherty M. Aerobic walking or strengthening exercise for osteoarthritis of the knee? A systematic review. *Ann Rheum Dis*. 2005;64:544–8.
16. Messier SP, Loeser RF, Miller GD, et al. Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the Arthritis, Diet, and Activity Promotion Trial. *Arthritis Rheum*. 2004;50:1501–10.
17. Bartels EM, Lund H, Hagen KB, et al. Aquatic exercise for the treatment of knee and hip osteoarthritis. *Cochrane Database Syst Rev*. 2007;17:CD005523.
18. Gomez-Cabell A, Arar I. Effects of training on bone mass in older adults: a systematic review. *Sports Med*. 2012;42:301–25.
19. Wolff I, van Croonenborg JJ, Kemper HC, et al. The effect of exercise training programs on bone mass: a meta-analysis of published controlled trials in pre and postmenopausal women. *Osteoporos Int*. 1999;9:1–12.
20. Howe TE, Shea B. Exercise for preventing and treating osteoporosis in postmenopausal women. *Cochrane Database Syst Rev*. 2011;6:CD000333.
21. Feskanich D, Willett W, Colditz G. Walking and leisure time activity and the risk of hip fracture in postmenopausal women. *JAMA*. 2002;288:2300–6.
22. Yeo S, Steele NM, Chang MC, et al. Effect of exercise on blood pressure in pregnant women with a high risk of gestational hypertensive disorders. *J Reprod Med*. 2000;45:293–8.
23. Dempsey JC, Sorensen TK, Williams MA, et al. Prospective study of gestational diabetes mellitus risk in relation to maternal recreational physical activity before and during pregnancy. *Am J Epidemiol*. 2004;159:663–70.
24. Robledo-Colonia AF, Sandoval-Restrepo N, Mosquera-Valderrama YF, et al. Aerobic exercise training during pregnancy reduces depressive symptoms in nulliparous women: a randomized trial. *J Physiother*. 2012;58:9–15.
25. Daley A, Jolly K, MacArthur C. The effectiveness of exercise in the management of post-natal depression: systematic review and meta-analysis. *Fam Pract*. 2009;26:154–62.
26. Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346:393–403.
27. Diabetes prevention program research group, Knowler WC, Fowler SE, et al. 10-year follow-up of diabetes incidence and weight loss in the diabetes prevention program outcomes study. *Lancet*. 2009;374:1677–86.
28. Lindström J, Louheranta A, Manninen M, et al. The Finnish Diabetes Prevention Study (DPS): lifestyle intervention and 3-year results on diet and physical activity. *Diabetes Care*. 2003;26:3230–6.
29. Hu FB, Stampfer MJ, Solomon C, et al. Physical activity and risk for cardiovascular events in diabetic women. *Ann Intern Med*. 2001;134:96–105.
30. Shaw K, Gennat H, O'Rourke P, Del Mar C. Exercise for overweight or obesity. *Cochrane Database Syst Rev*. 2006;18:CD003817.
31. Kayman S, Bruvold W, Stern JS. Maintenance and relapse after weight loss in women: behavioral aspects. *Am J Clin Nutr*. 1990;52:800–7.
32. Pavlou KN, Krey S. Exercise as an adjunct to weight loss and maintenance in moderately obese subjects. *Am J Clin Nutr*. 1989;49(5 Suppl):1115–23.
33. Catenacci VA, Wyatt HR. The role of physical activity in producing and maintaining weight loss. *Nat Clin Pract Endocrinol Metab*. 2007;3:518–29.
34. Li TY, Rana JS, Manson JE, et al. Obesity as compared with physical activity in predicting risk of coronary heart disease in women. *Circulation*. 2006;113:499–506.
35. Wolin KY, Yan Y, Colditz GA, Lee IM. Physical activity and colon cancer prevention: a meta-analysis. *Br J Cancer*. 2009;100:611–6.
36. Friedenreich CM, Cust AE. Physical activity and breast cancer risk: impact of timing, type and dose of activity and population subgroup effects. *Br J Sports Med*. 2008;42:636–47.
37. Moore SC, Gierach GL, Schatzkin A, Matthews CE. Physical activity, sedentary behaviors, and the prevention of endometrial cancer. *Br J Cancer*. 2010;103:933–8.
38. McNeely ML, Campbell KL, Rowe BH, et al. Effects of exercise on breast cancer patients and survivors: a systematic review and meta-analysis. *CMAJ*. 2006;175:34–41.
39. Song MR, Lee YS, Baek JD, Miller M. Physical activity status in adults with depression in the National Health and Nutrition Examination Survey, 2005–2006. *Public Health Nurs*. 2012;29:208–17.
40. DiLorenzo TM, Bargman EP, Stucky-Ropp R, et al. Long-term effects of aerobic exercise on psychological outcomes. *Prev Med*. 1999;28:75–85.

41. Herring MP, Puetz TW, O'Connor PJ, Dishman RK. Effect of exercise training on depressive symptoms among patients with a chronic illness: a systematic review and meta-analysis of randomized controlled trials. *Arch Intern Med*. 2012;172:101–11.
42. Heyn P, Abreu BC, Ottenbacher KJ. The effects of exercise training on elderly persons with cognitive impairment and dementia: a meta-analysis. *Arch Phys Med Rehabil*. 2004;85:1694–704.
43. Maki Y, Ura C, Yamaguchi T, et al. Effects of intervention using a community-based walking program for prevention of mental decline: a randomized controlled trial. *J Am Geriatr Soc*. 2012;60:505–10.
44. Morrow Jr JR, Defina LF, Leonard D, et al. Meeting physical activity guidelines and musculoskeletal injury: the WIN study. *Med Sci Sports Exerc*. 2012;44:1986–92.
45. Physical Activity Guidelines Advisory Committee Report, Part G. Section 10: adverse events. Available at: http://www.health.gov/paguidelines/report/G10_adverse.aspx#_Toc199767757. Accessed October, 2012.
46. Corrado D, Schmied C, Basso C, et al. Risk of sports: do we need a pre-participation screening for competitive and leisure athletes? *Eur Heart J*. 2011;32:934–44.
47. Whang W, Manson JE, Hu FB, et al. Physical exertion, exercise, and sudden cardiac death in women. *JAMA*. 2006;295:1399–403.
48. Elley CR, Kerse N, Arroll B, Robinson E. Effectiveness of counseling patients on physical activity in general practice: cluster randomized controlled trial. *BMJ*. 2003;326:793.
49. Lawton BA, Rose SB, Elley CR, et al. Exercise on prescription for women aged 40–74 recruited through primary care: 2 year randomized controlled trial. *BMJ*. 2008;337:a2509.
50. Moyer VA, U.S. Preventive Services Task Force. Behavioral counseling interventions to promote a healthful diet and physical activity for cardiovascular disease prevention in adults: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2012;157:367–71.
51. Dauenhaer JA, Podgorski CA, Karuza J. Prescribing exercise for older adults: a needs assessment comparing primary care physicians, nurse practitioners, and physician assistants. *Gerontol Geriatr Educ*. 2006;26:81–99.
52. Carroll JK, Antognoli E, Flocke SA. Evaluation of physical activity counseling in primary care using direct observation of the 5As. *Ann Fam Med*. 2011;9:416–22.
53. Whitlock EP, Orleans CT, Pender N, Allan J. Evaluating primary care behavioral counseling interventions: an evidence-based approach. *Am J Prev Med*. 2002;22:267–84.
54. Simons-Morton D, Hogan P. Characteristics of inactive primary care patients' baseline data from the Activity Counseling Trial. *Prev Med*. 2000;31:513–21.
55. Bajwa HA, Rogers LQ. Physical activity barriers and program preferences among indigent internal medicine patients with arthritis. *Rehabil Nurs*. 2007;32:31–4. 40.
56. Hong Y, Ory MG, Lee C, et al. Walking and neighborhood environments for obese and overweight patients: perspectives from family physicians. *Fam Med*. 2012;44:336–41.
57. Prochaska JO, DiClemente CC, Norcross JC. In search of how people change. Applications to addictive behaviors. *Am Psychol*. 1992;47:1102–14.
58. Horiuchi S, Tsuda A, Watanabe Y, et al. Validity of the 6 stages of change for exercise. *J Health Psychol*. 2012. doi:10.1177/1359105312437262.
59. • Centers for Disease Control and Prevention: How much physical activity do adults need? Available at: <http://www.cdc.gov/physicalactivity/everyone/guidelines/adults.html>. Accessed October, 2012. *Evidence-based physical activity dose recommendations for children, adults, and older adults are available on this web site. Statistics regarding percentage of the United States population that is obese and sedentary are also available as well and may be sorted by year or gender or state.*
60. • Garber CE, Blissmer B, Deschenes MR, et al. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc*. 2011;43:1334–59. *American College of Sports Medicine Position Stand describing recent evidence for benefits of exercise; rationale regarding frequency, intensity, duration, and types of exercise; and factors that improve adherence to an exercise prescription.*
61. Arikawa A, O'Dougherty M. Attrition and adherence of young women to aerobic exercise: lessons from the WISER study. *Contemp Clin Trials*. 2012;33:298–301.
62. Pavey T, Anokye N. The clinical effectiveness and cost-effectiveness of exercise referral schemes: a systematic review and economic evaluation. *Health Technol Assess*. 2011;15:i–xii. 1–254.
63. Müller-Riemenschneider F, Reinhold T, Nocon M, Willich SN. Long-term effectiveness of interventions promoting physical activity: a systematic review. *Prev Med*. 2008;47:354–68.
64. Lavie CJ, Milani RV. Cardiac rehabilitation and exercise training in secondary coronary heart disease prevention. *Prog Cardiovasc Dis*. 2011;53:397–403.
65. Elley CR, Arroll B. Refining the exercise prescription for hypertension. *Lancet*. 2005;366:1248–9.
66. Pescatello LS. Exercise and hypertension: recent advances in exercise prescription. *Curr Hypertens Rep*. 2005;7:281–6.
67. Ciolac EG. High-intensity interval training and hypertension: maximizing the benefits of exercise? *Am J Cardiovasc Dis*. 2012;2:102–10.
68. Ciolac EG, Bocchi EA, Greve JM, Guimarães GV. Heart rate response to exercise and cardiorespiratory fitness of young women at high familial risk for hypertension: effects of interval vs continuous training. *Eur J Cardiovasc Prev Rehabil*. 2011;18:824–30.
69. • Hunt SA, Abraham WT, Chin MH, et al. 2009 focused update incorporated into the ACC/AHA 2005 Guidelines for the Diagnosis and Management of Heart Failure in Adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines developed in collaboration with the International Society for Heart and Lung Transplantation. *J Am Coll Cardiol*. 2009;53:e1–90. *Expert guidelines developed by professional societies to guide treatment of patients with heart failure and includes updated recommendations for exercise training.*
70. O'Connor CM, Whellan DJ, Lee KL, Keteyian SJ, et al. Efficacy and safety of exercise training in patients with chronic heart failure: HF-ACTION randomized controlled trial. *JAMA*. 2009;301:1439–50.
71. Arena R, Myers J, Forman DE, et al. Should high-intensity-aerobic interval training become the clinical standard in heart failure? *Heart Fail Rev*. 2013;18(1):95–105.
72. Tabet JY, Meurin P, Teboul F, et al. Determination of exercise training level in coronary artery disease patients on beta blockers. *Eur J Cardiovasc Prev Rehabil*. 2008;15:67–72.
73. Eston RG, Thompson M. Use of ratings of perceived exertion for predicting maximal work rate and prescribing exercise intensity in patients taking atenolol. *Br J Sports Med*. 1997;31:114–9.
74. Scherr J, Wolfarth B, Christle JW, et al. Associations between Borg's rating of perceived exertion and physiological measures of exercise intensity. *Eur J Appl Physiol*. 2013;113(1):147–55.

75. AAOS Treatment of Osteoarthritis of the Knee (Non-arthroplasty). Available at: <http://www.aaos.org/research/guidelines/OAKguideline.pdf>. Accessed November, 2012.
76. Howe TE, Shea B, Dawson LJ, et al. Exercise for preventing and treating osteoporosis in postmenopausal women. Cochrane Database Syst Rev. 2011;6:CD000333.
77. Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev. 2012;9:CD007146.
78. ACOG Committee Opinion: exercise during pregnancy and the postpartum period. Available at: http://www.acog.org/Resources_And_Publications/Committee_Opinions/Committee_on_Obstetric_Practice/Exercise_During_Pregnancy_and_the_Postpartum_Period. Accessed November, 2012.
79. American Diabetes Association: Standards of medical care in diabetes – 2012. Available at: http://care.diabetesjournals.org/content/35/Supplement_1/S11.full#sec-15. Accessed November, 2012.