Physical Activity Prescription: Our Best Medicine

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Abstract

Healthy People 2010—a national initiative established by the U.S. Department of Health and Human Services and other federal and nongovernmental agencies—recommends 30 minutes of moderate activity (such as brisk walking) on 5 or more days of the week or 20 minutes of vigorous activity (such as jogging) 3 or more days per week. Moderate activity causes a noticeable increase in heart rate, while vigorous activity is associated with rapid breathing and a greater increase in heart rate. Unfortunately, fewer than 40% of Americans are meeting this goal.

Healthcare providers are uniquely positioned to influence this trend by prescribing physical activity more frequently and more precisely. Specific written exercise prescriptions can increase patient compliance substantially. The FITT principle—frequency, intensity, timing, and type of exercise—can be used to tailor physical activity recommendations to the needs and goals of individual patients. Frequency should be prioritized when health goals relate to preventing chronic diseases. Intensity has maximum impact on weight loss and athletic conditioning. Timing is particularly relevant for people with diabetes and blood sugar dysregulation. Types of activity include aerobic, balance, flexibility, and resistance (or strength) training, all of which help patients achieve different health goals.

This article summarizes the state of the science on physical activity for the overall prevention and treatment of common chronic diseases, as well as for treating cancer, improving diabetes management, preventing or reversing osteoporosis, ameliorating cardiovascular disease, and achieving weight loss.

Physical inactivity has become epidemic. The media is calling it Sedentary Death Syndrome, and your patients are (or should be!) asking you what to do about it.

As set forth in the Healthy People 2010 guidelines (a framework of recommendations created jointly by the U.S. Department of Health and Human Services, other federal agencies, and various nongovernmental agencies to challenge Americans to lead healthier lives), the recommended amount of exercise is 30 minutes of moderate activity on 5 or more days of the week or 20 minutes of vigorous activity 3 or more days per week.[1] Moderate activity (such as brisk walking) is defined as activity resulting in a noticeable increase in heart rate. Vigorous activity (such as jogging) is associated with rapid breathing and a greater increase in heart rate. Since 1984 state health departments, in conjunction with the Centers for Disease Control and Prevention, have been conducting the Behavioral Risk Factor Surveillance Survey (BRFSS), the world's largest, on-going telephone health survey that yearly tracks health conditions and risk behaviors in the United States. According to the most recent survey, BRFSS 2001, more than 60% of Americans do not achieve the recommended amount of physical activity, and 26% of Americans reported *no* leisure-time physical activity at all.[2]

This level of inactivity produces a notable problem: 12% of depression and anxiety and 31% of colon cancer, heart disease, osteoporosis, and stroke cases are attributable to physical inactivity.[3] For the first time in U.S. history, childhood lifespan predictions are *lower* than those for the previous generation. Largely attributed to pediatric obesity, many of today's children are not expected to outlive their parents.[4] For these reasons, doing more to help our patients get the recommended amount of physical activity and/or exercise is the strongest risk-reducing prescription we can offer to prevent chronic disease.[5]

The FITT Principle

In the same way that we pay attention to dosages, delivery forms, and frequencies when we prescribe supplements and medications, we should apply a similar degree of precision to our prescriptions for physical activity/exercise. A prescription for physical activity may be tailored to specific patient needs according to 4 different aspects of activity called the FITT principle: frequency, intensity, timing, and type.

Frequency refers to how often an individual engages in an activity, usually the number of days per week. In specific, frequency should be prioritized when health goals relate to preventing chronic diseases.

Intensity is the level of exertion experienced during the activity. Individuals can monitor their perceived exertion using a subjective, 10-point scale in which 1 is equivalent to the amount of exertion associated with sitting and 10 is the maximum. Moderate intensity rates a 5-6 on the scale, vigorous intensity rates 7 or 8. A person can also use a definitive scale by tracking heart rate. (The accompanying "Patient Handout" includes methods for calculating this.) Moderate-intensity exercise programs have a targeted heart rate around 55% to 65% of maximum heart rate. High-intensity exercise programs have a targeted heart rate around 65% to 75% of maximum heart rate. Intensity has a great impact on weight loss and athletic conditioning.

Timing refers to the time of day when an activity is performed. Timing is particularly relevant for people with diabetes and blood sugar dysregulation. To maximize compliance, patients should be advised to find a consistent time for exercise that fits into their schedules—when possible, morning is ideal. Exercising in the morning ensures that it won't be squeezed out by other priorities, and there may be slight metabolic advantages. First, circadian rhythm dictates cortisol. In addition,

other glucoregulatory hormones peak in the morning; and morning exercise, either before or after breakfast, improves glucose and insulin regulation and fat oxidation more so than exercise later in the day.[6] It is important to note that physical activity too close to starting sleep may disrupt sleep patterns.

Types of activity include aerobic, balance, flexibility, and resistance (or strength) training, and help patients achieve different health goals. Specifying a type of exercise most likely to meet the individual patient's goals is also helpful. Consider factors such as enjoyment and stress reduction to further define the type of physical activity, encouraging patients to engage in activities they enjoy (such as dancing as an aerobic activity). In addition, clinicians can target individual health goals and help motivate patients to exercise by detailing the specific health benefits offered by each type of exercise. (See Table 1.)

Table 1. Benefits of Different Types of Physical Activity

Strength Training/ Resistance	Improves insulin sensitivity Increases lean muscle Prevents age-related declines Safer for people at high CV risk Reduces blood pressure Improves bone mineral density Useful for weight loss
Aerobic	Improves overall glycemic control Improves mood Improves lipids/CV risk profile Intense aerobic activity is most effective for weight loss Improves cognitive function
Balance Training	Reduces risk of falling Improves core strength and stability Improves mobility and healing post-orthopedic surgery
Any Exercise	Improves glycemic control beyond weight loss alone Reduces the risk of diabetes, cancer, and heart disease Reduces stress

Physical Activity and Chronic Disease Prevention

Current data suggest that the amount of physical activity necessary to prevent chronic health problems such as cancer, diabetes, osteoporosis, and cardiovascular disease is quite easily attainable for most adults. Through effects on the regulation of sex hormones, insulin, prostaglandins, and immune system function, performing physical activity also contributes to the prevention of numerous diseases.[7, 8] In fact, a recent joint statement released by the American Cancer Society, American Diabetes Association, and American Heart Association spelled out nutrition and physical activity guidelines common to preventing all 3 of these chronic diseases.[9]

Physical Activity and Cancer

Epidemiologic studies indicate that relatively low doses of physical activity may reduce the risk of several types of cancer, including cancers of the breast,[10] prostate,[11] colon,[12] endometrium,[12] and possibly others. While exact mechanisms are still under investigation, we do know that physical activity is crucial to maintaining a healthy body weight, which is an independent risk factor for certain types of cancer. [13]

Physical Activity and Diabetes Management

Exercise has important effects on physiology for people with diabetes. Almost immediately upon initiating *any* physical activity (within 30 minutes), both glycogen utilization and insulin sensitivity improve in an intensity-dependent manner.[14] A single exercise session (jogging at 65-80% VO2 max, for example) can increase insulin sensitivity for 16 hours.[15] Relevant mechanisms include changes in gene transcription in GLUT4, AMP kinase, and myosin heavy-chain IIx, which impact skeletal muscle insulin sensitivity and glucose uptake.[14]

In 2002, the landmark Diabetes Prevention Program trial was completed. This trial compared the effects of the diabetes drug metformin with lifestyle changes—primarily, 150 minutes of exercise per week—on diabetes prevention. Results demonstrated that physical exercise reduced the incidence of diabetes by 58% (95% CI: 48–66%) over 2.8 years versus treatment with metformin, which reduced diabetes incidence by 31% (95% CI: 17–43%). In a "numbers needed to treat" analysis, 1 case of diabetes was prevented with every 6.9 individuals who received a lifestyle intervention. This number was 1 of 13.9 individuals if treated with metformin.[16]

As it relates to insulin, the intensity of physical activity appears to be of less significance than the volume or frequency. In a 4-arm trial that compared walking and jogging 12 miles vs 20 miles per week, 85% of the relative change in the insulin sensitivity index was explained by frequency, with 40% of improvement attributable to intensity.[17] These findings are especially valuable for motivating diabetes patients to begin moderate-paced physical activity, such as walking or riding a stationary bike. They don't need to become runners or "weekend warriors" (people who exercise strenuously but sporadically) to achieve benefits.

For people with diabetes, the timing of physical activity can have significant impact on blood sugar, which will ultimately be of benefit. When beginning a new exercise program, blood sugar should be checked before and after exercise until the person is familiar with how their exercise affects it. People who use insulin should always keep a glucose snack at hand when exercising in the event of unexpected hypoglycemia.

The benefits of resistance (or strength) training should not be overlooked, either. In addition to improving insulin sensitivity and glucose tolerance, strength training increases the number of skeletal and cardiac muscle cells, directly reduces blood pressure, and improves cardiac contractility and lipid profiles.[18] The diversity provided by engaging in both aerobic and resistance exercise may improve long-term compliance and can contribute to the social and psychological benefits of physical activity.

Physical Activity and Osteoporosis

Physical activity increases bone mineral density (BMD), but how much improvement can be expected, and what types of

activity are most effective? Physical activity to improve BMD must be weight bearing and place at-risk bones under stress, as demonstrated by clinical research. For example, after an 18-month program of high-impact exercise conducted 3 times a week, BMD at the femoral neck (a weight-bearing site) increased a mean 1.6% (95% CI 0.8–2.4). By contrast, at non-weight-bearing sites, such as the distal radius, no significant difference was observed between the training and control groups (-1.5% [-2.7 to -0.3] vs -0.7% [-1.9 to -0.5], P=.60).[19]

A novel study investigated the impact of t'ai chi chun on BMD. While t'ai chi did not increase BMD, researchers observed a significant 2.6- to 3.6-fold retardation of bone *loss* (P<.01). Additionally, they noted a reduction in fractures in the t'ai chi chun group, possibly due to the increase in balance and muscle strength achieved and a subsequent reduced risk of falling.[20] Consistent with this study, the American College of Sport Medicine/American Heart Association just updated their physical activity guidelines to reflect the importance of fall prevention. They now include recommendations for balance and flexibility for older adults.[21]

On average, BMD improvement in the range of +1.5% per year can be expected when pre-, peri-, and post-menopausal women engage in regular weight-bearing exercise.[19,22] However, strong evidence suggests that the most significant benefits can be achieved in adolescent girls. BMD gains in the lumbar spine of 41.7% and 24.8% in the femoral neck were seen over 15 months when 9-and-10-year-old girls participated in 45 minutes of aerobic dance 3 times per week.[23] Data such as this point out a critical need for practitioners to address primary prevention during childhood with specific physical activity recommendations.

Physical Activity for Cardiovascular Conditions

While not news, the Ornish trials are still among the most impressive holistic intervention studies to date. Ornish emphasizes a low-fat, primarily vegan diet; daily exercise; stress reduction; and quality social bonding through group support. After impressive results, the researchers concluded that comprehensive lifestyle changes can bring about regression of even severe coronary atherosclerosis after only 1 year, without the use of lipid-lowering drugs.[24] A meta-analysis of exercise-only secondary prevention studies highlights an approximate 31% reduction in cardiac mortality.[25] Sharing results like this can be highly motivating to high-risk patients who are experiencing a loss of control over their health.

For patients with cardiovascular disease risk factors such as hypertension and hyperlipidemia, providers should inform patients precisely how much benefit they can expect. For example, an average of a 4.6% increase in HDL-C and a 5% reduction in LDL-C can be achieved after 12 weeks of aerobic exercise. With the same activity program, patients can expect mean blood pressure reductions of 3.4 mm Hg (systolic) and 2.3 mm Hg (diastolic),[26] although women (specifically, Caucasian women) may experience greater benefit (up to an 11mm Hg reduction in systolic blood pressure).[27] This is a good example of the systemic benefits of exercise.

Physical Activity for Weight Loss

To add precision to an exercise prescription for weight loss, emphasize intensity over frequency. In one study, no differences in weight loss were observed between a 3–4 days/week and 6–7 days/week frequency after 6 months when other factors were constant.[28] Vigorous activity (at least 65–76% maximal heart rate) enhances insulin action and maximizes fat oxidation.[6,17,29] Additionally, when patients are struggling to prioritize calorie reduction versus increasing physical activity, evidence suggests they will achieve greater benefit from physical activity, including improvements in glucoregulatory factors, inflammatory markers, and other chronic disease risk factors.[30] It is also important to remember that, to help patients lose weight, the key message should be simply to make energy expenditure a priority—they simply need to burn more calories.

Counseling Patients About Physical Activity

Clinicians are uniquely positioned to play a critical role in helping patients increase their physical activity levels. A randomized, controlled trial that tested the delivery of a "written prescription" for physical activity (versus verbal instruction) showed the written prescription increased the proportion of people performing any activity from 51% to 86%—a remarkable difference (P=.004).[31] While long-term studies to quantify the benefits of counseling in primary care are lacking, the U.S. Preventive Services Task Force (an independent panel of experts in primary care and prevention that systematically reviews the evidence of effectiveness and develops recommendations for clinical preventive services) recently summarized the effectiveness of physician counseling.[32] They concluded that 1) women need more intensive instruction than men, 2) written instruction in addition to verbal counseling by the physician improved results, and 3) providing specific, detailed instruction may lead to better compliance.[32,33] Counseling techniques such as motivational interviewing (non-judgmental questioning to lead patients to understand the consequences of their behaviors) and helping patients set their own goals are also important strategies.[34]

A fascinating study recently modeled physician-counseling strategies to determine which techniques best motivated patients' physical activity. The 3 counseling strategies (based on Prochaska's 6 Stages of Change, including Pre-contemplators, Contemplators, and Relapsers) that most effectively promoted physical activity were: 1) arranging follow-ups for patient Pre-contemplators (OR=4.93), 2), giving Contemplators a detailed exercise plan (OR=2.34), and 3) asking Relapsers about their physical activity (OR=2.61).[35] For example a Pre-contemplator, a person who has no immediate intentions of increasing physical activity, should be encouraged to return to the clinic—at which time the idea should be suggested again. A Contemplator, a person considering exercise but who has not begun to move into Prochaska's Preparation stage, will benefit from seeing tangible examples of what an exercise program would look like. People in this phase are often focused on the negative aspects of adopting this new behavior, so emphasizing the benefits of the detailed plan is useful. Relapsers, people who have "fallen off the wagon," need to be asked about their level of physical activity to motivate them back into Prochaska's Action Stage.

In the only known study to investigate exercise-counseling practices among naturopathic physicians, an exercise prescription was offered to 94% of diabetic patients, and 38% of office visits with diabetic patients included instruction or follow up on physical activity.[36] While these statistics are above the bell curve, clearly we can all do better.

Practicing Safety

Safety precautions are also an important aspect of exercise prescription. The most common risk of physical activity is musculoskeletal injury, which can be minimized by advising patients to begin new physical activity habits gradually and ensure adequate warm up and cool down when engaging in more intensive physical activity.

In general, the American College of Sports Medicine recommends that most people can begin an exercise program without formal medical testing. However, there are some people who should discuss this in more detail with a doctor. Consider the following:

People with diabetic retinopathy or neuropathy should be cautioned against vigorous exercise, and all diabetics should be counseled to carefully monitor blood sugar before and following exercise. Delayed hypoglycemia can occur up to 6–15 hours after exercise as a result of the residual effects of exercise-heightened insulin sensitivity and depleted glycogen stores.

Consider a graded exercise electrocardiogram (ECG) for people with a Framingham cardiovascular risk score of greater than 10%.

Conclusion

While it is clear that everyone benefits from increased physical activity in any form, offering patients more specific instruction can help them better target individual goals. The FITT principle can be used as a simple tool to remind clinicians and patients to pay attention to the 4 key elements of physical activity: frequency, intensity, timing, and type. Exercise is a dose-dependent activity: up to a point, the more one does, the more benefit one can expect.

Frequency is important when prioritizing physical activity for the purpose of preventing chronic disease; *everyone* should accumulate a minimum of 150 minutes of moderate exercise per week. Intensity, as measured by heart rate, should be the priority when the focus of physical activity is weight loss or athletic performance. Counsel patients interested in weight loss to exercise at high intensities (65–76% of their maximal heart rate). Exercise timing is critical for people with diabetes to reduce the risks of hypoglycemia. To maximize compliance, you can match a specific type of exercise to an individual patient's goals. Factors such as enjoyment and stress reduction further define the type of physical activity. You can also advise patients to find a consistent time for exercise that fits into their schedules. Types of exercise include aerobic, resistance training, balance training, and flexibility training.

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