Exercise for the Inactive Hypertensive Patient

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Hypertension: a Growing Global Problem

By 2030, cardiovascular disease (CVD) is predicted to account for 41% of all deaths in working age individuals (35–64 years) in the developing world.[1] Trends in industrialization, urbanization, increased wealth, and an aging global population are key factors contributing to this rise. Prevalence of CVD risk factors such as hypertension and obesity are higher in urban areas than in rural communities. In India, overall prevalence of hypertension (>140/90 mm Hg) is estimated at 28.7%;[2] rates in urban areas are two to three times higher than rates in rural areas.[3] In the Asian-Pacific countries of the Philippines, Thailand, Sri Lanka, Nepal, and Pakistan, prevalence of hypertension ranges from 15%–35% in urban populations and is two to three times lower in rural populations. Estimates for China indicate that between 1995 and 2025, the prevalence of hypertension will increase from 18.6% to 25%.[4] In South Africa, the prevalence rate of hypertension in women living in rural areas is 50% less than in women living in urban regions.[5] These projections indicate that hypertension is a growing global health problem affecting individuals of all ethnicities.

In the United States, hypertension prevalence has increased across all ethnic groups, yet it remains highest for non-Hispanic Blacks (33.5%), especially women. Analysis of the National Health and Nutrition Examination Surveys (NHANES) data over three phases spanning 1988–1991, 1991–1994, and 1999–2000 indicates that non-Hispanic Black women have experienced the greatest increase (+7.2%), from 28.6% during the period 1988–1991 to 35.8% during the period 1999–2000.[2] Although hypertension prevalence rates have also increased in US Hispanic and Chinese populations, results of the Multi-Ethnic Study of Atherosclerosis (MESA) indicate that rates for Hispanic and Chinese populations do not differ significantly from rates for Whites.[6] Overall prevalence for hypertension in the United States was estimated at 24.9% in 1999, compared to 22.9% in 1991.[7] The corresponding cost of hypertension in the United States is estimated at $15.6 billion in direct health costs.[8]

The relationship between CVD, hypertension, and obesity is well established. An estimated 300 million people around the world are obese.[9] In the United States, increased prevalence of hypertension between 1988 and 2000 was associated with increased body mass index in each phase of the NHANES study.[2] The International Obesity Taskforce estimates that based on current trends, obesity levels will continue to rise in the early 21st century, especially in Asia, which is experiencing rapid growths in population and urbanization.[10] The rate of obesity has more than doubled over the past 20 years in Australia and the United States, while it has tripled in the United Kingdom.[11] Countries traditionally considered to have low obesity rates, such as France and Japan, are also seeing a trend toward increased obesity. In France, obesity in men and women is estimated at 11.4% and 11.3%, respectively, up from 8.4% and 8%, respectively, since 1997.[12] In the Netherlands, although obesity has increased since the 1970s, prevalence rates remain lower than in the United States and many other European countries at 8.5% and 9.3% for men and women, respectively.[12] In Japan, obesity rates have increased by

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three for men and four for women over the past 40 years.[13] As poorer countries become urbanized, changes in diet, physical activity, health, and nutrition occur. Urban populations have greater wealth, which is often associated with increased fat, salt, and calorie intake, leading to increased body weight and less physical activity. These events are evident in China, where consumption of high-fat foods has soared in conjunction with fourfold increases in per capita income since the late 1970s,[10] and hospital costs attributable to CVD totaled $9.6 billion.[14] As the global trend in industrialization, aging populations, decreased physical activity, and obesity continues, we can reasonably anticipate that the number of individuals with hypertension will also increase.

PHYSICAL ACTIVITY AND HYPERTENSION

Physical inactivity affects 20% of the adult population worldwide and increases the risk of hypertension by 30%.[15] A trend toward greater inactivity is evident in urban areas of both developed and developing countries. The economic costs of inactivity are daunting. In 1995, inactivity and obesity accounted for ≈9.4% of national health expenditures in the United States. In 2000, the medical cost of inactivity was estimated at $75 billion in the United States. In Canada, the medical cost of inactivity was estimated at $2.1 billion for 1999.[15] Physically active individuals have a lower risk of CVD and hypertension than do their obese counterparts. The risk of hypertension associated with weight gain is also lower in physically active individuals. As such, decreasing body weight and increasing physical activity are important components in treating hypertension.[16]

Regular physical activity of moderate intensity reduces body fat mass and improves the functioning of systems that influence blood pressure. Physical activity reverses increases in blood pressure associated with increased body fat mass, and this effect is equal to pharmacologic monotherapy.[17] A meta-analysis of 54 clinical trials indicated that aerobic exercise was associated with 4.9/3.7 mm Hg reductions in blood pressure in hypertensive adults, independent of body weight.[18] Stewart[19] concluded that as little as 30–60 minutes of increased physical activity per week can reduce blood pressure among hypertensive adults. This conclusion is consistent with that of the US Department of Health and Human Services, which predicted regular, moderate-intensity physical activity (eg, brisk walking) 30 minutes per day on most days can reduce hypertensive blood pressures by 4–9 mm Hg and that for every 10-kg reduction in body weight over 25 kg/m^2 body mass index, hypertensive blood pressures can be reduced by 5–20 mm Hg.[20] The American College of Sports Medicine (ACSM) also recommends regular physical activity as the cornerstone of therapy to prevent and reduce hypertension.[21] In their position statement on exercise and hypertension, ACSM states that the blood pressure–reducing effects of an acute bout of moderate-intensity exercise can be realized for up to 22 hours after completion of the exercise activity.[22] Although not as clinically profound, resistance training also reduces hypertension by 2% and 4%, respectively, for resting systolic and diastolic blood pressures.[23] The primary concern in prescribing resistance training to hypertensive patients has been the belief that blood pressure increases during this type of training. The actual rise in blood pressure during resistance training depends on a variety of controllable factors, including magnitude and duration of the isometric component, intensity, amount of muscle mass involved, and number of repetitions and/or load duration. Only moderate elevations in blood pressure have been observed among cardiac patients during low-intensity resistance training (40%–60% maximum voluntary contraction [MVC]) with 15–20 repetitions), similar to those seen during moderate endurance training.[24] Thus, resistance training carries no inherent higher risk than aerobic endurance training.[25] Resistance training can increase muscle strength and endurance and positively influence cardiovascular risk factors, metabolism, cardiovascular function, psychosocial well-being, and quality of life.[26] Based on this evidence, a number of professional health organizations have recommended incorporating increased levels of physical activity, including aerobic and resistance training, into the medical management of hypertension.

Physically active individuals have a lower risk of hypertension than do their physically inactive counterparts.[16] Physical inactivity is a recognized risk factor for hypertension. Physical inactivity contributes to increased body fat mass and adversely affects the nervous, renal, and cardiovascular systems, which in turn contribute to increases in blood pressure. However, these organ systems and body fat mass are particularly responsive to changes in physical activity.[27] Generally, as physical activity increases, body fat mass decreases, functioning of the nervous, renal, and cardiovascular systems improves, and blood pressure is maintained within a normal range. Maintaining adherence among overweight hypertensive patients with a program of regular physical activity involves more than simply providing the components of the physical activity prescription to the patient. Maintaining adherence with a program of regular physical activity involves consideration of the patient's stage of health behavior change, the patient's capacity to engage in physical activity, their objectives resulting from engaging in regular physical activity, and their resources and preferences to engage in a program of regular physical activity.

STAGE OF HEALTH BEHAVIOR CHANGE

For the obese patient with hypertension, increasing physical activity may represent a major lifestyle change. Assessing each patient's readiness to adopt and maintain a program of physical activity is essential to prescribing a physical activity program to which the patient will adhere. Before an inactive patient will adhere to a program of regular physical activity, the patient must first progress through the various stages of health behavior change. Prochaska and DiClemente's transtheoretical model[28] outlines five stages of change that individuals progress through as they attempt to modify a health behavior. The initial stage is termed "precontemplation" and describes an individual who does not identify the existence of a health problem and therefore does not recognize the need to change the health behavior that is causing the health problem. The second stage of this model is "contemplation" and is defined as the point in time when an individual acknowledges that he or she has a health problem and is seriously considering changing his or her behavior within the next six months. Individuals at this stage of change are contemplating the pros and cons of their current health behavior but have not yet made the decision to attempt to change their health behavior. Preparation is the third stage, when the individual evaluates the cons of physical inactivity as greater than the pros and considers various plans to adopt the new health behavior. At this stage, individuals have formulated a plan of action and may have already made some attempts to modify their health behavior (such as walking more around the house) but have not yet achieved a consistent change in their health behavior. "Action" is the stage in which the individual is adopting a new health behavior in an attempt to address the health problem. A measurable behavioral objective is common at this stage ("I will walk 1 block 3 times each week"). The final stage is "maintenance" and is characterized by evidence that the increase in physical activity has been maintained for six months, and risk of returning to a state of physical inactivity is low.

The transtheoretical model has been used by a number of investigators to design successful interventions for changing health behaviors such as smoking, emotional distress, alcohol abuse, weight loss, and mammography screening.[28] Success of implementing interventions based on the model is contingent, in part, on the understanding that linear movement back and forth between stages is common before a permanent change to the next stage is realized. For instance, an individual in the preparation stage may move back and forth between contemplation and preparation before permanently transitioning in the preparation stage. This understanding has implications for the practitioner prescribing increased physical activity to obese hypertensive patients. The practitioner must assess the patient's current stage of health behavior change. This assessment will in turn determine the nature of the initial interventions and future interventions designed to progress the patient through the stages to action and maintenance. Patients who present in the precontemplation and contemplation stages are more likely to progress through these stages of change as a result of cognitive interventions designed to enhance their knowledge, change their beliefs, or alter their attitudes regarding their perceptions between physical activity, body weight, and hypertension. Patients who present in the preparation, action, or maintenance stages respond more effectively to behavioral interventions designed to reinforce increased physical activity, reduce barriers, and enhance benefits of engaging in more physical activity and improve resource availability for supporting this new health behavior. For instance, cognitive approaches, such as asking open-ended questions about how a person feels about his or her current physical activity and physical appearance are most effective when individuals are considering changing their behavior (precontemplation and contemplation stages), while behavioral strategies, such as finding an exercise buddy or rewards for adhering to a greater level of physical activity, are appropriate when individuals have initiated, or are attempting to maintain, new behaviors (preparation, action, or maintenance stages).

Table 1 presents cognitive interventions that may be used with patients who present in the precontemplation, contemplation, or preparation stages. These interventions include, but are not limited to 1) consciousness raising (increasing knowledge of the relationship between obesity and hypertension, health effects of diet and physical activity; 2) reevaluation of self and environment (examining effects of current diet, physical activity, and environmental factors on one's obesity and health); 3) decisional balance to address the pros and cons or benefits and costs of inactivity and/or increased physical activity; and 4) social liberation through modification of diet, physical activity, and environmental factors (I tell myself I can change my diet, physical activity, and environment) resulting in social benefits. Table 2 lists behavioral interventions that are effective for aiding transition and sustaining behaviors during the later stages of action and maintenance. Behavioral approaches may include 1) stimulus-control (remove items or stimuli that remind me of my usual diet, physical activity, and environmental factors); 2) counter-conditioning or substitution (eg, drinking a glass of water instead of having a sugared soft drink, parking farther from store entrances, putting sneakers and suitable exercise clothing on in the morning instead of a robe); 3) self-talk during exercise ("that the ache in my

Table 1. Cognitive activities for facilitating increased physical activity

Cognitive-based activities (use during pre-contemplation, contemplation, and preparation)	Description
Complete a family tree of obesity- and hypertension-related diseases	Consciousness raising
Understand how to classify various levels of physical activity	Consciousness raising
List the pros and cons of being overweight and inactive	Decisional balance
Identify personal perceptions of weight and physical activity	Self-reevaluation
Identify recommendations for physical activity and compare to current, actual level of physical activity	Self-evaluation
Identify actual and desired body mass index	Self-reevaluation
Complete a log of the duration of time spent engaged in sedentary activity	Self-reevaluation
Identify the impact of obesity on current social functioning	Social liberation
Identify cues to not engaging in physical activity	Environmental reevaluation
Identify activities that prohibit or are done instead of physical activity	Environmental reevaluation
Identify choices that can increase the level of physical activity	Environmental reevaluation
Identify one friend who maintains a ''healthy'' or ''active'' level of physical activity	Environmental reevaluation

muscle is a sign that I am getting stronger''; ''Ten leg lifts a day keeps the cane away!''); 4) goal setting of weekly, monthly, or other goals for increasing physical activity; 5) record-keeping—write down personal exercise goals and keep an exercise log of daily/weekly progress; and 6) reward or reinforcement (''If I do three sets of seated leg lifts I will reward myself by spending half an hour on my favorite hobby.'').

Two final concepts that can be incorporated in the transtheoretical model framework are coping skills training and promotion of self-efficacy for exercise. Coping skills training refers to behavioral therapy techniques to enhance skills in assertiveness and everyday problem solving in order to improve psychological functioning and increase one's self-efficacy for disease and stress management. In this context, coping skills training should consist of 1) helping patients identify individual strategies for achieving physical activity goals (parking a farther distance from store entrances to increase walking activity) and 2) helping patients plan ways to overcome barriers or obstacles they might encounter (eg, ''When I'm not feeling motivated to exercise, I will ask someone to exercise with me or plan a reward for myself.''). To the extent that patients can anticipate barriers and develop strategies to overcome them, they will be more successful. Coping skills training is associated with reduced pain and anxiety among arthritis patients[29] and improvements in perceived health status and reductions in health-care utilization rates and costs for patient groups dealing with chronic illness.[30,31] Self-efficacy refers to an individual's assessment of his or her effectiveness or competency to perform a specific behavior (eg, exercise) successfully. It is a central concept of Bandura's social cognitive theory, which states that self-efficacy expectations are based in part on past performance and in part on learning, which suggests that self-efficacy expectations, and therefore expected outcomes, may be modifiable.[32,33] In this context, self-efficacy for increased physical activity can be promoted by instructing patients on proper exercise techniques, praising individual goal attainment, and through reinforcement of the individual's ability to make health changes. Several studies have demonstrated that preventive self-efficacy, ie, the individual's perceptions of his or her own ability to perform specific health behaviors, can greatly influence actual health behavior and health status.[33–36] In the population of obese individuals with hypertension, perceptions of self-efficacy may be particularly important given the high

Table 2. Behavioral activities for facilitating increased physical activity

Behavioral-based activities (use during pre-contemplation, contemplation, and preparation)	Description
Interact with others who engage in ''healthy'' eating and activity patterns	Stimulus control
Read all food labels before eating foods	Counter conditioning
Eat ''healthy foods'' in a fast food restaurant	Counter conditioning
Reduce barriers to physical activity (eg, put exercise clothes on first thing in the morning)	Counter conditioning
Set short- and mid-term goals for diet, weight, and physical activity	Goal setting
List barriers to exercise that might be encountered and write a solution for how you will overcome barriers	Coping skills/problem solving
Document eating new healthy foods	Record keeping
Keep an exercise log and review it frequently	Record keeping
Engage in self-talk to get through exercises and praise yourself for hard work	Self-talk
Reward yourself	Reinforcement

Table 3. Health conditions that absolutely contraindicate engaging in a program of regular physical activity

- Unstable angina
- Resting systolic blood pressure >200 mm Hg or resting diastolic blood pressure >110 mm Hg should be evaluated on a case-by-case basis
- Orthostatic blood pressure drop >20 mm Hg with symptoms during physical activity
- Critical aortic stenosis (peak systolic pressure gradient >50 mm Hg with an aortic value orifice area <.75 cm^2 in an average size adult)
- Acute systemic illness or fever
- Uncontrolled atrial or ventricular dysrhythmias
- Uncontrolled sinus tachycardia (>120 beats/minute)
- Uncompensated congestive heart failure
- Third degree atrioventricular block (without pacemaker)
- Active pericarditis or myocarditis
- Recent embolism
- Thrombophlebitis
- Resting ST segment displacement (>2 mm)
- Uncontrolled diabetes (fasting blood glucose >400 mg/dL)
- Severe orthopedic conditions that would prohibit exercise
- Other metabolic conditions, such as acute thyroiditis, hypokalemia or hyperkalemia, hypovolemia, etc

likelihood they have had negative experiences with increasing their physical activity in the past.

CAPACITY TO ENGAGE IN PHYSICAL ACTIVITY

The first step in prescribing increased physical activity is to assess the individual for any contraindications or limitations to engaging in regular physical activity. A limited number of individuals with specific health conditions are discouraged from engaging in even minor increases in physical activity because of the health risk associated with these conditions (Table 3).[37] Therefore, physician consent should be obtained before recommending increased physical activity for any hypertensive or obese individual. Other individuals may present with physical limitations that require individualized adjustments to their physical activity prescription in order to accommodate their condition. Physical limitations may be the result of inactivity (detraining), excessive body weight, or chronic conditions that limit physical activity (arthritis, amputation, etc). Most individuals with physical limitations can participate in some form of increased physical activity. For example, a severely obese individual with osteoarthritis of the knees that limits extended ambulation may participate in resistance training while sitting in a chair.

OBJECTIVES OF REGULAR PHYSICAL ACTIVITY

Once a hypertensive individual is deemed eligible for engaging in regular physical activity, individual objectives should be developed to ensure that the patient and practitioner understand and are in agreement with expected outcomes of any interventions. These objectives should be significant, measurable, attainable (ie, realistic), related to the individual patient, time limited, and sensitive to the patient's stage of change (SMARTS).[34] Significant means that a meaningful increase in physical activity will occur. Measurable implies that the physical activity can be objectively assessed and described in terms of a number. The components of the objective must be related to, or under the control of, the individual. Each objective should include a time frame for evaluating achievement or progress toward achieving the objective. Finally, the objective should also be sensitive to the individual's stage of health behavior change. Thus, if an individual presents in precontemplation or contemplation, his or her SMARTS objective needs to be cognitive in nature. For example, "After watching the 'Supersize Me' video, I will be able to list three negative effects of eating fast food." Individuals who are in the preparation, action, or maintenance stages should have their SMARTS objective include a behavioral component, eg, "I will walk for 15 minutes without stopping each day for the next week." The patient's SMARTS objectives should be developed in conjunction with the practitioner and evaluated according to the time frame stated in the objective.

Resources and Preferences to Engage in a Program of Regular Physical Activity

Once the hypertensive obese patient progresses to the preparation, action, or maintenance stage, an individual program of increased physical activity can be prescribed. Developing a prescription for increased physical activity for patients not exhibiting these stages of health behavior change is counterproductive and will result in a low rate of adherence. The physical activity prescription should also be individualized to the patient's ability to engage in physical activity. A number of morbidly obese patients cannot walk >20 yards without becoming short of breath and stopping. Thus, morbidly obese individuals may need to begin the aerobic component of their physical activity

Table 4. Generic program for individuals with hypertension

Component	Technique & Initial Level	Progression & Goal
Warm Up	Slow walking for 3–5 minutes	Increase by 1 minute per week to 5 minutes
Aerobic	Intensity: heart rate increases by 10–15 beats/minute over resting. Duration: 5 minutes Frequency: 2–3 times per week Mode: walking, stationary cycling, swimming, stair climbing	Intensity: as tolerated to 20–25 beats/minute above resting heart rate Duration: increase by 5 minutes each week up to 30–45 minutes Frequency: increase as tolerated to 5–7 days per week
Strength	Intensity: ''mild'' fatigue after 6 repetitions Repetitions: 6–8 repetitions Frequency: 2 days per week Mode: use gravity for resistance, light hand/ankle weights, weight machines, elastic bands, etc Upper Body • bicep curls • overhead press • tricep extensions • lateral raises • rows Lower Body • knee extension/flexion • plantar/dorsi flexion • hip abduction/adduction • hip extension/flexion Trunk • chair sit-ups	Intensity: ''moderate'' fatigue after 10–12 repetitions Repetitions: single set of 12 repetitions Frequency: increase as tolerated to 3 days per week
Cool Down	Stretching: Intensity: ''mild'' feeling of tension Repetitions: 2 per exercise Duration: 30 seconds Frequency: 2–3 times per week Mode: touch toes, overhead stretch, etc Slow walking for 3–5 minutes	Intensity: ''moderate'' feeling of tension Repetitions: 5 per exercise Duration: 30 seconds Frequency: Increase as tolerated to 5–7 days per week Mode: touch toes, overhead stretch, etc Increase by 1 minute per week to 5 minutes

prescription by walking 20 yards and then progressively increasing this distance. Although a person may require more time to progress through the aerobic component of a program, he or she may be able to engage in all prescribed resistance training exercises at the outset while sitting. This resistance training may accelerate the individual's capacity to engage in the aerobic component of the training. During the initial assessment, the practitioner should also discuss individual preferences and resources for engaging in increased physical activity. These preferences and resources should be carefully considered and incorporated in the individual's physical activity program. For example, a 58-year-old, obese female states difficulty arranging transportation to a gym. Setting an objective that involves training at a remote site 5 days per week is likely doomed to failure. A more practical approach would be to include exercises that can be completed in the individual's home or that involve minimal transportation. Including periodic telephone support and encouragement may increase the likelihood that this patient will maintain compliance with her prescribed physical activity prescription.

A generic physical activity prescription is presented in Table 4. This program includes warm up, aerobic, resistance, and cool down components. Corresponding with each of these components is a brief description of the technique and a recommended initial level of training. This generic program should be modified to each individual's initial capacity to engage in physical activity and any limitations imposed by medical conditions. This generic program must also be modified to the individual's preferences and resources for engaging in increased physical activity. Individuals may initially exhibit a training capacity above or below the initial level of physical activity stated in this generic program. The practitioner must assess the individual patient's capacity to perform the initially recommended level of physical activity and adjust the intensity, duration, frequency and/or mode of the training to this initial level. Optimally, the initial level of training should require the individual to engage in physical activity that is beyond his or her normal daily level without risking injury or resulting in undue stress. Similarly, progression in a physical activity program should constantly increase the intensity, duration, and frequency of training until achieving a predetermined level of recommended daily physical activity. Again, increases should be adjusted to the individual's capacities and responses to physical activity training and should minimize risk and undue stress. Thus, the initial level of training and the progression of the intensity, duration, frequency, and mode of training will be different for each individual based on his or her initial physical capacity and the degree to which he or she individually responds to increases in physical activity.

CONCLUSION

Hypertension is a significant global health problem that affects individuals of all ethnicities. Physical inactivity, increased body fat mass, and excessive weight gain contribute to this growing health problem. Regular physical activity of moderate intensity reduces body fat mass and improves functioning of the nervous, renal, and cardiovascular systems, which regulate blood pressure. Physical activity reverses increases in blood pressure associated with body fat mass, and this effect is equal to pharmacologic monotherapy. For the obese patient with hypertension, increasing physical activity may present a major lifestyle challenge. The transtheoretical model can be used by clinicians to better understand the stages of change experienced by patients trying to increase their physical activity level. The generic exercise program we describe is intended to provide health practitioners with a starting point; it should be modified and progressed based on the health practitioner's initial assessment of individual capacity and the health practitioner's and patient's goals.

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