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REVIEW
ΑΝΑΣΚΟΠΗΣΗ

Prescription of exercise in individuals with hypertension

Hypertension is a great public health problem worldwide and is associated with increased cardiovascular, cerebrovascular and renal complications. The development of nonpharmacological therapies is a cost-effective strategy that helps in the prevention of comorbidities. Beneficial effects of structured exercise have been demonstrated for the primary prevention and treatment of hypertension. This paper aims to review the components of exercise prescription and the approaches to developing appropriate exercise prescription for patients with hypertension.

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ΑΡΧΕΙΑ ΕΛΛΗΝΙΚΗΣ ΙΑΤΡΙΚΗΣ 2023, 40(5):583–589

M. Tsekoura,
K. Fousekis,
P. Angelopoulos,
K. Mylonas,
G. Xrysanthopoulos,
E. Tsepis,
E. Billis

Department of Physiotherapy, School of Health Rehabilitation Sciences, University of Patras, Egio, Greece

Συνταγογράφηση άσκησης σε άτομα με υπέρταση

Περίληψη στο τέλος του άρθρου

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1. INTRODUCTION

Hypertension is a global health concern. It is the most common, costly, and preventable cardiovascular disease risk factor.[1,2] Approximately 40% of adults worldwide have hypertension[3] (systolic blood pressure [SBP] ≥140 mmHg and or diastolic blood pressure [DBP] ≥90 mmHg).[2,4] The prevalence of hypertension in older adults is higher (i.e., approximately 70–80%).[5] This high prevalence of raised blood pressure (BP) is consistent across the world, irrespective of socio-economic status.[6] However, nearly four-fifths of deaths due to hypertension occur in low- and middle-income countries.[7]

Hypertension can lead to severe complications and increases the risk of coronary artery disease, heart failure, ischemic and hemorrhagic stroke, peripheral arterial diseases, renal failure and death.[1,7,8] It is also a leading risk for fetal and maternal death and maternal death in pregnancy.[9] The complications of hypertension account for 9.4 million deaths worldwide every year.[10] In addition, hypertension can damage brain structures and functions, leading to impaired cognitive functions.[11,12] Furthermore, brain damage caused by hypertension affects a person's mental ability to work and decreases their productivity, leading to social and economic problems.[12,13]

Elevated BP arises from a combination of environmental and genetic factors and the interactions of these factors.[14] There are modifiable risk factors for this disease like obesity, physical activity, diet, smoking, alcohol consumption, and diabetes mellitus, whereas some of them are not amenable to change; these include gender, age, genetics, and race.[1,15,16]

For all these reasons, hypertension screening and treatment is strongly recommended. Treatment of hypertension and its complications remains a major ongoing health care challenge.[17] Despite a plethora of available treatment options, many hypertensive people have uncontrolled BP. Antihypertensive medicines can effectively reduce BP and the risk of associated diseases.[18,19] Interventional strategies for the treatment of hypertension include also

dietary strategies (e.g. reducing sodium intake, limiting alcohol consumption, etc.). Changes in diet can lower BP, prevent the development of hypertension, and reduce the risk of hypertension-related complications.[14] As early as 1983, the World Health Organization recommended the use of non-pharmacological treatment of hypertension.[20] Organizations, including the American Heart Association, the American College of Sports Medicine, the Surgeon General of the United States, the National Institutes of Health, and the Centers for Disease Control have issued policy-statements supporting the role of exercise treatment in hypertension.[21,22] Exercise is one of the most frequently prescribed therapies both in health and disease and should be considered as a drug.[23] However, the dosage of exercise (volume and intensity), frequency of administration (sessions per week), type (e.g. aerobic or resistance exercise), and contraindications and side effects of the exercise must be taken into account to achieve the best clinical outcome. Dosage of exercise is important in clinical medicine and all marketed drugs require data on their efficacy and safety.[23,24] Thus, the aim of this review is to provide updated, evidence-based recommendations for health care professionals concerning the quantity and quality of exercise prescriptions for individuals with hypertension.

2. BENEFITS OF EXERCISE

Exercise is a key component of lifestyle therapy for the primary prevention and treatment of hypertension.[25] The first interventional study to demonstrate that exercise lowers the BP was published in 1970. Results showed that an aerobic interval training program 2 days/week elicited reductions in BP in both hypertensive and normotensive men.[26] Beneficial effects of exercise on hypertension have been demonstrated by various studies, with reductions in both systolic and diastolic BP with as much as 5–7 mmHg reductions in those with hypertension.[4,25,27,28]

The possible mechanism of the antihypertensive effects of exercise may include (a) reduction in sympathetically-induced vasoconstriction and reduced catecholamine segregation, (b) anti-inflammatory effects, (c) increased insulin sensitivity and (d) vascular structural adaptations.[29] The acute effect of exercise results in transient reductions in triglyceride levels, increases in HDL cholesterol level, decreases in BP, reductions in insulin resistance and improvements in glucose control.[30,31] The fall in BP seen after the exercise may be caused by a reduced signal transduction from sympathetic nerve activation into vasoconstriction and local vasodilator mechanisms.[32]

Hypertension is frequently characterized by pathologic left ventricular remodeling with concentric hypertrophy.[28] In hypertensive patients, physical activity has been associated with paradoxical regression or prevention of left ventricular hypertrophy, suggesting a mechanism by which exercise can benefit hypertensive patients. The effect of exercise on the sympathetic nervous system may play an important role in cardiac remodeling in the hypertensive heart. In addition to reductions in BP, regular exercise has been associated with beneficial effects on heart rate and insulin resistance, which have been attributed to decreased sympathetic activity.[33] Large-scale population-based trials have documented that 15 minutes of daily exercise in leisure-time will confer about 15% mortality reduction in cardiovascular mortality.[34] Persons with high BP in resting condition had greatly decreased their weight because of exercise.[33] Clinical outcomes of exercise include decrease in mortality, coronary heart disease mortality and cardiovascular events.[35] A summary of cardiometabolic effects of exercise are presented in table 1.

3. COMPONENTS OF EXERCISE

The modalities of exercise that have shown a relatively stronger supporting evidence are aerobic exercise (class I, level of evidence A), dynamic resistance exercise (class IIA, level of evidence B), and isometric handgrip (class IIB, level of evidence C).[36]

Table 1. Cardiometabolic effects of exercise.

Arteries	Decrease: Atherosclerosis, central wall thickness
	Increase: Vascular function, central artery compliance, angiogenesis
Hemodynamic	Increase: Stroke volume
	Decrease: resting heart rate, systemic vascular resistance
Heart	Increase: left ventricular diastolic relaxation and systolic contraction, ischemic tolerance, myocardial capillary density
	Decrease: left ventricular afterload
Cardiovascular risk factors	Decrease: blood pressure, body fat, waist circumference, triglycerides, blood glucose
	Increase: sleep duration and quality, maximal oxygen consumption, HDL cholesterol
Neural	Decrease: Heart rate variability
	Increase: muscle and renal sympathetic nerve activity, norepinephrine spill over
Metabolic	Decrease: oxidative stress inflammation, plasma renin activity
	Increase: insulin sensitivity, fibrinolytic activity

Numerous randomized controlled trials (RCTs) have been conducted investigating the antihypertensive effects of exercise. In an attempt to better quantify the antihypertensive effects of exercise, many meta-analyses of these RCTs have been published.[4] Aerobic exercise training lowers BP 5–7 mmHg, while dynamic resistance training lowers BP 2–3 mmHg among adults with hypertension.[4,37,38] Health care and exercise professionals should also consider the level of BP control, recent changes in antihypertensive drug therapy, medication-related adverse and exercise effects, and the presence of target organ disease and or other comorbidities with adjustments made accordingly.[4]

3.1. Aerobic exercises

Aerobic exercise reduces BP in both hypertensive and normotensive persons.[39] It is one of nonpharmacological treatment methods and is recommended by European and American hypertension guidelines to reduce BP.[40–42] Aerobic exercise is any repetitive activity that increases the heart rate for an extended period of time.[43] There is a general consensus that aerobic exercise training reduces systolic blood pressure and diastolic blood pressure of hypertensive patients.[44] A recent review of 27 randomized controlled trials, a total of 1.480 participants, expanded on the effects of aerobic exercise for lowering BP in participants with hypertension and observed a mean reduction of 10.8/4.7 mmHg for systolic and diastolic BP, in the included trials with 3+ level of evidence.[45]

Increasing evidence has indicated that aerobic exercise has favorable effects on cardiovascular risk factors, cardiac autonomic function, and endothelial pathophysiology in individuals with hypertension.[46] It should be noted that the hemodynamic determinants of post-exercise hypotension following aerobic exercise seem to be different between individuals with normal BP and hypertension.[2] The main hemodynamic determinant of post-exercise hypotension is reduced systemic vascular resistance; however, the post-exercise hypotension in older adults overweight and hypertensive individuals is more associated with a decrease in cardiac output post-exercise, especially due to a reduction in stroke volume.[47]

In the absence of major comorbidities, patients with hypertension (stage 2 or below) should be encouraged to undertake a light-to-moderate intensity exercise program without needing to consult with their doctor.[35] Joint guidelines from the American Heart Association (AHA) and American College of Sports Medicine (ACSM) have recommended moderate-intensity aerobic exercise for a minimum of 30 minutes per day, 5 days a week or vigorous-intensity aerobic exercise for a minimum of 20 minutes per day, 3 days a week.[4,48] Individuals with hypertension are encouraged to engage in greater frequencies of aerobic exercise than those with normal BP because we know that a single bout of aerobic exercise results in immediate reductions in BP of 5–7 mmHg, that persist for up to 24 hours (i.e., post-exercise hypotension). For this reason, individuals with hypertension are encouraged to exercise on most days of the week in order to benefit from the acute effects of aerobic exercise on BP. New and emerging evidence suggest that the magnitude of the BP reductions that result from aerobic exercise occur as a direct function of intensity, such that the more vigorous the intensity, the greater the resultant BP reductions.[4] Individuals who are willing and able may consider progressing to more vigorous intensities; however, the risk-to-benefit ratio has not yet been established.[4] Regarding duration of exercise programs, literature shows that the degree of BP reduction significantly differs among studies for all durations of exercise (less than 8 weeks, 8–12 weeks, and more than 12 weeks), and aerobic exercise that lasts for about 8 weeks may have a better antihypertensive effect.[46]

Practical recommendations: Rhythmic exercises should be performed using the large muscle groups (e.g. brisk walking, cycling, and swimming) on most, preferably all days. The intensity of exercise should be moderate (i.e., 40% to <60% VO_{2max} or HR reserve; 11–13 rating of perceived exertion [RPE] on the 6–20 Borg Scale.[49,50] Aerobic exercise should be performed for 30 to 60 minutes per day that is continuous or accumulated. If accumulated, bouts should be at least 10 min in duration to total 30 to 60 minutes of exercise per day. The pained should always cool down slowly and drink plenty of fluids before, during, and after exercise, especially if you plan to exercise on a hot day or for a long time.[4,51]

3.2. Resistance exercises

Resistance exercise increases cardiopulmonary functions and lowers the elasticity of the vessel wall or decreases the damage of the inner vessel wall to improve vascular function.[52] The AHA recommends that uncontrolled hypertension (180/110 mmHg) can be an absolute contraindication for resistance training.[53] This person should consult with a physician before initiating resistance training. Resistance training may supplement aerobic training and should consist of 2–4 sets of 8–12 repetitions for each of the major muscle groups. High-intensity resistance exercise (80–100% 1-rep maximum) can invoke excessive elevations in BP. As a result, resistance training at this intensity should be

avoided in persons with hypertension.[53] The majority of this support arises from the recognition that participation in regular resistance exercise is the most effective method of improving musculoskeletal function (muscle size, strength, endurance, and power).[53,54]

Practical considerations: Dynamic resistance exercise should consist of two to three sets of 10 to 12 repetitions for 8 to 10 exercises that target the major muscle groups of the upper and lower body. The duration of exercise should total 150 min or more per week. Dynamic resistance training equipment may include machine weights, free weights, and resistance bands, as well as functional body weight exercises. Progression should be gradual, avoiding large increases in any of the frequency, intensity, type, and time (FITT) components of the exercise, especially intensity (tab. 2). The patients should avoid holding their breath when lifting and plan a day of rest between sessions.[4]

3.3. Concurrent exercise training

Concurrent training, the combination of dynamic resistance and aerobic exercise training is an exercise modality recommended by ACSM for adults with high BP. ACSM recommends at least 30 minutes of moderate aerobic exercise (40–60% VO_2 reserve) on most, preferably all, days of the week, supplemented by moderate resistance exercise (60–80% of one-repetition maximum), 8–12 repetitions, 2–3 days per week.[4] The overall effects of combined exercise training across all BP categories are reductions of −5.5/−4.1 mmHg.[17,57,58]

In summary, combined exercise training seems to be of lesser added value in individuals at risk of developing hypertension. In patients with manifested hypertension, however, combined exercise may be an efficient alternative treatment option, but more studies are necessary to determine the BP lowering effects of combined exercise as the primary outcome in patients with hypertension.[17]

3.4. Special considerations

People with severe uncontrolled hypertension based on clinic BP (systolic ≥180 mmHg and or diastolic ≥110 mmHg) should firstly be evaluated by their doctor prior to regular exercise training (preferably with addition of out-of-clinic BP measures to confirm BP control).[34]

There is greater propensity for sudden excessive hypotension in the immediate post-exercise period among people taking alpha blockers, calcium channel blockers, or vasodilating drugs, as well as in elderly people.[51,59,60] This may be mitigated with an extended cool down period of light activity. Individuals should also avoid to suddenly stop exercise. Beta blockers and diuretics can alter thermoregulation during exercise.[4,51] A summary of clinical and practical considerations[61] are presented in table 3.

4. CONCLUSIONS

Substantial research indicates that regular cardiopulmonary exercise has a favorable effect on lowering overall BP and should be the main emphasis of an exercise program designed to prevent and control hypertension.[39,55] Aerobic training is the first-line exercise therapy in patients with

Table 2. FITT principle to design and implement a safe, effective, and enjoyable program.

	European Society of Hypertension/ European Society of Cardiology[40]	American College of Sports Medicine[4,55]	Canadian Hypertension Education Program[56]
Frequency	5–7 days/week	Most, preferably all, days of the week	4–7 days·week^{-1} in addition to habitual, daily activity
Intensity	Moderate intensity, 40–<60% $VO_{2reserve}$ or an intensity that causes noticeable increases in heart rate and breathing; vigorous or high intensity, ≥60% $VO_{2reserve}$ or an intensity that causes substantial increases in heart rate and breathing	Moderate 40–<60% of $VO_{2reserve}$	Moderate intensity, 40–<60% $VO_{2reserve}$ or an intensity that causes noticeable increases in heart rate and breathing; vigorous or high intensity, ≥60% $VO_{2reserve}$ or an intensity that causes substantial increases in heart rate and breathing
Time	≥30 min·day^{-}	30–60 min continuous or accumulated in bouts ≥10 min each	Accumulation of 30–60 min/day
Type of exercise	Aerobic	Aerobic	Aerobic
Primary	Dynamic RT 2–3 days/week	Dynamic Resistance 2–3 days/week, moderate 60–80% of 1-RM, 8–12 repetitions	Resistance Isometric, or Handgrip resistance training
Adjuvant			

Table 3. Practical considerations of exercise in patients with hypertension.

1. Exercise should not begin if the individual presents values of arterial pressure of 180/105 mmHg or higher
2. Blood pressure should be monitored during (or at the end of a set) the exercise programme by the average of two consecutive measurements spaced by 30 sec
3. Progression of exercise should be gradual
4 High number of repetitions should be avoided
5 Exercises with the head lower than the hips should be avoided (declined exercises)
6. A cooldown phase of at least 5–10 min is necessary on order to avoid an excessive post exercise hypotension effect
7. If the response to exercise is hypotensive, that is, an inability to increase blood pressure despite increased demands for physical exercise, usually less than 20–30 mmHg, exercise must stop
8. A sufficient recovery time, at least 30 seconds should be provided, in order the individual to return to baseline conditions of the cardiovascular system

hypertension. Resistance training can be recommended as part of primary and secondary prevention programs of arterial hypertension and as a second-line exercise treatment.[17] Health professionals should be aware of the importance of integrating exercise into the daily life of every individual with hypertension.

ΠΕΡΙΛΗΨΗ

Συνταγογράφηση άσκησης σε άτομα με υπέρταση

Μ. ΤΣΕΚΟΥΡΑ, Κ. ΦΟΥΣΕΚΗΣ, Π. ΑΓΓΕΛΟΠΟΥΛΟΣ, Κ. ΜΥΛΩΝΑΣ, Γ. ΧΡΥΣΑΝΘΟΠΟΥΛΟΣ, Η. ΤΣΕΠΗΣ, Ε. ΜΠΙΛΛΗ

Τμήμα Φυσικοθεραπείας, Σχολή Επιστημών Αποκατάστασης Υγείας, Πανεπιστήμιο Πατρών, Αίγιο

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Η υπέρταση είναι ένα παγκόσμιο θέμα που απασχολεί την υγεία και σχετίζεται με αυξημένες καρδιαγγειακές, εγκεφαλοαγγειακές και νεφρικές επιπλοκές. Η ανάπτυξη μη φαρμακολογικών θεραπειών αποτελεί οικονομική στρατηγική με ελάχιστες επιπλοκές, που βοηθά την πρόληψη των συννοσηροτήτων. Τα θεραπευτικά οφέλη της άσκησης είναι γνωστά τόσο για την πρόληψη όσο και για τη θεραπεία της υπέρτασης. Ο σκοπός της παρούσας εργασίας είναι η ανασκόπηση των διαφορετικών τύπων άσκησης σε ασθενείς με υπέρταση.

Λέξεις ευρετηρίου: Αεροβική, Αντιστάσεις, Άσκηση, Υπέρταση

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Corresponding author:

M. Tsekoura, 6 Psaron street, 251 00 Egio, Greece
e-mail: mariatsekoura@upatras.gr