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# Exercise in the treatment and prevention of hypertension

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Literature review current through: **Jul 2023**.

This topic last updated: **Jun 15, 2023**.

## INTRODUCTION

The health benefits of regular exercise are well established. Regular exercise is recommended for many purposes, including blood pressure lowering [1-5]. Other health benefits include a reduced risk of cardiovascular disease, diabetes, lipid disorders, breast and colon cancer, weight gain, frailty, and bone disease.

The effects of exercise on blood pressure are presented in this topic.

The benefits of exercise on other health outcomes are discussed separately. (See "[The benefits and risks of aerobic exercise](#)" and "[Physical activity and exercise in older adults](#)" and "[Exercise for adults: Terminology, patient assessment, and medical clearance](#)" and "[Exercise and fitness in the prevention of atherosclerotic cardiovascular disease](#)" and "[Exercise guidance in adults with diabetes mellitus](#)" and "[Obesity in adults: Role of physical activity and exercise](#)" and "[Exercise-based therapy for low back pain](#)" and "[Effects of exercise on lipoproteins and hemostatic factors](#)".)

## CLASSIFICATION OF EXERCISE

Exercise is classified as dynamic aerobic, dynamic resistance, and isometric resistance [1]:

- Dynamic (also termed isotonic) refers to the regular, purposeful movement of joints and large muscle groups.

- Isometric exercise involves the static contraction of muscles without joint movement.
- Aerobic versus anaerobic describes the availability of oxygen for energy production during contraction and most often reflects the relative intensity of exercise.

Activities typically involve a combination of dynamic aerobic, dynamic resistance, and isometric resistance exercise; in this context, classification is usually based upon the dominant characteristics of the exercise.

For each type of exercise, key features, all related to "dose," are duration, intensity, and frequency. In contrast to the term "exercise," the term "sedentary behavior" is characterized as very low energy expenditure, while in a sitting, reclining, or lying position, over prolonged periods of time.

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## GUIDANCE FOR CLINICIANS

Clinicians have an important role in promoting lifestyle changes, of which increased physical activity should be a major goal.

A brief, supportive message on the benefits of increasing physical activity and reducing sedentary behavior, even without extensive counseling, should be beneficial. Many organizations emphasize a greatly enhanced role of clinicians to promote and monitor physical activity [5].

**Our approach** — Most patients who are capable of exercising, whether normotensive or hypertensive, should be advised to perform moderate-intensity and/or vigorous-intensity dynamic aerobic exercise. Aerobic exercise lowers blood pressure in normotensive individuals, most of whom will develop hypertension over their lifetime [6]. In addition, there is inverse association of higher exercise dose with a lower incidence of hypertension incidence [7] and a lower rate of mortality ( [figure 1](#)) [8]. (See "[The benefits and risks of aerobic exercise](#)".)

A medical evaluation is usually unnecessary prior to either prescribing exercise or reinforcing the patient's current level of physical activity (if adequate). However, some patients should undergo an evaluation (for example, with electrocardiogram [ECG] exercise testing) to determine if initiating an exercise program is safe. (See '[Deciding whether exercise testing is needed](#)' below.)

There is no one exercise prescription for all adults. In general, reasonable weekly goals for dynamic aerobic exercise are at least 150 minutes of moderate-intensity physical activity (approximately 30 minutes per day, five or more days per week) or at least 75 minutes of

vigorous-intensity physical activity (approximately 30 minutes per day, three or more days per week). (See '[Type of exercise](#)' below and '[Dose of exercise](#)' below.)

**Deciding whether exercise testing is needed** — Exercise testing is recommended in some, but not most, patients who start an exercise program [9]. However, recommendations are in flux.

In general, sedentary patients with known or, based upon signs and symptoms, suspected cardiovascular disease, diabetes, or kidney disease should undergo exercise testing before embarking on an exercise plan ( [algorithm 1](#)). Among those already engaged in moderate- or vigorous-intensity physical activity, new signs or symptoms of cardiovascular disease should prompt a cessation of exercise until further testing can be done.

**Type of exercise** — Numerous studies, including clinical trials, have examined the effects of exercise on blood pressure and other health outcomes. The available evidence supports dynamic aerobic exercise as a means to lower blood pressure and prevent and control hypertension. The evidence supporting resistance exercise is less compelling. The American Heart Association affirmed these benefits in a 2021 scientific statement on the BP-lowering effects of aerobic and resistance training [10].

**Dynamic aerobic exercise** — The most extensively studied form of exercise is dynamic aerobic exercise, which is the regular and purposeful movement of large muscle groups in moderate and/or vigorous activity that places stress on the cardiovascular system. Examples include brisk walking, jogging, dancing, bicycling, swimming, and using certain exercise equipment, such as elliptical machines.

The amount of aerobic exercise performed is measured as the intensity compared with rest (expressed in metabolic equivalents [METs]), duration (minutes per session), and frequency (number of sessions per week).

More intense exercises require more METs; walking at 3 miles/hour uses 3.5 METs, jogging at a 14 min/mile pace uses 6 METs, and jogging at a 10 min/mile pace uses 10 METs. The total amount of dynamic aerobic activity can then be expressed as "exercise volume," which is the product of average METs multiplied by the total number of minutes per week, with the goal of reaching 500 to 1000 MET min/week. As an example, walking 3 miles/hour for 30 minutes, five times per week (ie, 150 minutes per week) requires 525 MET min/week.

Several meta-analyses and systematic reviews of trials that examined the effects of aerobic exercise on blood pressure have been conducted [1,3,11-15]. In one meta-analysis that aggregated data across 72 trials in hypertensive adults, aerobic exercise significantly lowered resting clinic systolic/diastolic blood pressure by 3.0/2.4 mmHg and daytime ambulatory blood

pressure to a similar extent (3.3/3.5 mmHg) [12]. The blood pressure reductions were greater in trials of hypertensive patients as compared with trials of nonhypertensive individuals (6.9/4.9 compared with 1.9/1.6 mmHg). Overall, there was no observed effect of exercise dose, training frequency, training intensity, training session time, or specific type of exercise on the magnitude of the blood pressure reduction. However, meta-analyses are poorly suited to address such questions.

**Dynamic resistance exercise** — Evidence on the effects of dynamic resistance exercise is limited and inconsistent, even though some meta-analyses have concluded that dynamic resistance exercise modestly lowers blood pressure [15-17]. This type of exercise is characterized by effort that is performed against an opposing force accompanied by purposeful movement of joints and large muscle groups. Common types of dynamic resistance exercise include weight lifting and circuit training, often with the use of exercise equipment. These types of exercise are typically performed with a goal of progressively increasing muscle strength. An ancillary benefit might be blood pressure reduction.

One meta-analysis included 25 trials that examined the effect of resistance training on blood pressure [16]. Mean reductions in systolic/diastolic blood pressure were 2.7/2.9 mmHg. However, many of the included studies had design limitations, and the quality of evidence was poor. Further, in a subsequent trial including 2157 adults  $\geq 70$  years, participation in a strength-training exercise program did not lower blood pressure [18]. Importantly, however, there was no evidence of harm from dynamic resistance exercise (such as an acute triggering of cardiovascular events during exercise or a chronic worsening of blood pressure). Hence, resistance training for most individuals with hypertension is not contraindicated.

**Isometric resistance exercise** — Even less evidence is available to support the blood pressure effects of isometric resistance exercise.

Isometric resistance is characterized by sustained contraction of muscles with no change in the length of the involved muscle groups and no change in joint angle. Some isometric resistance exercise may involve equipment, such as handgrips or weighted resistance machines; other forms do not use equipment and involve maintaining a constant position such as sitting against a wall without a chair or maintaining a "plank" position.

Most trials of traditional isometric resistance exercise were short in duration and/or enrolled few participants [1,19]. Although meta-analyses of these studies have been published, some concluding a beneficial effect on blood pressure [17,20], the data are too limited to draw such conclusions.

**Dose of exercise** — There is no one exercise prescription that is appropriate for all adults. The prescription should be individualized to the patient's capabilities and to prevent injuries and maximize incentives for maintaining a consistent regimen.

Changing patients' behavior is often challenging, and supplying information and general recommendations alone is often insufficient. Hence, clinicians should provide the exercise prescription coupled with practical solutions, such as exercising with companions, joining community groups, and tracking minutes or counts of physical activity.

Reasonable exercise prescriptions include, but are not limited to, the following (see "[Exercise prescription and guidance for adults](#)", section on 'Prescribing an exercise program'):

- At least 150 minutes of **moderate-intensity** physical activity per week; this corresponds to approximately 30 minutes per day, five or more days per week.
- At least 75 minutes of **vigorous-intensity** physical activity per week; this corresponds to approximately 30 minutes per day, three or more days per week.

In some patients, it is also reasonable to advocate for a modest increase in physical activity even if the specific goals above are not met.

Moderate and vigorous activity are technically defined by percentile of peak  $VO_2$  (ie, the peak rate of oxygen consumption) or by maximum heart rate. However, describing exercise to patients in these terms is not practical. Rather, clinicians should mention that, in general, individuals can talk during moderately intense activity. However, during vigorous-intensity activity, individuals can say no more than a few words without pausing for a breath.

Many patients and providers want to know how much exercise is necessary to achieve health benefits, as well as the corollary issue of whether vigorously intense exercise is more beneficial than moderately intense exercise. Unfortunately, data from trials on dose-response relationships are insufficient to answer these questions, at least for blood pressure. However, there are data from observational studies that suggest a progressive relationship of exercise dose with a lower hypertension incidence [7] and with mortality ( [figure 1](#) ) [8].

**Major professional society recommendations** — The table provides an overview of exercise recommendation to prevent and control blood pressure by professional societies ( [table 1](#) ) [1,3,21-26]. Differences, for the most part, are subtle, with the typical recommendation being moderately intense physical activity on most days of the week, for at least 30 minutes/day.

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## MECHANISMS

As with many therapeutic modalities, including both nondrug and drug therapies, the mechanisms by which exercise lowers blood pressure and prevents hypertension are uncertain, in part because the etiology of elevated blood pressure is multifactorial. Findings from animal studies suggest aerobic exercise may prevent increases in blood pressure through beneficial changes in insulin sensitivity and autonomic nervous system function [27] while resistance training may prevent increases in blood pressure through reduced vasoconstriction [28]. Other potential mechanisms include reduced inflammation, oxidative damage, sodium sensitivity, and arterial stiffness [2].

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## OTHER ISSUES AND CONSIDERATIONS

**Effect of antihypertensive medications** — The ability to perform exercise may be adversely affected by antihypertensive medications. Beta blockers, particularly those that are nonselective, can significantly diminish exercise performance. There is, however, a training effect, and maintenance of performance levels has been observed in patients treated with beta blockers [29]. Other classes of antihypertensive drugs have no detrimental effect on the ability to exercise.

**Role in weight control** — Clinicians and patients often ask about the relative importance of reduced calorie intake versus increased calorie expenditure (ie, exercise) on weight control. For weight loss, it is extremely difficult, although not impossible, to achieve a sufficiently large calorie deficit from increased exercise alone. In one trial, for example, individuals assigned to either 400 or 600 kcal of aerobic exercise/session, five sessions/week for 10 months, lost 3.9 and 5.2 kg, respectively [30].

In individuals who have lost weight, a high level of physical activity (eg, one hour/day or more of moderate aerobic activity) is often needed to sustain the weight loss.

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## INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5<sup>th</sup> to 6<sup>th</sup> grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10<sup>th</sup> to 12<sup>th</sup> grade reading

level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topic (see "[Patient education: Controlling your blood pressure through lifestyle \(The Basics\)](#)")
- Beyond the Basics topic (see "[Patient education: High blood pressure, diet, and weight \(Beyond the Basics\)](#)")

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## SUMMARY

- Exercise is classified as dynamic aerobic, dynamic resistance, and isometric resistance. For each type of exercise, key features, all related to "dose," are duration, intensity, and frequency. (See '[Classification of exercise](#)' above.)
- Most patients who are capable of exercising, whether normotensive or hypertensive, should be advised to perform moderate-intensity and/or vigorous-intensity dynamic aerobic exercise. Aerobic exercise lowers blood pressure in normotensive individuals and is associated with a reduced incidence of hypertension and a lower mortality rate ( [figure 1](#)). (See '[Our approach](#)' above.)
- A medical evaluation is usually unnecessary prior to either prescribing exercise or reinforcing the patient's current level of physical activity (if adequate). However, some patients should undergo an evaluation (for example, with electrocardiogram [ECG] exercise testing) to determine if initiating an exercise program is safe. (See '[Deciding whether exercise testing is needed](#)' above.)
- There is no one exercise prescription for all adults. In general, reasonable weekly goals for dynamic aerobic exercise are at least 150 minutes of moderate-intensity physical activity (approximately 30 minutes per day, five or more days per week) or at least 75 minutes of vigorous-intensity physical activity (approximately 30 minutes per day, three or more days per week). (See '[Type of exercise](#)' above and '[Dose of exercise](#)' above.)
- Exercise testing is recommended in some, but not most, patients who start an exercise program. In general, sedentary patients with known or, based upon signs and symptoms, suspected cardiovascular disease, diabetes, or kidney disease should undergo exercise

testing before embarking on an exercise plan ( [algorithm 1](#)). Among those already engaged in moderate- or vigorous-intensity physical activity, new signs or symptoms of cardiovascular disease should prompt a cessation of exercise until further testing can be done. (See '[Deciding whether exercise testing is needed](#)' above.)

- The available evidence supports dynamic aerobic exercise as a means to lower blood pressure and prevent and control hypertension. The evidence supporting resistance exercise is less compelling. (See '[Type of exercise](#)' above.)
- There is no one exercise prescription that is appropriate for all adults. The prescription should be individualized to the patient's capabilities and to prevent injuries and maximize incentives for maintaining a consistent regimen. Reasonable exercise prescriptions include, but are not limited to, the following (see '[Dose of exercise](#)' above):
  - At least 150 minutes of **moderate-intensity** physical activity per week; this corresponds to approximately 30 minutes per day, five or more days per week.
  - At least 75 minutes of **vigorous-intensity** physical activity per week; this corresponds to approximately 30 minutes per day, three or more days per week.

In some patients, it is also reasonable to advocate for a modest increase in physical activity even if the specific goals above are not met.

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## ACKNOWLEDGMENT

The UpToDate editorial staff acknowledges Norman M Kaplan, MD, who contributed to an earlier version of this topic review.

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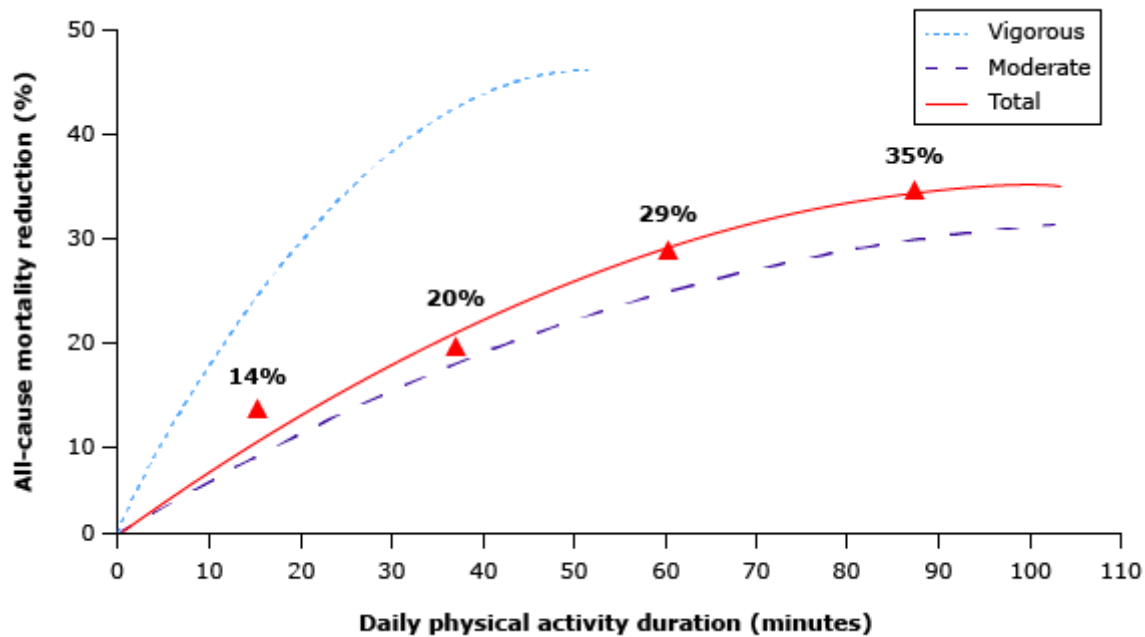
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## GRAPHICS

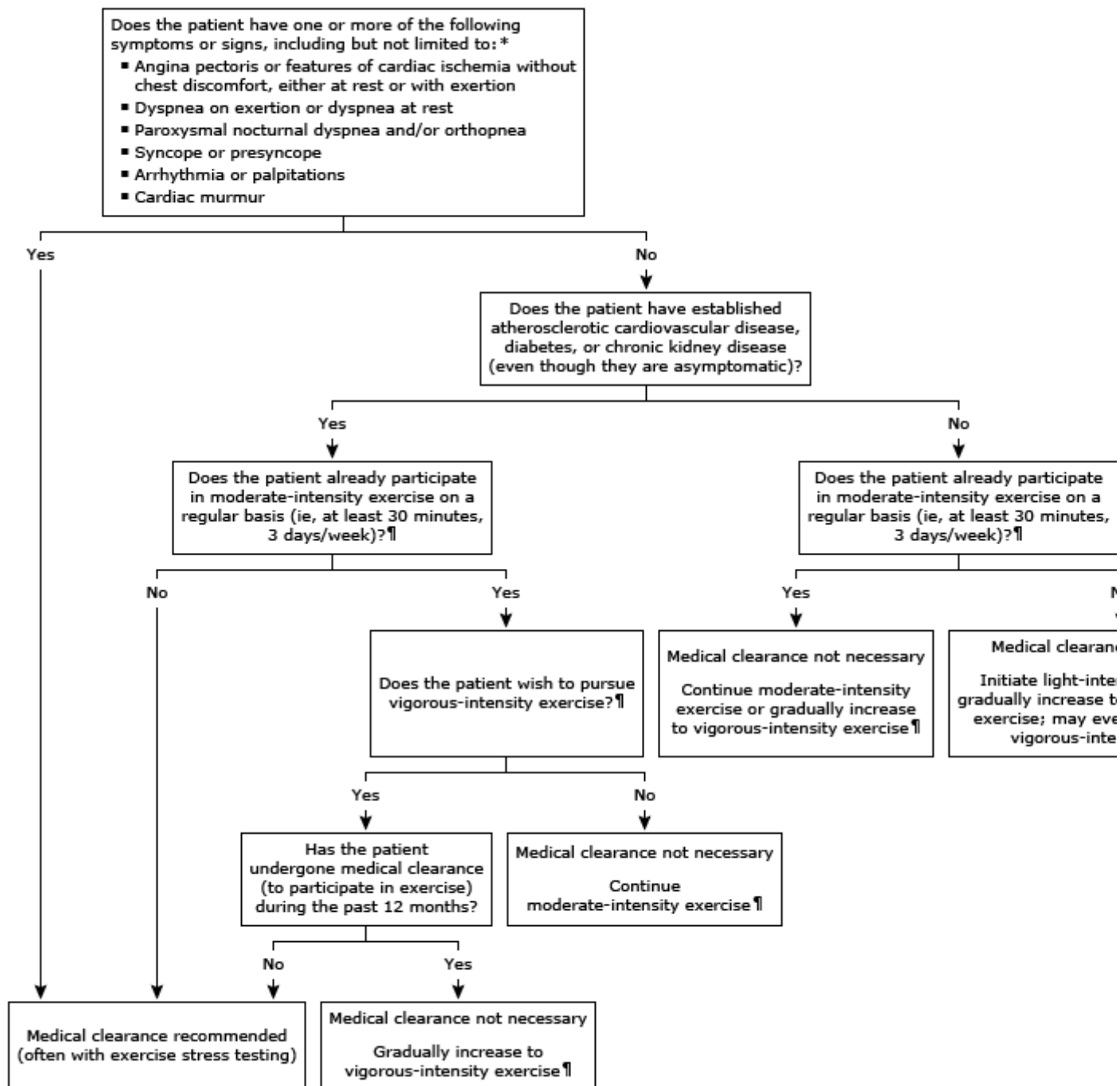
### Exercise intensity and duration and reduction in mortality



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Graphic 82815 Version 2.0

## Health screening process in patients wishing to participate in exercise



\* List is not meant to be exhaustive. For example, the presence of a heart murmur, depending on its feature warrant evaluation.

¶ Refer to UpToDate topics on prescribing exercise for adults and on exercise in the treatment of hypertension definitions of light-, moderate-, and vigorous-intensity exercise.

Adapted from: Riebe D, Franklin BA, Thompson PD, et al. Updating ACSM's Recommendations for Exercise Preparticipation Health Screening. *Sports Exerc* 2015; 47:2473.

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## Exercise recommendations to lower blood pressure from professional committees and organizations

The FITT of the Exercise Rx	Professional committee/organization					
	JNC 8 <sup>[1]</sup> and AHA/ACC Lifestyle Work Group <sup>[2]</sup>	JNC 7 <sup>[3]</sup>	AHA <sup>[4]</sup>	ACSM <sup>[5]</sup>	ESH/ESC <sup>[6]</sup>	CHEP <sup>[7]</sup>
Frequency (how often?)	3 to 4 sessions/week ≥12 weeks	Most days of the week	Most days of the week	Most, preferably all, days of the week	5 to 7 days/week	4 to 7 days/week in addition to habitual activity
Intensity (how hard?)	Moderate to vigorous*	None specified	Moderate to high, >40 to 60% of maximum	Moderate 40 to <60% of VO <sub>2</sub> reserve	Moderate*	Moderate
Time (how long?)	40 minutes/session	≥30 minutes/day	150 minutes/week	30 to 60 minutes continuous or accumulated in bouts ≥10 minutes each	≥30 minutes/day	Accumulation of 30 to 60 minutes/week
Type (what kind?) Primary	Aerobic	Aerobic	Aerobic	Aerobic	Aerobic	Dynamic exercise (aerobic)
Evidence rating	"High" <sup>¶</sup> Δ Grade B <sup>¶</sup> Δ Class IIa level of evidence A <sup>◇</sup>		Class 1 level of evidence A <sup>◇</sup>	Evidence category A, <sup>§</sup> ¥ evidence category B <sup>§</sup> ¥	Class 1 level of evidence A-B <sup>‡</sup>	Grade D <sup>‡</sup>
Adjuvant			Dynamic RT	Dynamic RT 2 to 3 days/week Moderate 60 to 80%	Dynamic RT 2 to 3 days/week	Dynamic, isometric, handgrip

				1-RM, 8 to 12 repetitions		
Evidence rating			Class IIa level of evidence B <sup>◇</sup>	Evidence category B <sup>§</sup> , ¶¶		Grade D <sup>†</sup>
BP reduction (mmHg)	1 to 5	4 to 9		5 to 7 among those with hypertension	2 to 3 overall; 5 to 7 among those with hypertension	

FITT: Frequency, Intensity, Time, and Type of the exercise prescription; Ex R<sub>x</sub>: exercise prescription; JNC 8: Eighth Joint National Committee; AHA: American Heart Association; ACC: American College of Cardiology; JNC 7: Seventh Joint National Committee; ACSM: American College of Sports Medicine; ESH: European Society of Hypertension; ESC: European Society of Cardiology; CHEP: Canadian Hypertension Education Program; VO<sub>2reserve</sub>: oxygen uptake reserve; RT: resistance training; 1-RM: one repetition maximum; BP: blood pressure; NHLBI: National Heart, Lung, and Blood Institute.

\* Moderate intensity is defined as 40 to <60% VO<sub>2reserve</sub> or an intensity that causes noticeable increases in heart rate and breathing; vigorous or high intensity is defined as ≥60% VO<sub>2reserve</sub> or an intensity that causes substantial increases in heart rate and breathing.

¶ The NHLBI<sup>[2]</sup> rating system grades the strength of the evidence (Evidence Statement) and the strength of the recommendation(s) (Evidence Recommendation); adapted from the US Preventive Services Task Force.<sup>[8]</sup>

Δ The Lifestyle Work Group rated the Evidence Statement for aerobic exercise to lower blood pressure as "high"<sup>†</sup>; the Evidence Recommendation for the Ex R<sub>x</sub> (or FITT) to lower blood pressure was rated grade B<sup>¶</sup> or "moderate"; corresponding to class IIa level of evidence A<sup>◇</sup>.

◇ Classification of recommendations and level of evidence per AHA guideline criteria.<sup>[4,9,10]</sup>

§ NHLBI grading of evidence.<sup>[11]</sup>

¥ The strength of evidence was rated: Evidence category B<sup>§</sup> for the immediate effects of aerobic exercise or postexercise hypotension; evidence category A<sup>§</sup> for aerobic exercise to lower blood pressure; evidence category B<sup>§</sup> for the recommended aerobic Ex R<sub>x</sub> (or FITT) to lower blood pressure.

‡ ESC recommendations.<sup>[12]</sup>

† CHEP graded recommendations by the underlying evidence<sup>[13]</sup> using grade A (strongest evidence, based on high-quality studies) to grade D (weakest evidence, based on low-power imprecise studies or expert opinion alone).

\*\* CHEP assigned grade D<sup>†</sup> to "higher intensity exercise is not more effective."

¶¶ The strength of evidence was rated evidence category C<sup>‡</sup> for the immediate effects of dynamic resistance exercise or postexercise hypotension.

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## Contributor Disclosures

**Lawrence J Appel, MD, MPH** No relevant financial relationship(s) with ineligible companies to disclose. **George L Bakris, MD** Grant/Research/Clinical Trial Support: Bayer [Diabetic nephropathy]; KBP Biosciences [Resistant hypertension]; Novo Nordisk [Diabetic kidney disease]. Consultant/Advisory Boards: Alynlam [Resistant hypertension]; AstraZeneca [Diabetic nephropathy]; Bayer [Nephropathy]; Ionis [Resistant hypertension]; KBP BioSciences [Resistant hypertension]; Vifor [Hyperkalemia]. All of the relevant financial relationships listed have been mitigated. **Karen Law, MD** No relevant financial relationship(s) with ineligible companies to disclose. **John P Forman, MD, MSc** No relevant financial relationship(s) with ineligible companies to disclose.

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